

# Identification Manual

## Volume 1: Flora



The CITES Identification Manual is a collection of data sheets designed to help identify various species of fauna and flora with drawings, photographs, maps and concise descriptions. The manual's sheets were published over a 26 year period, from 1980–2009. All sheets are provided as originally published, and, as such, no warranty of any kind is given as to the completeness or accuracy of their content. Identification materials are not available for every species, and may be absent particularly for species listed in the CITES Appendices after 2009.

Users should note that the CITES listing and taxonomy of taxa described in the materials may have changed since the materials were first published. For current CITES nomenclature and listing information, please refer to the main Checklist of CITES Species site (and dedicated downloads for listings/names) and Species+.

The manual contains materials available in the three working languages of the Convention (English, French and Spanish), but materials in French and Spanish are available for fewer taxa. Materials are provided in the language specified where possible, but where materials are not available in French and Spanish, they are instead provided in English.

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<b>Commercial names:</b>	engl.: Monkey puzzle tree, Chilean pine, Parana pine esp.: Pino Araucana, Pino de Paraná, Pino de Chile fr.: Pin du Chili
<b>Common names:</b>	Araucaria, Araucaria espinuda, Araucaria de Chile, Araucaria imbricata, Monkey Puzzle, Pehuén, Pino, Pino de Neuquén, Piñón, Piñonero.
<b>Scientific synonyms:</b>	<i>A. imbricata</i> Pavón <i>A. chilensis</i> Mirb. <i>A. dombeyi</i> Rich.
<b>Subject to CITES regulations:</b>	All parts and derivatives.
<b>Macroscopic characteristics of the wood:</b>	Wood: yellowish white, that turns slightly pink in the light, non porous. Heartwood and sapwood are identifiable only by a slight darkening of the heartwood. Growth rings are not visible to the naked eye, their width is quite regular and very narrow. Occasionally, the autumn wood is wider than the spring wood. Fibres are straight. Hardness: soft and semisoft Grain: very fine to fine Specific weight: 0.55 – 0.60 g/cm <sup>3</sup>
<b>Microscopic characteristics of the wood:</b>	Non-porous wood. Resin canals absent. Growth rings vaguely visible; in transversal section characterized by two rows of tracheids at the end of late-growth wood with thickened walls, compressed in the radial direction. The tracheids are arranged radially, intercellular spaces present. One or two rows of polygonal bordered pits on the tangential walls. Tracheids (5800 –) 7400 (– 9000) µm long, with a diameter of 10 µm. Axial parenchyma absent. Rays homogeneous, uniseriate, 1 – 8 cells high. The horizontal walls of the radial cells are thin, smooth and without pits. Cross-fields pits cupresoid, averaging 4 to 6 per field.
<b>Characteristics of the trees:</b>	This species can grow up to a maximum height of 50 metres in height and up to 2.2 metres in diameter, most trees, however, are 25 metres tall and 0.7 to 1.1 metres in diameter. The crown is pyramidal, in the shape of an umbrella. The trunk is usually straight, cylindrical, with a very thick bark, 10 – 14 cm, deeply cracked in the form of hexagonal plaques of several sizes and dark grey in colour. The base of the trunk is sometimes very enlarged. The branches grow in whorls, and in the young trees they grow even near the base. There are usually almost no traces of branches on the trunk.  This species is endemic to the South American subantarctic forests. It grows on clay and volcanic soils between 800 and 1600 metres in altitude.

**Distribution:** The Andes in Argentina and Chile.



**Characteristics of trade:** The commercial name of Parana pine corresponds, in fact, to that of *Araucaria angustifolia* (found in Argentina, Brazil and Uruguay), but it is also the name given to this species because of the similar characteristics of the wood. When it is traded with bark, the bark is very characteristic and easily identifiable because it is very cracked and divided into easily recognizable very regular plaques.

**Use:** The wood is used for many purposes in interior finishing (doors and stairs), although its lack of resistance makes it unsuitable for use in scaffolding or stairs. It is used locally for furniture, lath work and beams. Elsewhere, it is used for telephone poles, piling and shoring. The trunks are stripped of bark for manufacturing plywood and high-quality veneers. It is also used for paper pulp. The seeds are edible and are used to make a drink, in a soup (*mudai*) made from dry seeds and meat, as a flour for a bread known as *canuto* and an alcoholic drink prepared from fermented seeds.

**Similar species:** There are 21 species in the genus *Araucaria*, of which 19 species occur in the southwestern Pacific and two in South America (Argentina, Brazil and Chile). Several species in the genus *Agathis* are very similar.

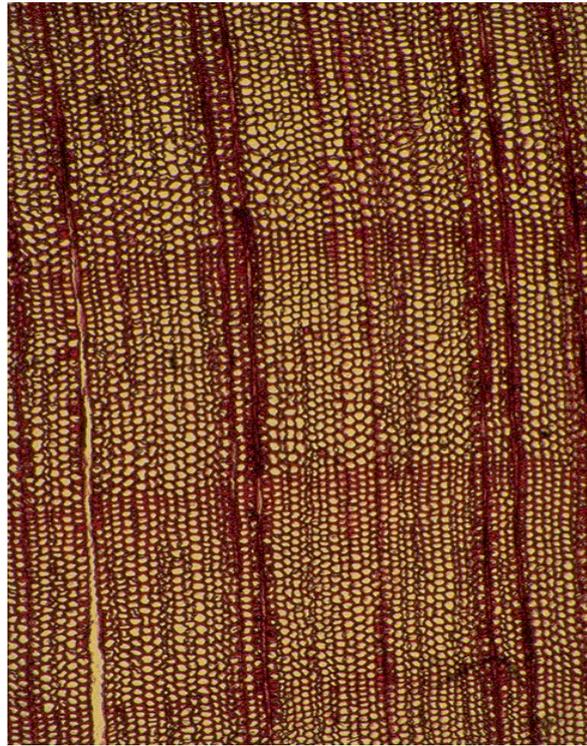


Similar species	Distribution	Common name
<i>Araucaria angustifolia</i>	Argentina, Brazil, Uruguay	Parana pine
<i>Araucaria bidwillii</i>	Australia	Kauri
<i>Araucaria cunninghamii</i>	Australia	Kauri
<i>Agathis alba</i>	Australia	Kauri
<i>Agathis australis</i>	Australia	Kaori, Kowdie
<i>Agathis lanceolata</i>	Australia, Oceania	Kaori
<i>Agathis microstachya</i>	Australia	Kaori
<i>Agathis obtusa</i>	Australia	Kaori
<i>Agathis palmerstonii</i>	Australia	Kaori
<i>Agathis robusta</i>	Australia	Dundathu pine
<i>Agathis vitiensis</i>	Australia	Kaori

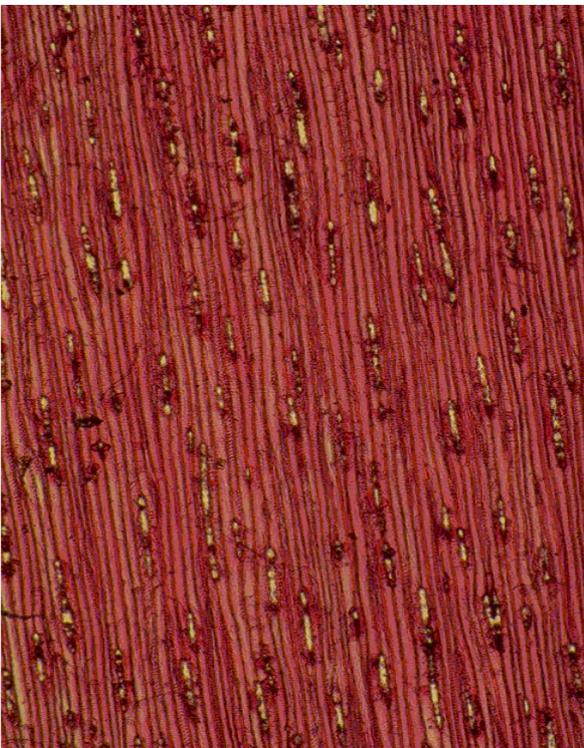
Species → Characteristics ↓	<i>Araucaria araucana</i>	<i>Araucaria angustifolia</i>	<i>Araucaria cunninghamii</i>	<i>Agathis alba, australis, bidwillii, lanceolata, microstachya, obtusa, palmerstonii, robusta, vitiensis</i>
Colour sapwood	yellowish white	yellowish white	yellowish white	yellowish brown
Colour heartwood	rosy yellow	brown with red lines	brown	dark yellowish brown
Grain	very fine to fine	fine and uniform	very fine and uniform	fine
Fibres	straight	straight	straight	straight
Hardness	semisoft	semisoft	semisoft	semisoft
Specific weight	0.55 - 0.60 g/cm <sup>3</sup>	0.54 g/cm <sup>3</sup>	0.56 g/cm <sup>3</sup>	0.30 - 0.70 g/cm



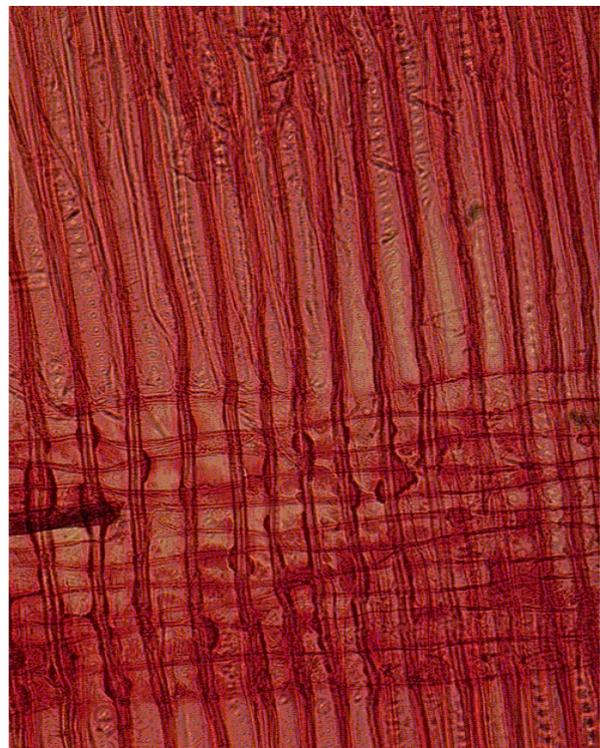




transverse section



tangential section



radial section



**Commercial names:**  
engl.: Mexican fir  
esp.: Abeto mexicano  
fr.:

**Common names:** Abeto, Guatemalan fir, Guayami, Hallarin, Oyamel, Pinabere, Pinabete, Plumajatzin, Plumajillo de montaña

**Subject to CITES regulations:** All parts and derivatives.

**Macroscopic characteristics of the wood:** Wood: greyish-brown, without vessels, odourless. To the naked eye, there is no clear distinction between growth rings. Growth rings are heterogeneous in width, the spring wood broader than the summer wood. Sapwood and heartwood distinct. The sapwood varies from yellowish white to pink and can also be light brown in colour. The heartwood is dark greyish brown and without resin. Fibres straight.  
Hardness: easily marked with the thumbnail  
Grain: fine to medium  
Specific weight: 0.35 g/cm<sup>3</sup> (very light wood)

**Microscopic characteristics of the wood:** Wood non-porous. Resin canals absent. Growth rings sometimes poorly distinguishable. Tracheids square or polygonal in transversal section distributed in radial lines, have bordered pits in a single row, occasionally in more than one row, arranged on opposite sides of the radial walls, more than 10 µm in diameter. Crassulae (Sanio's bands) in the form of thickenings at the bottom of the pit chamber, frequently present. The pit borders on the tangential walls smaller than on the radial walls. Tracheids more than 3200 µm long. Axial parenchyma (precumbert) with nodular end walls. Cells of the vascular rays horizontal with many pits, a rough surface and nodular terminal walls. Rays uniseriate, variable in form, usually more than 20, on average (2 –) 24 cells high, sometimes with crystals. Cross-field pits taxodioid and piceoid. Radial tracheids absent. Traumatic canals occasionally present.

**Distribution:**

El Salvador, Guatemala, Honduras and Mexico

**Use:**

Used locally. Use of this species for lumber and firewood goes back to the Mayan period. It was employed intensively by the Spanish for construction and is now used locally for hand looms. Branches are used to build temporary shelters in the mountains and for decoration of churches and houses. Young trees are used as Christmas trees.

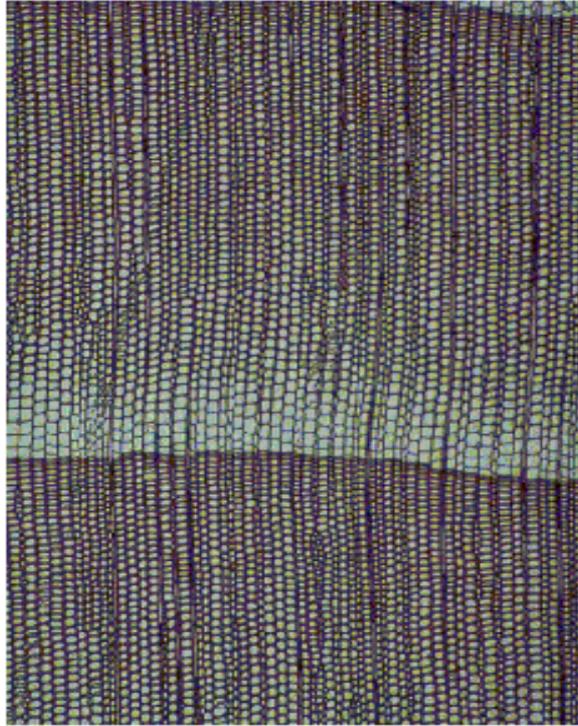
The CITES report trade database contains records of the export of seeds from Guatemala to the United States of America.

**Similar species:**

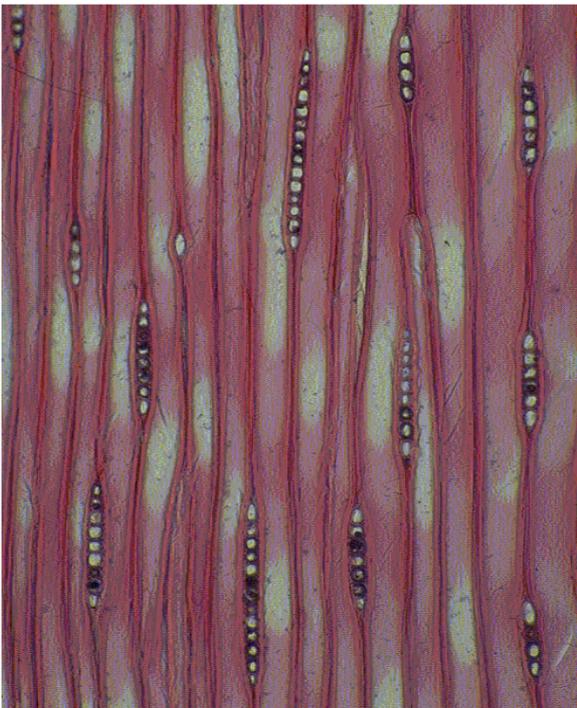
This genus has some 39 species in the temperate regions of North America, Central America and Europe. The wood resembles *A. durangensis* Martínez; *A. mexicana* Martínez; *A. oaxacana* Martínez; *A. religiosa* (H.B.K.) Schlecht. and Cham.; *A. vejari* Martínez. It has the general appearance of the pines and spruces.

# Abies guatemalensis

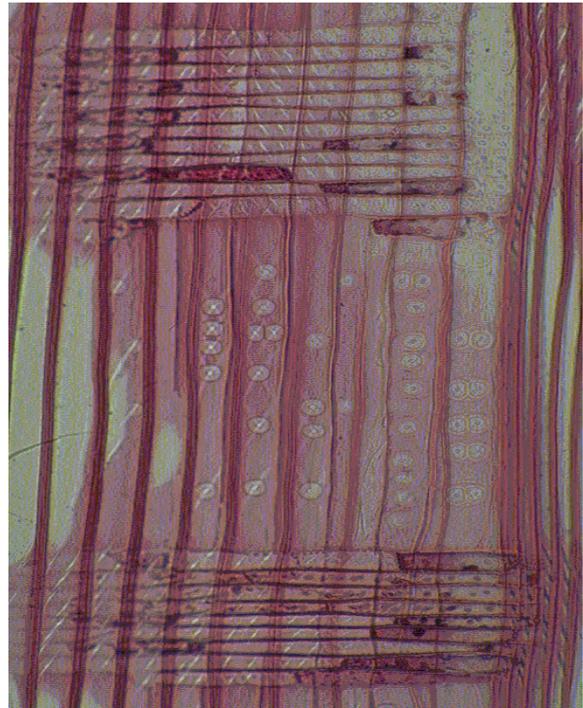




transverse section



tangential section



radial section

# Adonis vernalis

L.



**Family:** Ranunculaceae

**Synonyms:** *Adonis apennina* L.  
*Adonis davurica* Rchb.

**Vernacular names:**

- english: Ox-eye, Spring adonis, yellow pheasant's-eye
- french: Adonide du printemps, faux ellébore noir, grand oeil de bœuf, oeil du Diable
- spanish: Adonis de primavera, adonis vernal, eliboro falso, ojo de perdiz
- german: Frühlings-Adonisröschen, Frühlings-Teufelsauge, Falsche Nieswurz
- italian: Adonide, adonide gialla

**Geographical range:** Mainly distributed from the eastern part of central Europe through east and southeast Europe, west Siberia to east Siberia (Jenissei region); disjunct occurrences in central and southwest Europe, from southeast Sweden (Gotland) to southeast Spain.

**Distribution by country:** Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Italy (probably extinct), Kazakhstan, Poland, Romania, Russian Federation, Slovakia, Spain, Sweden, Switzerland, Ukraine, Yugoslavia.

**Protection:** CITES Appendix II (#2), since 19.07.2000

**Use:** Medicinal plant, horticultural plant.



Figure 1. *Adonis vernalis*: Segments of pinnate leaflets and fruits of *Adonis vernalis* (a, c) and *Adonis vernalis* (b, d).

## Botanical drugs in trade

**Plant parts used:** herb (aerial shoots)

**Pharmaceutical names:**

latin:	Adonidis herba, Herba Adonidis, Herba Adonidis vernalis, Adonis vernalis (homeopathy.)
english:	Adonis herb, herb of lynchis, herb of Spring adonis, ox-eye herb
french:	Adonis, herbe adoine, herbe d'adonide
spanish:	Ojo de perdiz, yerba de adonis
german:	Adoniskraut, Adonis-vernalis-Kraut, Böhmisches Christwurzkrout, Frühlings-Adoniströschenkraut
italian:	Adonide

**Countries of export:** Bulgaria, Romania, Russian Federation, Ukraine.

**Source:** Wild collection.

**Commodities in trade:** Mainly the dried, whole (crude drug) or cut (cut drug) herb; sometimes also the powdered herb or the fresh herb.

### Characteristics:

**Crude drug:** (Fig. 2, 3) Consists of the dried stems, leaves and to a lesser degree of flower parts and fruits; plant parts are in most cases irregularly coarsely broken; stems green but also brown in the lower part, up to 35 cm long and 3 mm thick, round to flattened, pithy, longitudinally striped, ± glabrous; at the bottom of the stem often with scale-like black-brown leaves; cauline leaves sessile (without leaf stalk), ± glabrous, fine, 2-3 pinnatisect into narrowly linear, entire and acute lobes; flowers pale yellow to whitish, with 10-20 ca. 2 cm long, glabrous, elliptical to oblong petals; sepals green, on the lower surface pubescent, only half as long as the petals; stamens yellow and numerous; infructescences oblong, made of numerous, pubescent, globose to ovoid singular fruits, showing a recurved beak (pistil);

**Cut drug:** (Fig. 4) Consists of 1-5(-15) mm-long fragments of the crude drug of varying size; colour dull, olive to green scattered with brown, light green and whitish spots; main components of the botanical drug are the green, narrow-linear and revolute fragments of the pinnate leaflets as well as the longitudinally striped stem parts; occasionally intermixed by pale yellow to whitish petals, green, pubescent sepals, stamens, ovaries, infructescences and fruits with reticulate and rugose surface;

**Odour:** Odourless;

**Taste:** Somewhat bitter and spicy; **caution:** the drug is **toxic!**

**Fresh herb:** In homeopathy the fresh herb (aerial shoot or whole plant) is used. It is of minor importance in trade.

### Similar drugs/ adulterations:

Adulterations with annual *Adonis* species occur. They are easily recognizable due to their black-red stamens, glabrous fruits and the mainly red petals.

Most of the perennial *Adonis*-species, including *A. vernalis*, look very similar, however. The most important species in this context are *A. sibirica* and *A. villosus*, and above all *A. volgensis*. *A. sibirica* has glabrous sepals and *A. villosus* pubescent stems and leaves. *A. volgensis* differs from *A. vernalis* by broad, pubescent pinnate leaflets and appressed fruit beaks (Fig. 1).

**References:** Lange, D. (2000): Conservation and sustainable use of *Adonis vernalis*, a medicinal plant in international trade. Plant species conservation monographs 1; 88 pp.; Bonn (Federal Agency for Nature Conservation).



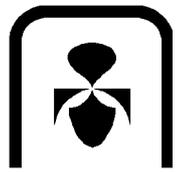
Figure 2. Crude drug, Adonidis herba; species: *Adonis vernalis*, (copyright BfN).



Figure 3. Crude drug, Adonidis herba; species: *Adonis vernalis*, (copyright BfN).



Figure 4. Cut drug, Adonidis herba; species: *Adonis vernalis*, (copyright BfN).

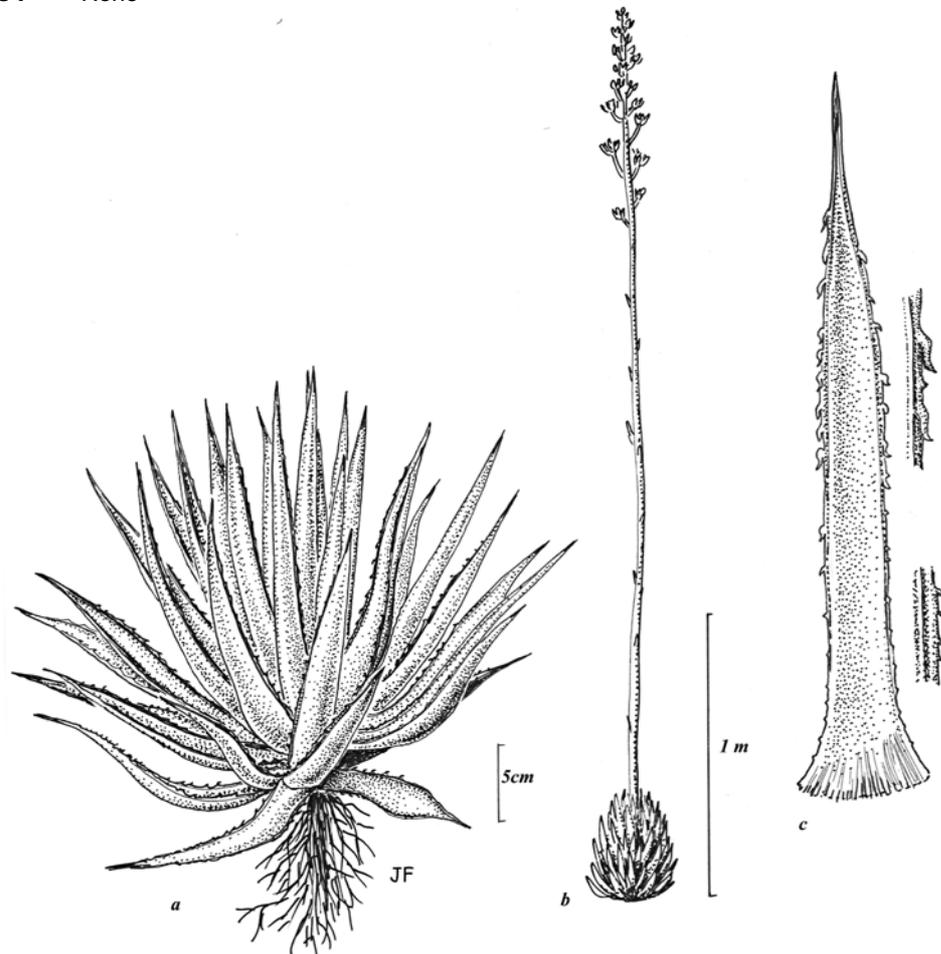


# Agave arizonica

Gentry &amp; G.H Weber

**Common name:** engl.: New River agave  
 esp. :  
 fr.:

**Scientific synonyms :** None



**Illustration:**

a. *Agave arizonica* habit of plant.  
 b. with inflorescence.  
 c. leaf form with 2 spine forms in detail (after Gentry, 1982).

## Characteristics:

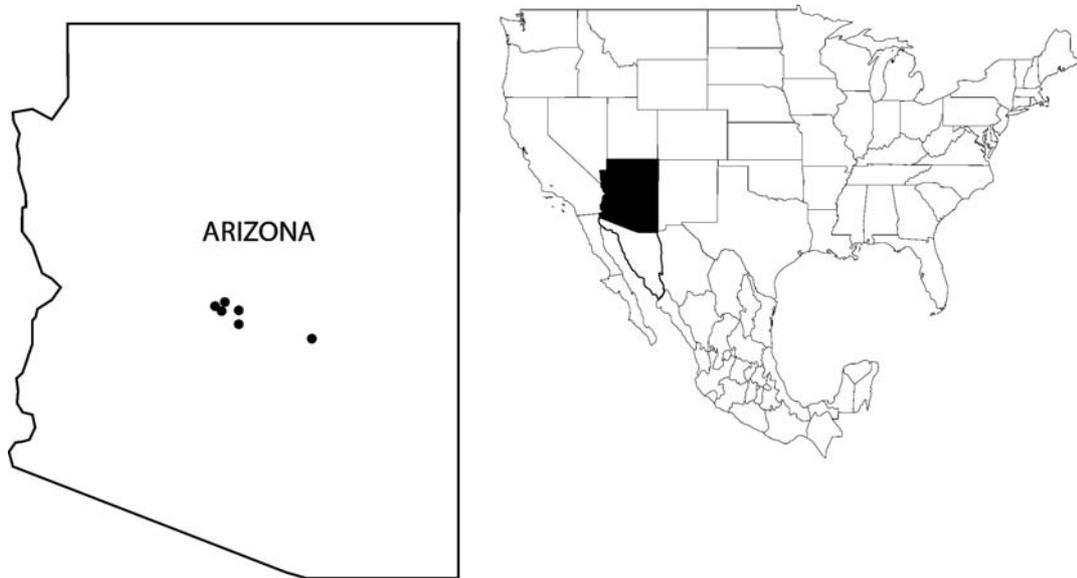
**Vegetative:** Plants small, forming single rosettes 30 cm high by 40 cm wide, leaves 17-24 cm x 2-4 cm, broadest in the middle. Leaf colour greyish green with leaf margins reddish brown to light gray. Teeth on leaves vary from sharp pointed to depressed curved.

**Inflorescence:** Stalks 3-4 meters tall, slender with 35-50 short lateral branches; flowers 25-32 mm long, in clusters of 10-20, pale yellow.

**Similar species:** *Agave utahensis*: different from *Agave arizonica* by having marginate leaves, flower clusters more umbrella shaped, more cylindrical flowers with a deeper tube

**Distribution:**

Arizona, central, in Tonto National Forest near New River Mountains and also a small separate population 65 kilometres east in creek bottoms and granite hills in association with Arizona chaparral and juniper grassland at 900-1830 meters.



- Distribution of *Agave arizonica*

**Threats:**

Illegal collecting, cattle grazing and deer browsing on young flowers. Various available as a propagated plant in the nursery trade.

**References:**

Gentry, H.S., 1982, *Agaves of Continental North America*, University of Arizona Press: Tucson.

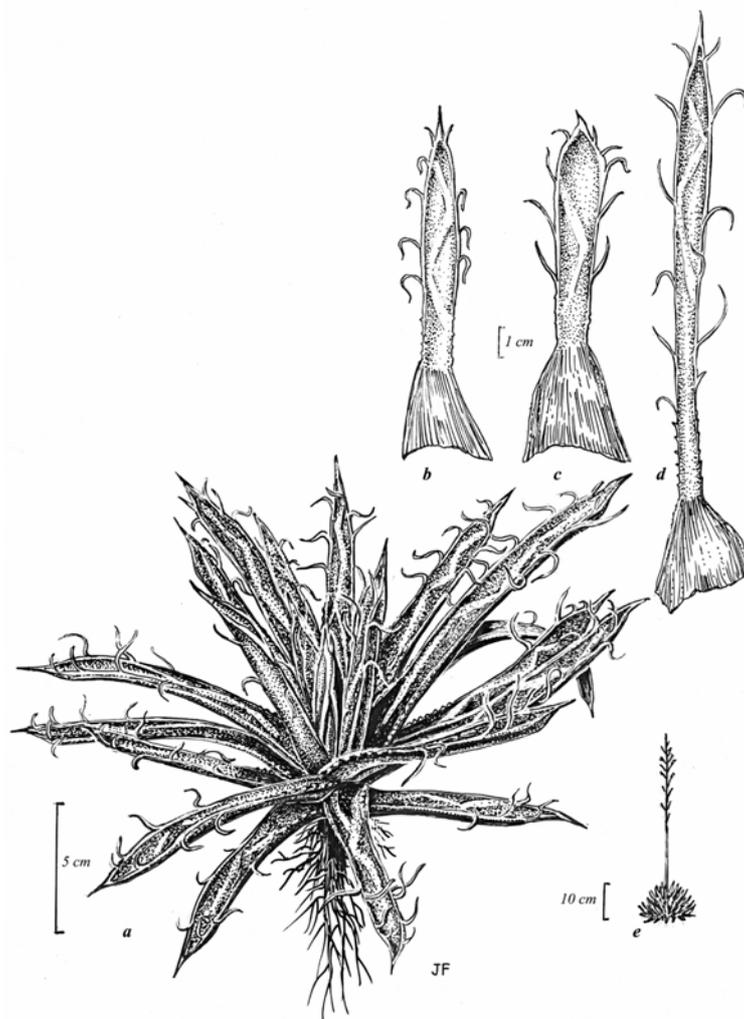
Gentry, H. S., and Weber J. H., 1970, *Cactus and Succulent Journal*, 42: 223.



# Agave parviflora

Torr.

**Common name:** engl.: Santa Cruz striped agave,  
 esp.: Tauta, tautilla, sobali, sobari  
 fr.:  
**Scientific synonyms :** None



**Illustration:** a. *Agave parviflora* habit of plant.  
 b. leaf of *A. parviflora parviflora*.  
 c,d. two forms of leaf of *A. parviflora flexiflora* (after Gentry, 1984).  
 c. with inflorescence.

## Characteristics:

**Vegetative:** Very small, single or growing in tufts or clumps, rosettes 10-15 cm high, 15-20 cm broad; leaves 6-10 cm x 0.8-1 cm oblong, linear, widest at or above middle, green with white, filiferous margin.

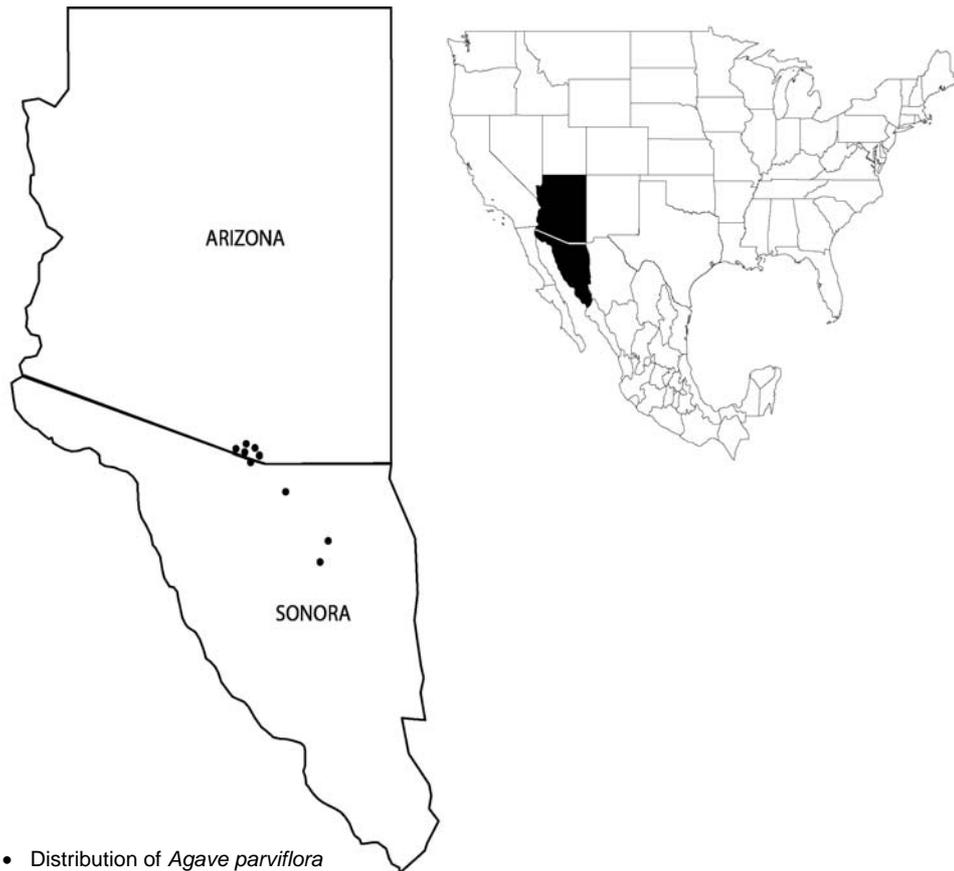
**Inflorescence:** Stalks slender, 100-180 cm high, 1 to 3 flowers at each node, 13-15 mm long (smallest flowers in the genus). *Agave parviflora* spp. *parviflora* differs from *Agave parviflora* spp. *flexiflora* by the latter having down flexed flowers and with some populations showing longer leaves.

Similar species:

*Agave polianthiflora* separable only by flowers which are larger.

**Distribution:**

*Agave parviflora* spp. *parviflora* is found adjacent to the US-Mexico border 10-15 miles west of Nogales, Arizona and Nogales, Sonora in the Pajarito Mountains in both the US and Mexico on north facing slopes at 4000 feet in oak woodlands. *Agave parviflora* spp. *flexiflora* is found in eastern Sonora, Mexico in the Bavispe and Moctezuma Rivers region in volcanic rocks of oak woodlands between 2000 and 4000 feet.



**Threats:**

Illegal collecting and cattle grazing. Available as a propagated plant in the nursery trade.

**References:**

The Agave Family in Sonora, 1972, Ag. Handbook #399, Washington DC:US Dept. of Agriculture.

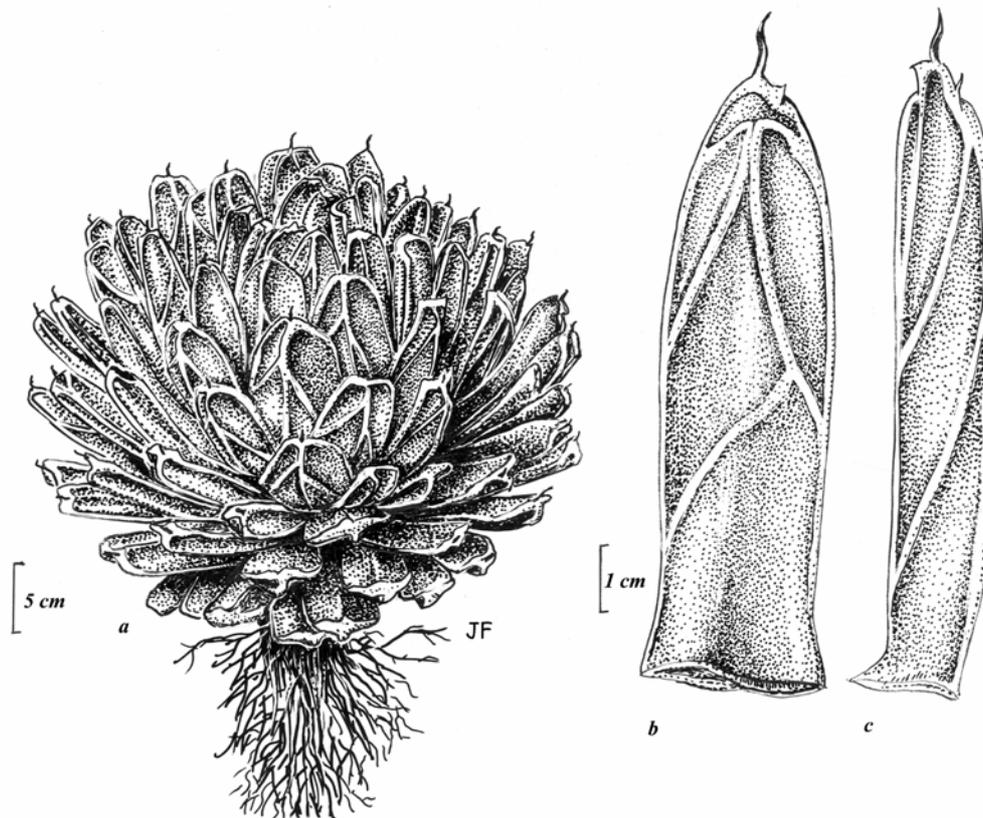


# Agave victoriae-reginae

T. Moore

**Common name:** eng.: Queen Victoria agave  
 esp.:  
 fr.:

**Scientific synonyms :** *Agave consideranti* Carr.  
*Agave fernandi-regis* Berger.  
*Agave nickelsii* R. Gosselin.



**Illustration:** a. *Agave victoriae-reginae* habit of plant.  
 b. face of leaf.  
 c. side view of leaf.

## Characteristics:

**Vegetative:** Small, compact, single or with a few offsets, rosettes 50-70 cm in diameter, many leaves, 15-20 cm long and 4-6 cm broad, abruptly rounded to a narrow apex, straight or incurved, rigid, thick with strong keel below, margin white corneous, usually toothless, with terminal spines, usually one, but sometimes with 2 auxiliary ones, 1.5-3 cm long. White markings appear on both faces of leaves.

**Inflorescence:** Stalk 3-5 m tall, erect, inflorescence dense with cream coloured flowers in pairs or triplets, 40-46 mm long with stems tinged with red or purple.

**Similar species:** The species has variants within its distribution, of which five forms are described by Breitung (1960), which are also found in cultivation.

**Distribution:** Nuevo Leon, Coahuila, and Durango, Mexico at 4000-5000 feet elevation on limestone soils.



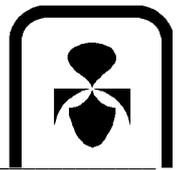
**Threats:** Habitat destruction, grazing, and illegal collection. Artificially propagated plants are prevalent in the nursery trade.

**References:** Breitung, A. J., 1960, Cultivated and native agaves in the south western United States, *Cactus and Succulent Journal*, 32: 35-38.

Gentry, H.S., 1982, *Agaves of Continental North America*, University of Arizona Press: Tucson.

# Aloe ferox

Mill.



**Family:** Aloaceae (Liliaceae)

**Synonyms:** *Aloe horrida* Haw.  
*Aloe socotorina* Masson  
*Aloe pseudoferox* Salm-Dyck

**Vernacular names:**

english:	Bitter aloe, Cape aloe
french:	Aloès du Cap
spanish:	Acíbar, áloe
afrikaans:	Bitteraalwyn, Bergaalwyn
german:	Afrikanische Aloe, Bitterschopf, Gefährliche Aloe, Kap-Aloe
italian:	Aloe del Capo

**Geographical range:** Southern Africa; from the Swellendam district in the Western Cape province through the Eastern Cape province (including Transkei and Ciskei), the southern part of Lesotho to the south of Kwazulu-Natal.

**Distribution by country:** Lesotho, South Africa.

**Protection:** CITES Appendix II (#1), since 01.07.1975.  
 Except *A. barbadensis* (deleted since 16.02.1995) all *Aloe* species are included in CITES Appendix I or II.

**Use:** Medicinal and aromatic plant, horticultural plant.

## Botanical drugs in trade

**Plant parts used:** Concentrated and solidified juice of leaves (extract).

**Pharmaceutical names:**

latin:	Aloe capensis, Aloe lucida, Aloe (homeopathy.)
english:	Aloe(s), aloe bitters (crystals), Cape aloe(s), lucid aloe
french:	Aloès, aloès du Cap, suc d'aloès
spanish:	Áloes
chinese:	Lu Hui (Luhui)
german:	Aloe, Aloe-ferox-Saft, Berg-Aloe, Bitter-Aloe, Kap-Aloe
italian:	Aloë, aloë del Capo

**Countries of export:** South Africa;  
 Re-export: Belgium, China, **Germany**, Israel, Italy, Japan, Republic of Korea, Spain, Switzerland, Venezuela.

**Source:** Mainly wild-collection.

- 
- Commodities in trade:** Big pieces of the extract, not or at most coarsely chopped (crude drug) or the same diminished (cut drug); in addition the powdered extract (powdered drug), aloe dried extract, liquid aloe gel, aloe gel powder and minutely cut (Aloe tea, Fig. 1) or even powdered leaves.
- Characteristics:**
- Crude drug: (Fig. 2) Consist of variably sized, irregularly shaped, firm, opaque and dark brown pieces (lumps), frequently coated with a yellowish to greenish powder (greenish to ochre-coloured shimmer); fractures shiny, acute-angled,  $\pm$ conchoidal; mixed with small, (red-)golden to dark brown, strongly-shining sometimes translucent fragments;
- Cut drug: Irregularly shaped, small fragments or splinters of the crude drug; fragment 2-6 mm long, often flattened, like the crude drug coated with yellow- to greenish powder, partly with acute edges, mainly opaque, but thin pieces translucent; fractures shining, conchoidal;
- Powdered drug: (Fig. 3) Greenish-brown to dark brown; soluble in warm ethanol, partly soluble in boiling water, and insoluble in ether and chloroform;
- Odour: Characteristic, strong, somewhat sour;
- Taste: Bitter, unpleasant
- Aloe dried extract: (Fig. 4) (Aloes extractum siccum) brown to yellowish brown powder, hardly soluble in boiling water;
- Similar drugs/ adulterations:** *Aloe barbadensis* Miller (syn. *Aloe vera* (L.) Burm.f.; English: Aloe vera; German: Echte Aloe): The extract of the leaves is traded as Aloe barbadensis, Aloe curassavica, Aloe hepatica or Aloe vera (English: Barbados Aloe, Curaçao Aloe; Spanish: sávilá, závila; German: Barbados-Aloe, Curaçao-Aloe, Venezuela-Aloe, Westindische Aloe);
- Regions of origin: North Africa, Near East, India, China, North and South America (West Indies, Venezuela, frequently exported via Curaçao); cultivated;
- Characteristics: Crude drug: irregularly shaped and variably sized, dark brown, opaque pieces with dull or at most weakly shining and brownish coated surfaces; fractures dull, waxy, often conchoidal; powdered drug: brown; odour: penetrant; taste: unpleasant, bitter, disgusting;
- Additional commodities in trade: Aloe vera gel (Aloe vera, Aloe extract). The viscous and almost colourless gel is the stabilized juice from the mucilage-containing inner parts of the leaves.
- Aloe* spp.: Additionally, the leaves of some other African *Aloe* species are used to produce Aloe: *inter alia* *Aloe perryi* Bak. (English: Socotrine or Zanzibar aloe; German: Aloe-Sokotrina), *Aloe africana* Mill. (German: Kap-Aloe).
- References:** Newton, D.J. & Vaughan, H. (1996): South Africa's *Aloe ferox*: plant, parts and derivatives industry. – 61 pp.; Johannesburg (TRAFFIC East/Southern Africa-South Africa).



Figure 1. Cut leaves, Aloe tea; species: *Aloe ferox*, (copyright BfN).



Figure 2. Crude drug, extract pieces variable in size, Aloe capensis; species: *Aloe ferox*, (copyright BfN).

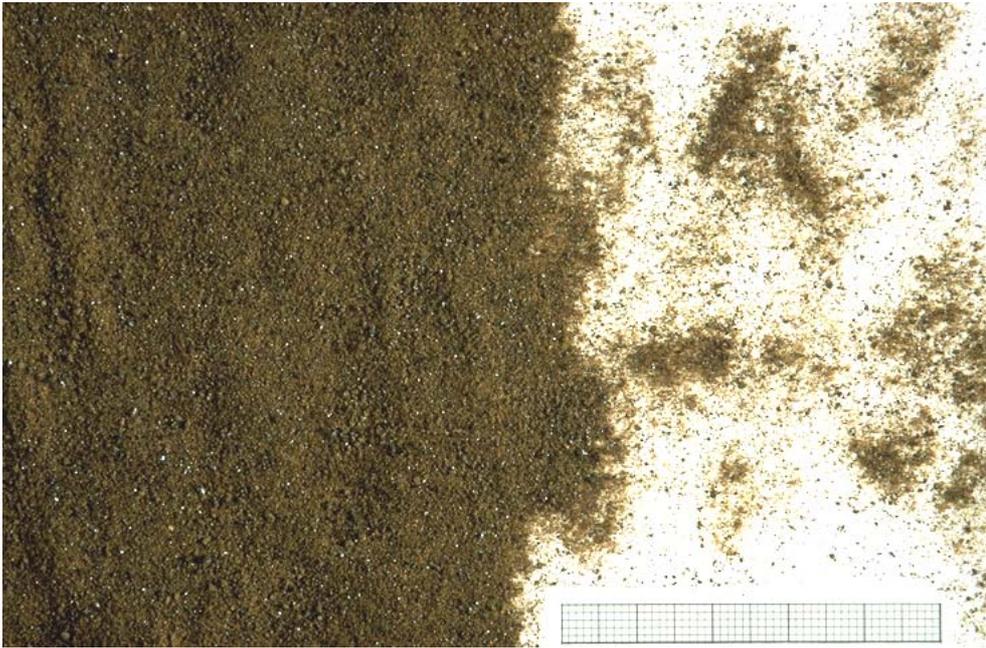


Figure 3. Powdered drug, *Aloe capensis pulv.*; species: *Aloe ferox*, (copyright BfN).



Figure 4. Powdered extract, *Aloe extractum sicc. pulv.*; species: *Aloe ferox*, (copyright BfN).

# Aquilaria malaccensis

Lam.



**Family:** Thymelaeaceae

**Synonyms:** *Agallochum malaccense* (Lam.) Kuntze  
*Aquilaria agallocha* Roxb.  
*Aquilaria secundaria* DC.  
*Aquilariella malaccense* Thiegh.

**Vernacular names:**  
 english: Eaglewood tree  
 french:  
 spanish:  
 german: Adlerholz-Baum  
 italian:

**Geographical range:** From north-east India to the Philippines in the east and to Sumatra and Borneo in the south.

**Distribution by country:** Bangladesh, Bhutan, Cambodia, India, Indonesia (Kalimantan, Sumatra), Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand.

**Protection:** CITES Appendix II (#1), since 16.02.1995

**Use:** Medicinal and aromatic plant, timber (furniture, wooden objects).

## Botanical drugs in trade

**Plant parts used:** Resinous (dark) heartwood.

**Pharmaceutical names:**  
 latin: Aquilariae lignum, Lignum Aquilariae, Lignum Agallochi, Lignum Aloes, Lignum Aspalathi, Agar, Aggar, Uggor  
 english: Agar, agalwood, agallochum, agarwood, aloe wood, eagle wood, gaharu wood, paradise wood  
 french: Agar, bois d'aigle, bois d'aloès  
 spanish: Madera de agar  
 german: Adlerholz, Aloeholz, Aquilariahartzholz, Aquilaria-malaccensis-Holz, Paradiesholz  
 hindi: Agar  
 italian: Legno di aloe, legno di aquila, legno di aquilaria, legno aquilario  
 malay: Calambac, gaharu, kayu garu, kelambak  
 sanskrit: Agar

**Countries of export:** Bhutan, India, **Indonesia**, Lao PDR, **Malaysia**, Myanmar, **Singapore**, Thailand, Viet Nam.  
 Re-export: China (including Hong Kong SAR and the province of Taiwan).

**Source:** Mainly wild-collection.

- 
- Commodities in trade:** Mainly dried, resinaceous, cut heartwood of variable shape and size (crude drug) or the same minutely cut (cut drug); in addition powdered wood and essential oil; different grades are distinguished according to the resin content which may have different names in different languages (e.g. gaharu and kemedangan in Indonesia).
- Characteristics:**
- Crude drug: (Fig. 1, 2) Wood pieces irregularly shaped, up to ca. 10(20) cm long and 2-4 cm wide, prone to splitting, with uneven surface, knife marks and sometimes signs of rotting, occasionally circular (drill-)hole visible; fractures or cut surface strongly fibrous; wood variable depending on the resin content: (1) wood pieces poor in resin are light-coloured and light-weighted, yellow-brown to brown and show varying proportions of dark, resinous rich areas; darker lines and spots of variable size on the section surfaces and circular to spindle-shaped areas in transverse sections mark the resinous areas filled with amber-coloured to or even black shining resin; resin ignites easily and exudes oil when burning; (2) wood pieces rich in resin, i.e. without the light wood parts lacking resin, are dark, almost black, hard, heavy and sink in water;
- Cut drug: Thin, light to dark brown or even black shavings; other characters as mentioned in section "Crude drug";
- Odour: Weak at room temperature, strongly aromatic when burning;
- Taste: Aromatic-bitter, slightly astringent;
- Essential oil: Known in trade as Agar oil, Adlerholzöl, Attar or Aggar-Atta.
- Similar drugs/ adulterations:**
- Aquilaria* spp.
- Several other *Aquilaria* species produce agarwood (Aloeholz, Adlerholz or Gaharu), *inter alia*:  
*A. beccariana* Tiegh. Indonesia (Sumatera, Kalimantan), Malaysia  
*A. crassna* Pierre Cambodia, Lao PDR, Thailand, Viet Nam  
*A. cumingiana* Hallier f. Indonesia (east Kalimantan, Moluccas), Philippines  
*A. filaria* (Oken) Merr. Indonesia (Irian Jaya, Moluccas)  
*A. hirta* Ridl. Indonesia (Sumatera), Malaysia (Sarawak), Singapore  
*A. khasiana* Hallier f. India  
*A. microcarpa* Baill. Indonesia (Sumatera, Kalimantan), Singapore (distribution incomplete)  
*A. sinensis* (Lour.) Spreng. China
- Aquilaria sinensis* (Lour.) Spreng. (English: Chinese eaglewood tree; German: Chinesischer Adlerholz-Baum): in trade known as *Aquilariae lignum resinatum* or *Lignum Aquilariae resinatum* (Chinese: Chenxiang; English: Chinese Agar, Chinese eaglewood wood; German: Aquilariaharzholz). The drug originates mainly in China. – Characteristics similar to *A. malaccensis*.
- Methods of macroscopic or microscopic identification of the woods of *Aquilaria* species are not known.
- Moreover, the wood of other species such as *Gonystylus bancanus* (Miq.) Baill. and *Cinnamosma fragrans* Baill. are used.
- References:**
- Chakrabarty, K., Kumar, A. & Menon, V. (1994): Trade in Agarwood. – 51 pp.; New Delhi (WWF-India/TRAFFIC-India).
- Soehartono, T. (1997): Overview of trade in gaharu in Indonesia. – In: Conservation and sustainable management of trees. Report of the third regional workshop, 18-21 August 1997, Viet Nam: 27-33.
- Barden, A., N. Awang Anak, T. Mulliken & M. Song (2000): Heart of the matter. Agarwood use and trade and CITES implementation for *Aquilaria malaccensis*. – viii+52 pp., Traffic International, Cambridge.
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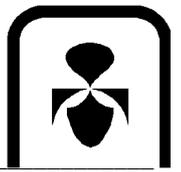


Figure 1. Crude drug of vesinous wood, Aquilariae lignum; species: *Aquilaria malaccensis*, (copyright BfN).



Figure 2. Crude drug of vesinous wood, Aquilariae lignum; species: *Aquilaria malaccensis*, (copyright BfN).



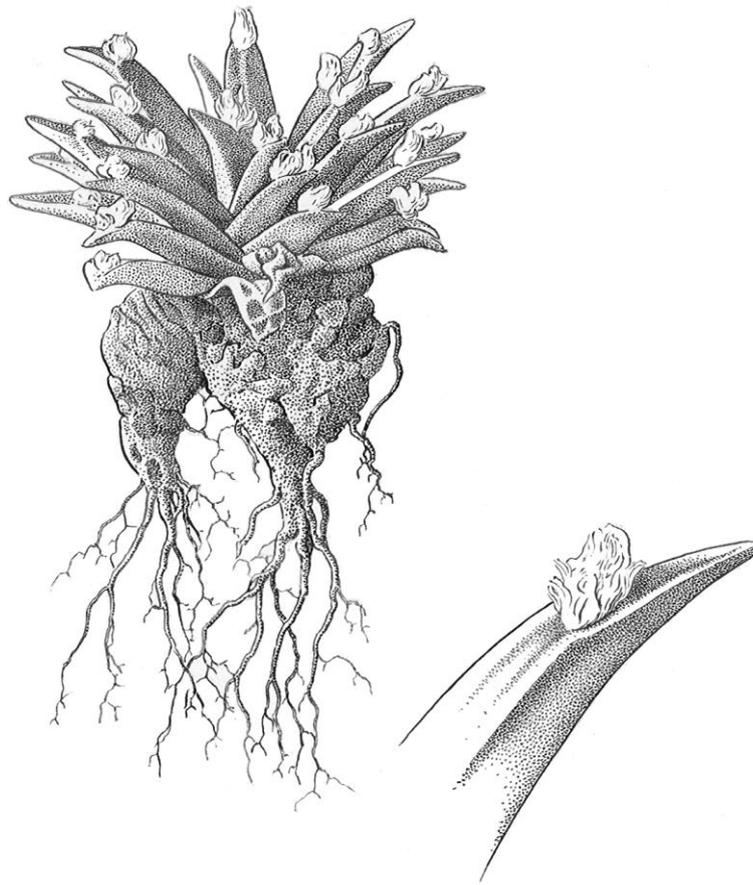
# Ariocarpus agavoides

(Castañeda) E. F. Anderson 1962

**Common names:** engl.: Living rock cactus  
esp.: Chaute, magueyito

**Scientific synonyms:** = *Neogomesia agavoides* Castañeda 1941  
= *Ariocarpus kotschoubeyanus* ssp. *agavoides* (Castañeda) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 06.06.1981 (Prop. USA).



**Characteristics:** Very distinctive for its small size and rather few greyish, elongated, strap-like tubercles with a tuft of wool near the tip, emerging from a subterranean, bulbous stem/taproot. Extremely cryptic in habitat when without flowers, almost geophytic. Spines usually absent.

**Roots:** Taproot from deep-seated, subterranean, bulbous stembase.

**Stem:** Solitary, entirely subterranean in habitat, only the tubercles rising above ground, whole plant incl. tubercles rarely exceeding 8 cm Ø.

**Tubercles:** Only ca. 5-10 (in cultivated specimens more numerous), slender, ascending to divergent, 3-7 cm long, 0.5-1 cm wide, pointed, somewhat flaccid and flattened on the upper surface, often recurved, grey-green, with a distinct, corrugated microstructure of the surface.

**Areoles:** Woolly, circular, on upper surface of the tubercle, positioned 5-12 mm below the tip.

**Spines:** Absent in adult specimens, exceptionally 1-2 (-4), 2-4 mm long, white to brown, weak, non pungent, ascending or in specimens from the state of San Luis Potosí distinctively persistent,

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Flowers: relatively strong, ascending-appressed.  
Fruits: From the centre of the stem apex, reddish-purple or magenta, 2-5 cm long and 3.5-4 cm Ø.  
Seeds: Pinkish-red to red-purple, 10-20 mm long, 5-12 mm Ø.  
Juvenile plants: Black, tuberculate.  
Globular hypocotyl with slender, ascending, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** States of Tamaulipas and San Luis Potosí, Mexico



**Trade:** Long known as a strictly local endemic of the surroundings of the City of Tula, Tamaulipas. Only recently (Sotomayor & al. 2000) reported from adjacent San Luis Potosí. Much in demand by collectors and highly popular in horticultural trade. Wild collected specimens fetched prices up to US\$ 35.-- in USA (Anderson 1963). Many were reported in trade in USA, Europe and Japan prior to listing in Appendix I and some are still observed. More recently also traded as artificially propagated seedlings on own roots. Also collected by local residents for medicinal purposes or sold to tourists. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** *Ariocarpus fissuratus* ssp. *bravoanus* differs by the distinctly papillate upper surface of the much shorter and thicker tubercles. *A. scaphirostris* has much thicker, rather straight or curved inward tubercles with bow-shaped tips, lacking areolar woolly tufts near the tips.

**Bibliography:** Anderson, E. F. (1963): A study of the proposed genus *Neogomesia*. *Cactus and Succulent Journal (U. S.)* 35 (5): 138-145.  
Anderson, E. F., S. Arias & N. P. Taylor (1994): *Threatened Cacti of Mexico*. *Succulent Plant Research*, Vol. 2. Royal Botanic Gardens Kew, UK.  
Anderson, E. F. & W. A. Fitz Maurice (1997): *Ariocarpus* revisited. *Haseltonia* 5: 1-20.  
Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
Glass, C. E. (1998): *Identification Guide to Threatened Cacti of Mexico*. Fideicomiso Fondo para la Biodiversidad. Mexico.  
Hunt, D., ed. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition Royal Botanic Gardens, Kew, UK.  
Sotomayor, J. M., A. Arredondo & M. Martinez (2000): *Neue Fundorte von Ariocarpus agavoides*. *Kakt. and. Sukk.* 51 (5): 113-118.  
[www.living-rocks.com](http://www.living-rocks.com)

# Ariocarpus fissuratus ssp. bravoanus

(H. Hernández & E. F. Anderson) J. Lüthy 1999

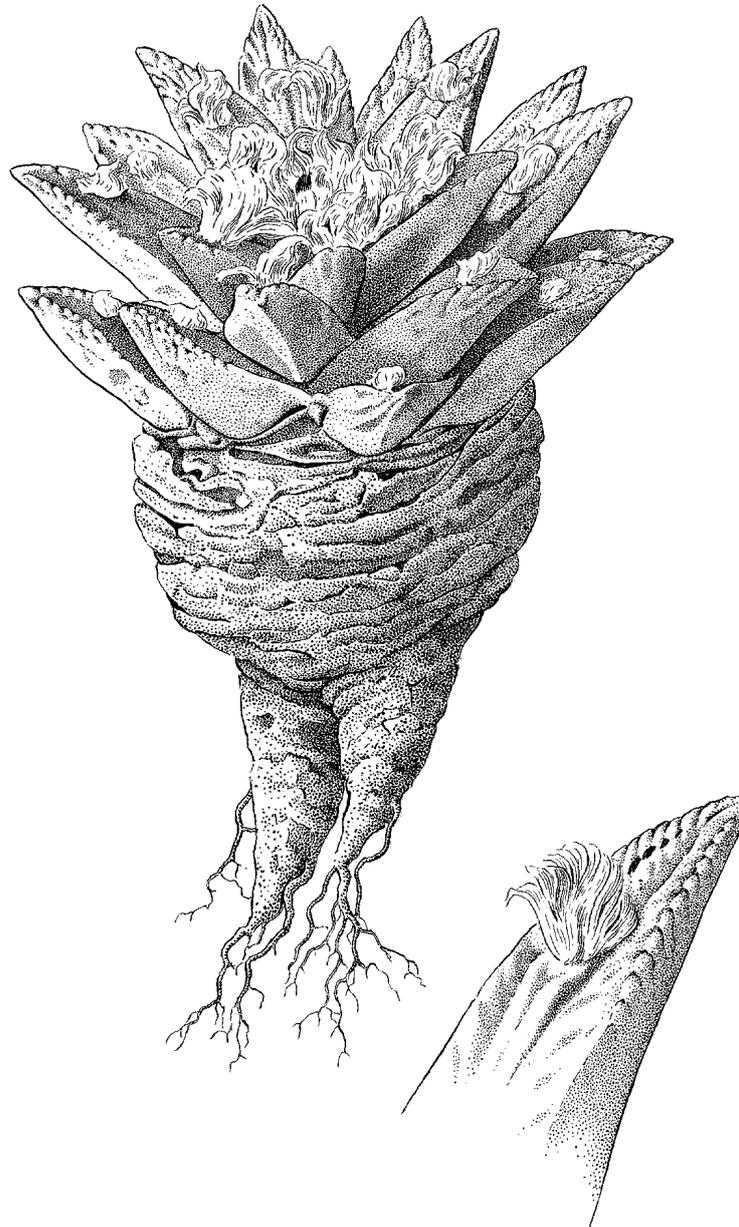


**Common names:** none

**Scientific synonyms:** = *Ariocarpus bravoanus* H. Hernandez & E. F. Anderson 1992  
= *Ariocarpus kotschoubeyanus* ssp. *bravoanus* (H. Hernandez & E. F. Anderson) Halda 1998

**Excluded taxa:** *Ariocarpus bravoanus* ssp. *hintonii* (W. Stuppy & N. P. Taylor) E. F. Anderson & W. A. Fitz Maurice 1997  
= *Ariocarpus fissuratus* var. *hintonii* W. Stuppy & N. P. Taylor 1989  
= *Ariocarpus fissuratus* ssp. *hintonii* (W. Stuppy & N. P. Taylor) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. NL).



**Characteristics:** Rosettelike shape and rocklike appearance, small rosette of a few, very finely roughened, triangular, ascending tubercles, hard tissue, greyish colour, tubercles distinctively papillate, with a tuft of wool. Spines absent. Very cryptic in habitat, imitating the surrounding substrate.

**Roots:** Branched taproot from deep-seated, subterranean stembase.

**Stem:** Solitary, turnip-shaped, largely subterranean, only tubercles rising above ground level in habitat, to 6 (-8.5) cm Ø (incl. tubercles).

**Tubercles:** Ascending or erect rather than horizontally spreading, triangular, grey or dark olive green with reddish tinge, to 3.7 cm long and 2 cm wide basally, upper surface finely fissured with rudimentary lateral groove to distinctly papillate (depending on the size of the tubercle and individual variability).

**Areoles:** Woolly, circular, in the centre of the concave upper surface of the tubercles, in adult specimens only.

**Spines:** Absent in adult specimens.

**Flowers:** From the centre of the stem apex, 2.5 cm long, deep magenta-red.

**Fruits:** Inconspicuous, drying on the plant.

**Seeds:** Black, tuberculate.

**Juvenile plants:** Globular hypocotyl with slender, ascending, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Strictly local endemic with only a single, rather small, known locality. After the description in 1992, many illegally wild collected plants and seeds have been observed in international trade. The demand by collectors is extremely high. No legal exports from Mexico (except for scientific purposes) are reported. All adult material observed in international trade is still surely wild-collected and thus illegal. The illustrated specimen was confiscated in Germany. Illegally traded plants are reported also in Italy, Czech Republic and Switzerland (1999). Smuggled seeds are offered in published seed lists (1997). The population at the very type locality declined dramatically (Sotomayor 1999, pers. com.) and will soon be depleted to near extinction. Luckily, an extension of the range has recently been found, where sites are still undisturbed (Sotomayor 2001, pers. com.). Some legal offspring of confiscated specimens is now becoming available. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** The quite similar *Ariocarpus fissuratus* ssp. *hintonii* has more spreading tubercles with a finely fissured surface, distinct lateral longitudinal furrows and a central woolly groove. *Ariocarpus fissuratus* ssp. *fissuratus* has broad, spreading tubercles with a coarsely fissured surface, a woolly central groove and distinct lateral longitudinal furrows (which may be absent in var. *lloydii*). Young, immature specimens of the 3 taxa lack the distinguishing characters of the tubercle surface and can very easily be confounded. *Ariocarpus agavoides* has much longer, more slender and flaccid tubercles, lacking a papillate surface-structure. *Ariocarpus scaphirostris* has no woolly tufts on the tubercles (only axillary areoles), a non-papillate tubercle surface and bow-shaped tubercle tips.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Anderson, E. F. & W. A. Fitz Maurice (1997): *Ariocarpus* revisited. *Haseltonia* 5: 1-20.  
 Glass, C. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
 Hunt, D., ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition Royal Botanic Gardens, Kew, UK.  
 Lüthy, J. M. (2000): *Ariocarpus fissuratus*, a variable species. *Cactus & Co.* 4 (4): 192-202.

Family Cactaceae

**Ariocarpus fissuratus**  
**ssp. bravoanus**

(H. Hernández & E. F. Anderson) J. Lüthy 1999



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# Ariocarpus fissuratus

## ssp. fissuratus „var. lloydii“

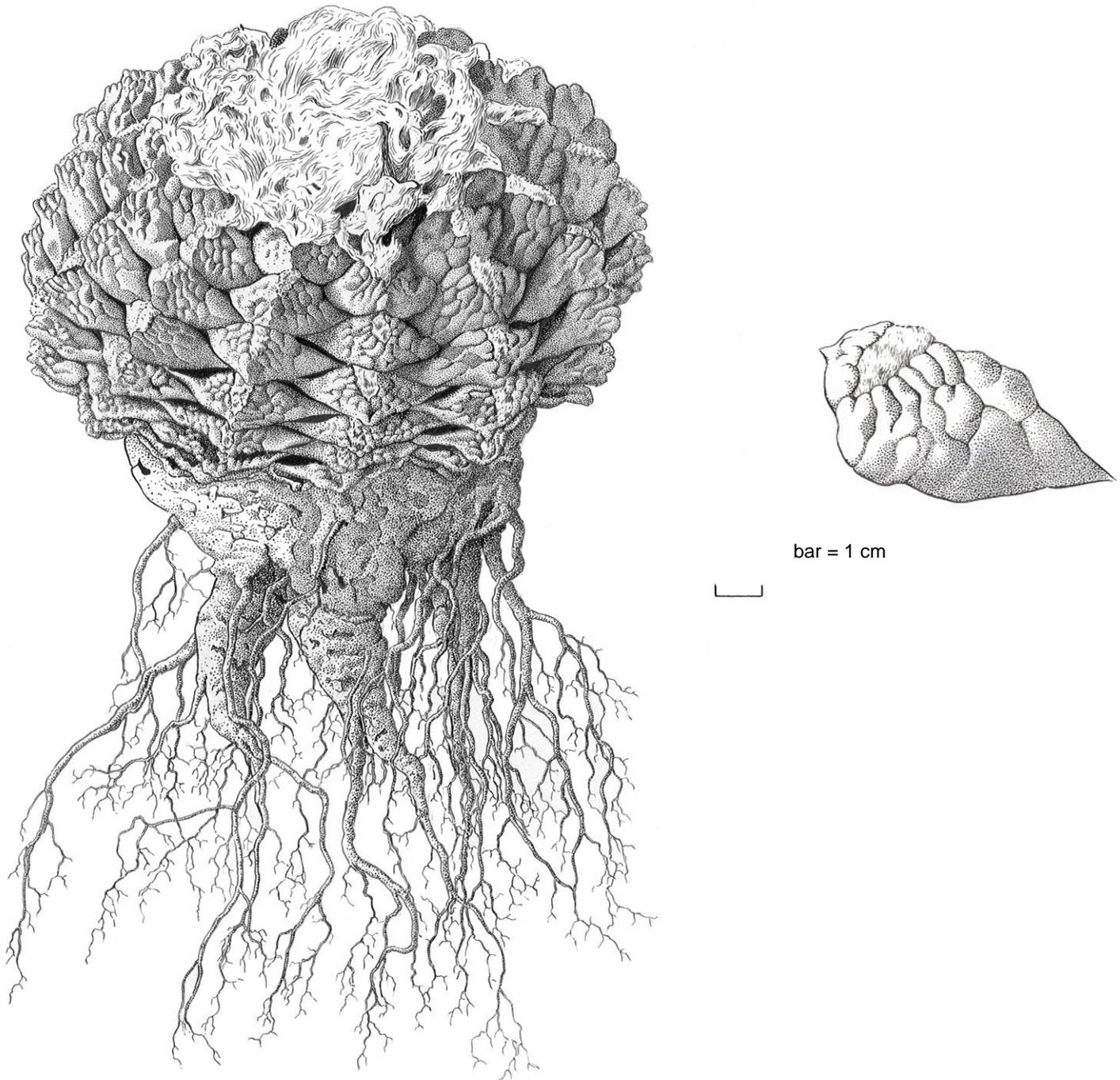
(Rose) W. T. Marshall 1941



**Common names:** engl.: Living rock.  
esp.: Chautle, chaute.

**Scientific synonyms:** = *Ariocarpus lloydii* Rose 1911  
= *Roseocactus lloydii* (Rose) A. Berger 1925  
→ *Ariocarpus lloydii* var. *mayor* Frič 1926  
→ *Roseocactus intermedius* Backeberg & Kilian 1960  
→ *Ariocarpus fissuratus* ssp. *pailanus* Halda 1998 (possibly referable to *A. fissuratus* var. *lloydii*?)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. NL).



**Characteristics:** Rounded, semi-globose shape and rocklike appearance, greyish colour. No spines but some wool. Tubercles hard, distinctively and coarsely fissured (hence the species name), rounded, lacking longitudinal lateral furrows (in contrast to the typical variety). Very cryptic in habitat, imitating the surrounding substrate.

**Roots:** Branched taproot from deep-seated, subterranean stem-base.

**Stem:** Solitary, grey-green to reddish or brownish, depressed globose, rounded on the top, often rises considerably above ground level, up to 15 cm Ø. May grow to huge dimensions and cylindrical shape in cultivation and show big amounts of wool, which in nature weathers away soon.

**Tubercles:** Spreading, broader than long, deltoid, tip and edges rounded, upper surface coarsely fissured, lateral longitudinal furrows absent, with only a central longitudinal woolly areolar groove.

**Areoles:** Central longitudinal woolly areolar groove

**Spines:** Absent on adult specimens.

**Flowers:** Light magenta, 2.5-4.5 cm Ø, from the centre of the stem apex.

**Fruits:** Whitish or greenish, drying at maturity, usually remaining hidden in the dense wool of the stem apex.

**Seeds:** Black, tuberculate, 1.85x1.35 mm.

**Juvenile plants:** Globular hypocotyl with slender, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** States of Durango, Coahuila and Zacatecas, Mexico



**Trade:** *A. fissuratus* var. *lloydii*, despite its rather weak taxonomical position, has always been kept well separate in horticulture and trade, where it has been observed for a very long time already. It has been extensively collected in its habitat, especially by traders from USA, and big, old specimens in nurseries and collections are often of wild origin, but may well be pre Convention specimens. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001 (also "*intermedius*").

**Similar species:** *Ariocarpus fissuratus* var. *lloydii* is linked with the typical variety through intermediate forms, where the distribution areas meet in southern Coahuila (*Roseocactus intermedius*) and thus can't be given the rank of a separate subspecies, although "typical" specimens from the region of Parras, Coahuila, look quite distinctive and the variety is geographically rather well, but not completely, separated, occurring more to the Southwest. *Ariocarpus fissuratus* var. *lloydii* has a rather globose stem and distinctively rounded tubercles with a coarser surface structure. It lacks the lateral, longitudinal furrows of the typical variety.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
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 Hunt, D., ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition Royal Botanic Gardens, Kew, UK.  
 Lüthy, J. M. (2000): *Ariocarpus fissuratus*, a variable species. *Cactus & Co.* 4 (4): 192-202.  
 Stuppy, W. & N. P. Taylor (1989): A new variety of *Ariocarpus fissuratus* (Cactaceae). *Bradleya* 7: 84-88.  
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# Ariocarpus fissuratus

## ssp. fissuratus

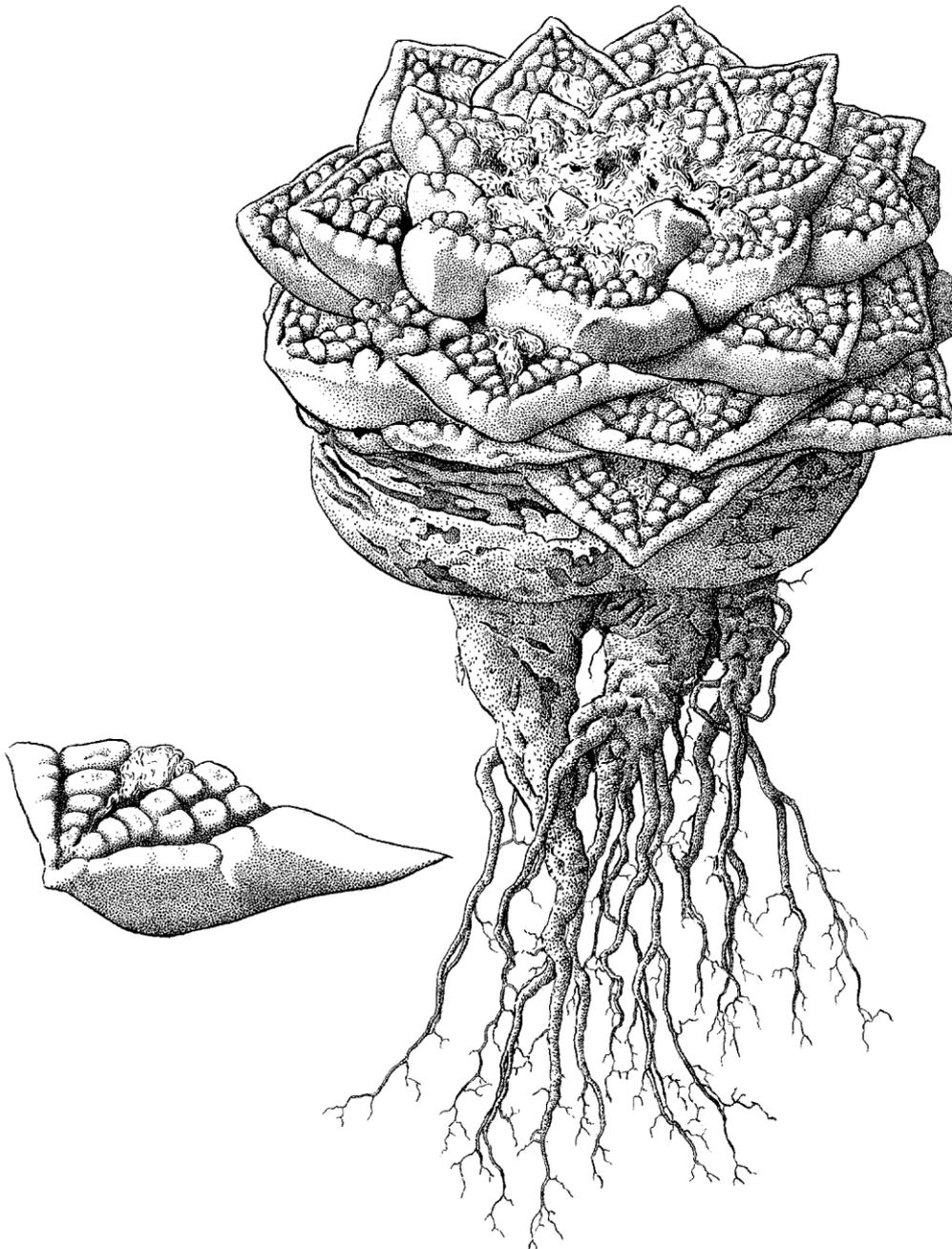
(Engelmann) K. Schumann 1894



**Common names:** engl.: Living rock cactus.  
esp.: Chautle, peyote cimarron, chaute.  
dt.: Wollfrucht-kaktus

**Scientific synonyms:** = *Mammillaria fissurata* Engelmann 1856  
= *Anhalonium fissuratum* (Engelmann) Engelmann 1856  
= *Roseocactus fissuratus* (Engelmann) A. Berger 1925  
→ *Anhalonium engelmannii* Lemaire 1868  
→ *Ariocarpus fissuratus* ssp. *pailanus* Halda 1998 (maybe referable to *A. fissuratus* var. *lloydi*?)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. NL).



<b>Characteristics:</b>	Star-like shape and rocklike appearance, hard consistence, no spines but some wool, greyish colour, tubercles distinctly fissured (hence the species name) with longitudinal lateral furrows along the sides. Spines absent. Very cryptic in habitat, imitating the surrounding substrate.
Roots:	Branched taproot from deep-seated, subterranean stem-base.
Stem:	Solitary, grey-green, turnip-shaped, largely subterranean, only the flattened or somewhat convex top above substrate in habitat, to 10 cm Ø.
Tubercles:	Spreading, usually broader than long, deltoid, flattened on top, tip somewhat acute, edges rounded, upper surface distinctively fissured, with distinct lateral longitudinal furrows along the sides and a central areolar groove, grey or dark olive green with reddish tinge.
Areoles:	Central longitudinal woolly areolar groove, up to 12 mm long, 3-6 mm broad.
Spines:	Absent on adult specimens.
Flowers:	Appearing in August and September from the centre of the stem apex, to 3.5(4) cm long and 3.5(4) Ø, pink to magenta,
Fruits:	White to greenish, drying at maturity, 6-15 mm long, 3-6 mm Ø, remaining embedded in wool.
Seeds:	Black, tuberculate, 1.85 x 1.35 mm.
Juvenile plants:	Globular hypocotyl with slender, ascending, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:**

State of Coahuila, Mexico



State of Texas, USA



**Trade:** In international trade for a very long time, big, old specimens observed in nurseries and collections are often wild-collected, but may well be pre Convention specimens. The illustrated, wild collected specimen originates from USA and has been confiscated in Switzerland (1998). Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar taxa:** *Ariocarpus fissuratus* var. *lloydii* has a more rounded stem (almost globose in cultivated specimens) and more rounded tubercles, without lateral furrows. It occurs more to the south-west of the range of typical *fissuratus*. There are intermediate forms, known as *Roseocactus intermedius*. Probably, *A. fissuratus* ssp. *pailanus* is referable here. *Ariocarpus fissuratus* ssp. *hintonii* is considerably smaller, with a more delicate surface structure of the tubercles, more pronounced lateral furrows and sharper edges of the tubercles. *A. fissuratus* ssp. *bravoanus* is much smaller and typically has somewhat ascending, small tubercles with a central, round, woolly areole (not a groove) and a rather papillate than fissured surface of the tubercles.

**Bibliography:** Anderson, E. F. & W. A. Fitz Maurice (1997): *Ariocarpus* revisited. *Haseltonia* 5: 1-20.  
 Benson, L. (1982): *The Cacti of the United States and Canada*. Stanford University Press, Stanford, California.  
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 Stuppy, W. & N. P. Taylor (1989): A new variety of *Ariocarpus fissuratus* (Cactaceae). *Bradleya* 7: 84-88.  
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# Ariocarpus fissuratus ssp. hintonii

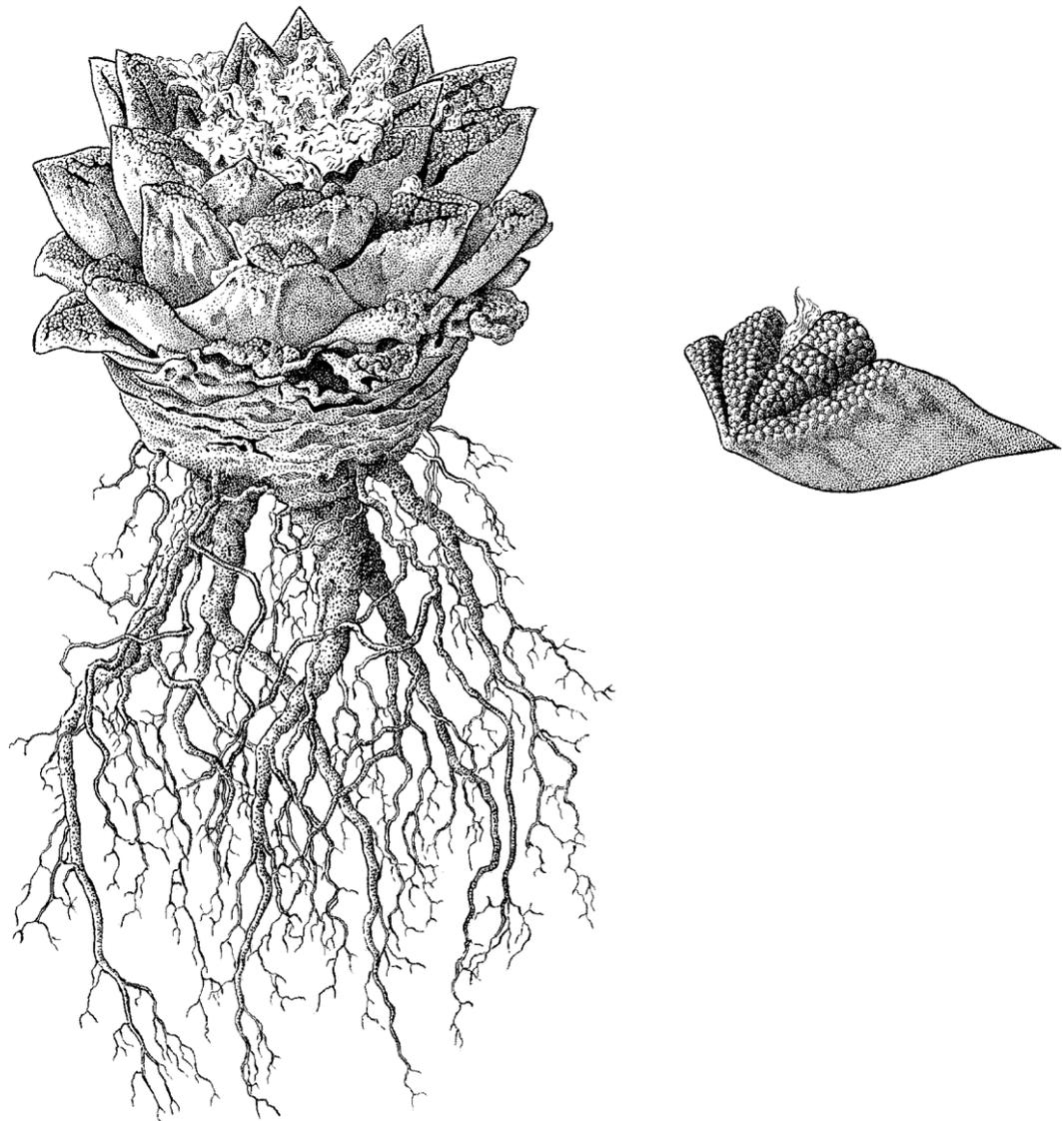
(W. Stuppy & N. P. Taylor) Halda 1998



**Common names:** none

**Scientific synonyms:** = *Ariocarpus fissuratus* var. *hintonii* W. Stuppy & N. P. Taylor 1989  
= *Ariocarpus bravoanus* ssp. *hintonii* (W. Stuppy & N. P. Taylor) E. F. Anderson & W.A. Fitz Maurice 1997

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. NL).



**Characteristics:** Star-like shape and rocklike appearance, rosette of a few, very finely roughened, triangular tubercles, hard tissue, no spines but some wool, greyish colour, tubercles distinctively fissured (hence the species name) with longitudinal lateral furrows along the sides, rather sharp-edged. Very cryptic in habitat, imitating the surrounding substrate.

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Roots: Branched taproot from deep-seated, subterranean stem-base.  
Stem: Solitary, largely subterranean, stem apex nearly level with the ground, up to 6 cm Ø.  
Tubercles: Slightly ascending to spreading, longer than broad, deltoid, flattened on top, nearly triangular in cross-section, dark olive green, sometimes with reddish tinge, 2 cm long, apex and edges acute and well defined, upper surface finely and densely fissured (verrucose), with a central longitudinal woolly areolar groove and two pronounced lateral longitudinal furrows.  
Areoles: Central longitudinal woolly areolar groove.  
Spines: Absent on adult specimens.  
Flowers: From the centre of the stem apex, lively pinkish-magenta, expanding to 4 cm Ø.  
Fruits: Pale red, 2 cm long.  
Seeds: Black, tuberculate, 1.1-1.5 x 0.95-1.2 mm.  
Juvenile plants: Globular hypocotyl with slender, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** State of San Luis Potosí, Mexico



**Trade:** Local endemic, first reported 1981 as specimens cultivated by local residents in Mexico. Habitat discovered 1984 by G. S. Hinton. First in trade as '*Ariocarpus fissuratus* var. *minimus*' (invalid name). Big quantities of wild collected specimens and seeds are observed now in international trade. However, no legal exports from Mexico are known (except for a few specimens for scientific purposes) and consequently all adult specimens observed in trade were smuggled. Demand is very high. The taxon has become very rare in its only 2 sites known to collectors. It is also gathered by local residents in considerable quantities and sold to tourists, as observed 1998 (Eyer 1999, pers. com.). Most recently, in October 2001, new localities with several thousand plants have been discovered (Sotomayor, in lit.). Today, artificially propagated young seedlings are observed in international trade, but it will take many more years, until mature, artificially propagated specimens are available. Nurseries registered for artificial propagation: Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** *Ariocarpus fissuratus* ssp. *fissuratus* has a bigger stem, tubercles broader than long and more coarsely fissured, with more rounded edges. *Ariocarpus fissuratus* ssp. *bravoanus* has distinctively ascending tubercles with a central, round woolly areole instead of an areolar groove, the surface of the tubercles is rather papillate than fissured and lacking distinct lateral furrows.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
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Glass, C. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
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Lüthy, J. M. (2000): *Ariocarpus fissuratus*, a variable species. *Cactus & Co.* 4 (4): 192-202.  
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# Ariocarpus kotschoubeyanus

(Lemaire) K. Schumann 1897

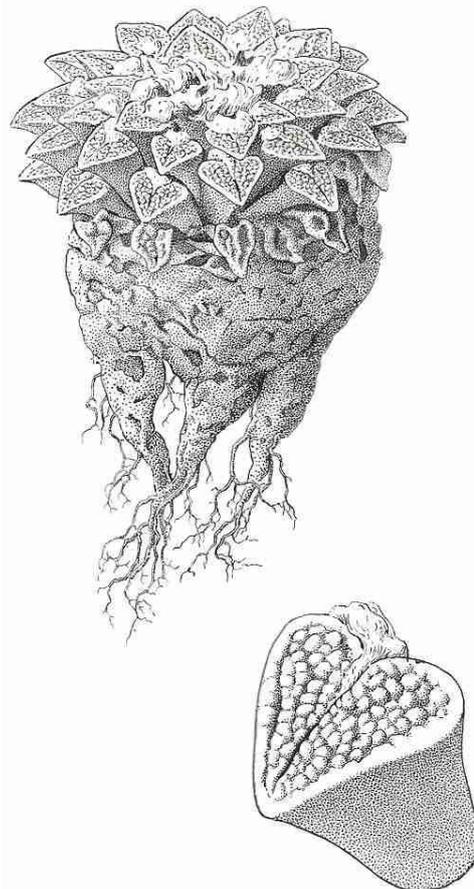
**Common names:** esp.: Pezuña de venado, pata de venado

**Scientific synonyms:**

- = *Anhalonium kotschoubeyanum* Lemaire 1842
- = *Roseocactus kotschoubeyanus* (Lemaire) A. Berger 1925
- *Anhalonium fissipedum* Monville 1846
- *Anhalonium sulcatum* Salm-Dyck 1850
- *Stromatocarpus kotschoubeyi* Karwinsky 1869
- *Cactus kotschoubeyi* Kuntze 1891
- *Ariocarpus macdowellii* Marshall 1941 (nom. nud.)
- *Roseocactus kotschoubeyanus* ssp. *macdowellii* (Marshall) Backeberg 1949 (nom. illeg.)
- = *Ariocarpus kotschoubeyanus* var. *macdowellii* (Marshall) Krainz 1965 (nom. illeg.)
- = *Roseocactus kotschoubeyanus* var. *macdowellii* (Marshall) Backeberg 1961 (nom. illeg.)
- = *Ariocarpus kotschoubeyanus* ssp. *macdowellii* (Backeberg) Halda 1998
- *Roseocactus kotschoubeyanus* var. *albiflorus* Backeberg 1935 (nom. inval.)
- = *Roseocactus kotschoubeyanus* ssp. *albiflorus* (Backeberg) Backeberg 1949 (comb. nud.)
- = *Roseocactus kotschoubeyanus* var. *albiflorus* Backeberg 1951
- = *Ariocarpus kotschoubeyanus* ssp. *albiflorus* (Backeberg) Glass 1997
- = *Ariocarpus kotschoubeyanus* var. *albiflorus* (Backeberg) Glass 1997
- *Ariocarpus kotschoubeyanus* var. *elephantidens* Skarupke 1973 (nom. inval.)
- *Ariocarpus kotschoubeyanus* ssp. *elephantidens* Halda 1998
- *Ariocarpus kotschoubeyanus* ssp. *tulensis* Halda 1998 (nom. illeg.)
- *Ariocarpus kotschoubeyanus* ssp. *sladkovskyi* Halda & Horacek 1998

**Excluded taxa:** *Ariocarpus kotschoubeyanus* ssp. *bravoanus* (H. Hernandez & E. F. Anderson) Halda 1998 = *A. fissuratus* ssp. *bravoanus* (H. Hernández & E. F. Anderson) J. Lüthy 1999

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. NL).



**Characteristics:** Very small, star-like, extremely cryptic plant, lacking spines, the flattened stem apex level with the

substrate in habitat, the single tubercle surfaces resembling the hoof of a deer (hence the Mexican vernacular name).

**Roots:** Branched taproot from deep-seated, subterranean stem-base.

**Stem:** Solitary, largely subterranean except for the totally flat to concave stem apex, 2-8 cm Ø.

**Tubercles:** Minute, upper surface triangular, flattened, with finely structured surface, olive-green, sometimes with a distinct reddish tinge, (3-) 7 (-10) mm wide, with central longitudinal, woolly groove and a conspicuous tuft of wool in the axil, very characteristic, hoof-like appearance.

**Areoles:** Central longitudinal woolly areolar groove.

**Spines:** Absent on adult specimens.

**Flowers:** From the centre of the apex, 2.5-3 mm long, 1.5-2.5 cm Ø, magenta or light pink to nearly white.

**Fruits:** Reddish or pinkish, 5-18 mm long, 1-3 mm Ø.

**Seeds:** Black, tuberculate.

**Juvenile plants:** Globular hypocotyl with slender, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** States of Coahuila, Nuevo León, San Luis Potosí, Zacatecas, Tamaulipas and Querétaro, Mexico



**Trade:** In international trade for a very long time, first imported to Europe in 1840. Exported in large numbers from Mexico after the second World War. Old specimens in nurseries and collections are often of wild origin, but may well be pre Convention specimens. Illegal trade is still substantial, a single shipment confiscated in NL (1990) contained 363 specimens. It is also collected by local residents for medicinal purposes, but the main threat is habitat destruction by agriculture. Now extensively artificially propagated. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001 (also "*albiflorus*", "*elephantidens*" and "*macdowellii*").

**Similar species:** None. Small, juvenile specimens of other *Ariocarpus* spp. don't show the hoof-like shape of the tubercle surface. There is some remote similarity with *A. fissuratus* for the spreading tubercles with a central longitudinal areolar groove, but the latter is much bigger in dimensions and has a much more coarsely fissured tubercle surface with longitudinal lateral furrows. The northern populations of *A. kotschoubeyanus* are dwelling in alkaline dry lakes, whereas the geographically isolated southern populations from Queretaro dwell on gravelly hillsides, but a corresponding taxonomical subdivision of the species has not been attempted. The segregation of the whitish flowering population of the region of Tula, Tamaulipas (ssp. *albiflorus* or ssp. *tulensis*) is hardly justified.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.

Anderson, E. F. & W. A. Fitz Maurice (1997): *Ariocarpus* revisited. *Haseltonia* 5: 1-20.

Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.

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# Ariocarpus retusus ssp. trigonus

(F. A. C. Weber) E. F. Anderson & W. A. Fitz Maurice 1997

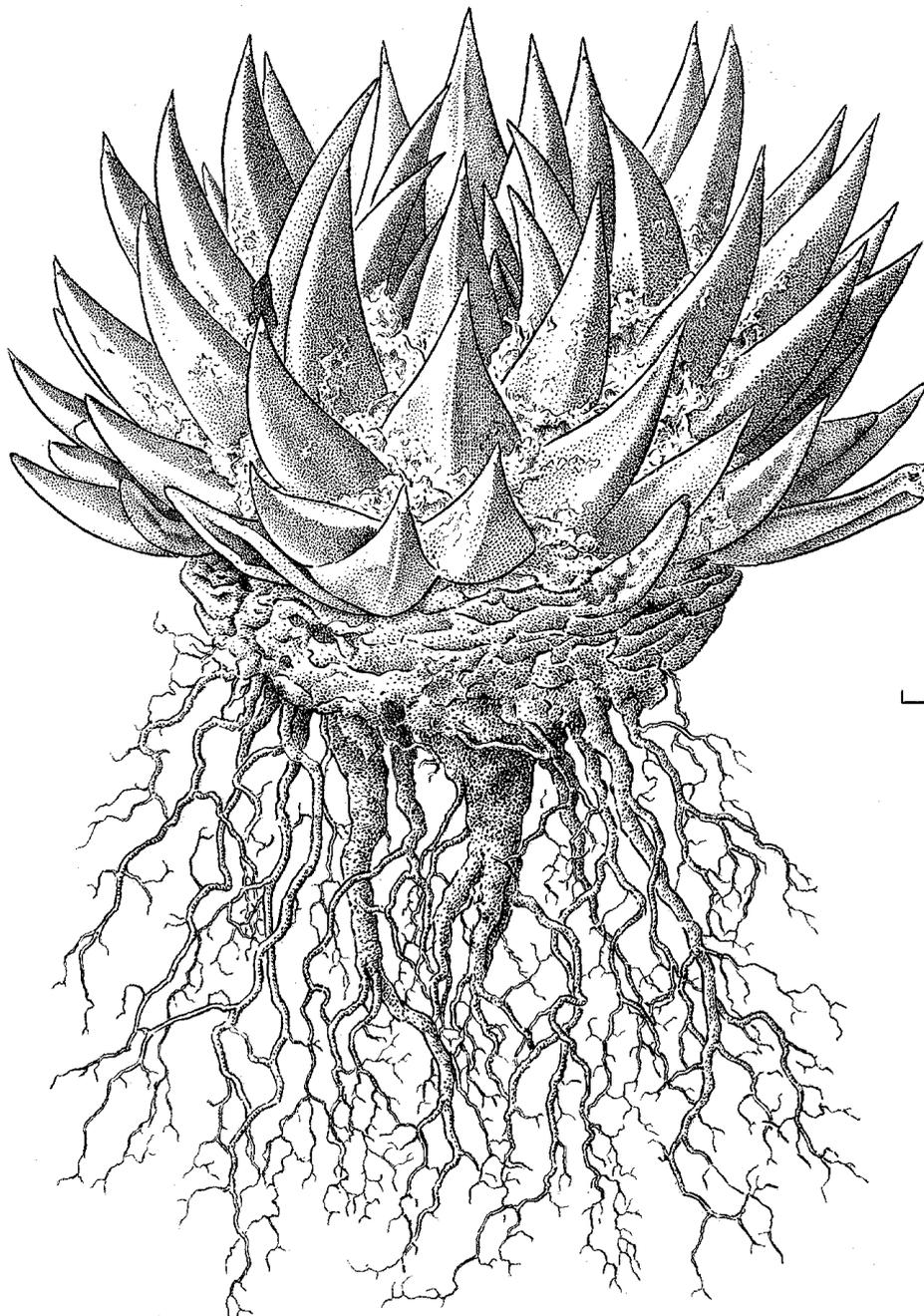


**Common names:** esp.: Chaute, chautle

**Scientific synonyms:** = *Anhalonium trigonum* F. A. C. Weber 1893  
= *Ariocarpus trigonus* (F. A. C. Weber) K. Schumann 1898  
→ *Ariocarpus trigonus* var. *minor* Voldan 1976  
→ *Ariocarpus trigonus* var. *horaceki* Halda 1997  
= *Ariocarpus elongatus* ssp. *horaceki* Halda 1998

**Excluded taxa** *Ariocarpus trigonus* fa. *rubriflorus* Lodé 1997 (nom. inval) referred to *A. retusus* ssp. *confusus*

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. US).



bar = 1 cm

**Characteristics:** Rosette-like shape, many acute, yellowish green, very hard, incurved tubercles, spines absent, conspicuous amount of wool between the tubercles.

**Roots:** Branched taproot from deep-seated, subterranean stem-base.

**Stem:** Large, 25-30 cm Ø, largely subterranean with just the tubercles above ground.

**Tubercles:** ± erect, strongly incurved and sharply pointed but with rounded edges, never with an angled keel, 3-8 cm long, 1-2.5 cm wide near base, olive-green to yellowish-green (but not greyish), surface smooth, lacking a woolly areole on or near tip.

**Areoles:** Woolly, at the base of the tubercles.

**Spines:** Absent in adult specimens.

**Flowers:** Subapical, in a ring around the apex of the plant from the base of the tubercles, 2.5-4 cm long, 3-5 cm Ø, bright yellow.

**Fruits:** 7-20 mm long, 5-10 mm Ø, whitish to greenish.

**Seeds:** Black, tuberculate

**Juvenile plants:** Globular hypocotyl with slender, ascending, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** State of Tamaulipas, Mexico



**Trade:** The mucilage is used by local residents as a glue for fixing broken pottery. In international trade for a very long time. Reported to be heavily impacted by collectors (U. S. Fish and Wildlife Service 1983). Very big specimens in the cactus trade are probably field-collected. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001 (also "*elongatus*" and "*minus*").

**Similar species:** *Ariocarpus retusus* ssp. *retusus* differs by greyish colour of its tubercles, which are not incurved, usually have an angled keel, are mostly about as long as broad and may bear a woolly areole near the tip. The flowers of ssp. *retusus* are white to pinkish, never yellow. *A. retusus* ssp. *confusus* has much elongated and rather greyish tubercles and magenta or white flowers and is very closely related, if not identical with ssp. *retusus*.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
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# Ariocarpus retusus

## ssp. retusus (incl. ssp. confusus)

Scheidweiler 1838



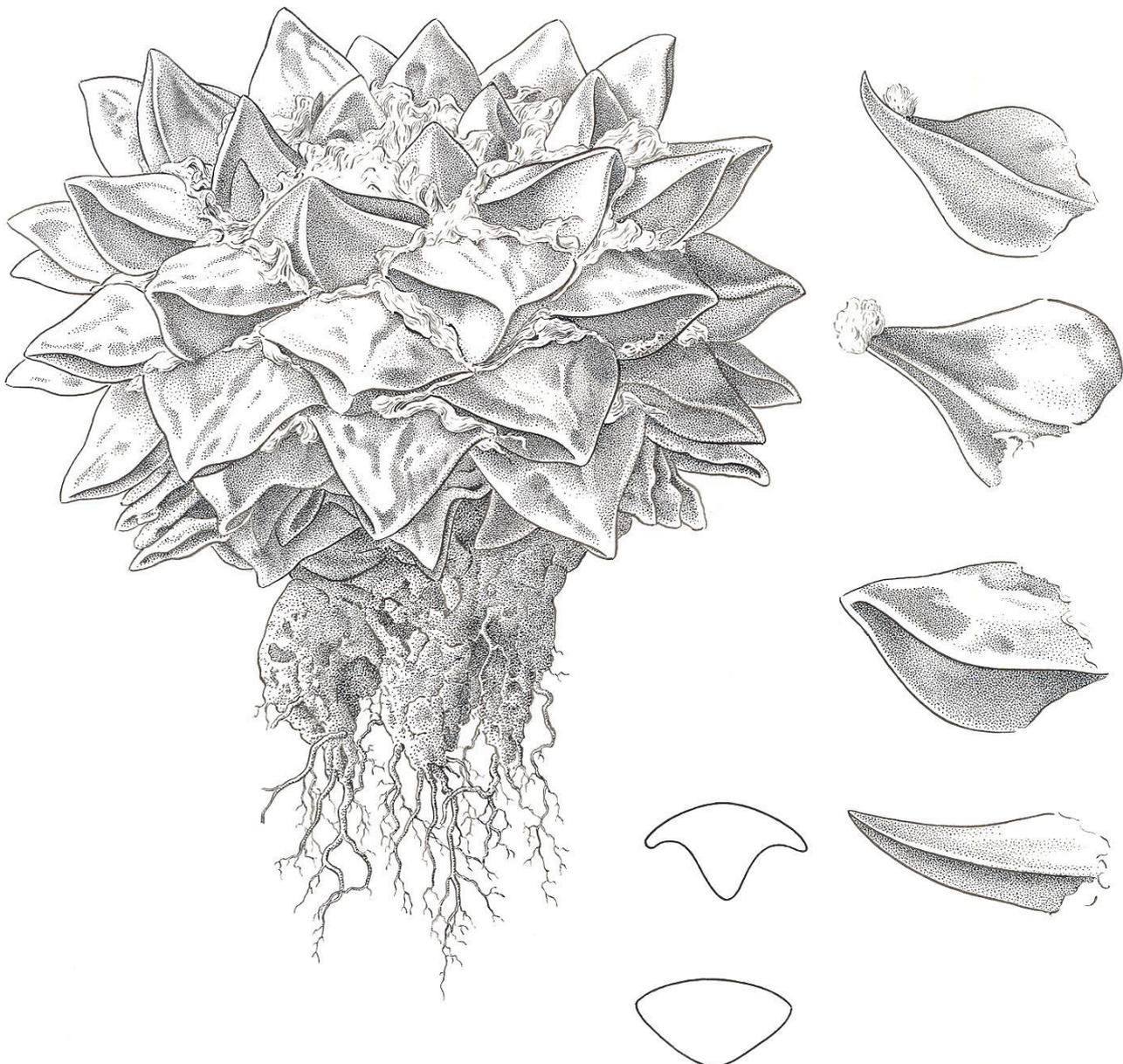
**Common names:** esp.: Chaute, peyote cimarron, falso peyote.

**Scientific synonyms:**

- *Anhalonium prismaticum* Lemaire 1839
- *Anhalonium elongatum* Salm-Dyck 1850
- = *Ariocarpus elongatus* (Salm-Dyck) Lee 1937
- = *Ariocarpus trigonus* var. *elongatus* (Salm-Dyck) Backeberg 1961
- *Mammillaria furfuracea* S. Watson 1890
- = *Ariocarpus furfuraceus* (S. Watson) W. Thompson 1898
- = *Ariocarpus retusus* var. *furfuraceus* (S. Watson) Frank 1975
- *Ariocarpus furfuraceus* var. *rostratus* A. Berger 1929

- *Ariocarpus confusus* Halda & Horacek 1997
- = *Ariocarpus retusus* ssp. *confusus* (Halda) J. Lüthy 1999
- *Ariocarpus retusus* ssp. *scapharostroides* Halda & Horacek 1997
- *Ariocarpus retusus* ssp. *jarmilae* Halda, Horacek & Panarotto 1998
- *Ariocarpus retusus* ssp. *horaceki* Halda & Panarotto 1998
- *Ariocarpus retusus* ssp. *panarottoi* Halda & Horacek 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. NL).



**Characteristics:** Rosette-like shape, grey, very hard triangular tubercles of variable shape (broad to acute), usually keeled below, spines absent, conspicuous amounts of wool between the tubercles, in some populations an additional small woolly areolar tuft at or near the tip. Rather polymorphic species with a wide distribution. Quite cryptic in habitat, imitating the surrounding substrate.

**Roots:** Branched taproot from deep-seated, subterranean stem-base.

**Stem:** Largely subterranean, only stem apex with tubercles rising above ground level, reaching 25 cm Ø.

**Tubercles:** Grey-green to blue-green, highly variable in shape, 1.5-4 cm long, frequently as long as broad at base, but some populations (e.g. Huizache) and ssp. *confusus* (see lowest illustrated tubercle) with rather elongated, longer than broad tubercles, divergent, ± erect, tapering or attenuate to a pointed tip, rounded or nearly flat on top, with or without an angled keel, triangular in cross-section with sharp edges, surface smooth.

**Areoles:** Woolly, without spines, divided into a fertile portion (producing flowers) at the base of the tubercle and in some populations ('*furfuraceus*') a separate, small woolly sterile portion, only producing wool, at or little below the tip of the tubercle (upper two illustrated tubercles).

**Spines:** Absent in adult specimens.

**Flowers:** White to pinkish-white (white or magenta in ssp. *confusus*), 4-5 cm Ø.

**Fruits:** White, green or rarely pinkish, becoming brownish, dry and papery at maturity.

**Seeds:** Black, tuberculate

**Juvenile plants:** Globular hypocotyl with slender, ascending, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** States of Coahuila, Nuevo León, Zacatecas, San Luis Potosí and Tamaulipas, Mexico



**Trade:** The mucilage is used by local residents as a glue for fixing broken pottery. In international trade for a very long time. Specimens with an areolar tuft near the tip of the tubercles have also been traded as '*furfuraceus*'. Has been subjected to extremely heavy collecting, as it is one of the most popular Mexican cacti in cultivation. Many thousands of specimens are estimated to have reached Japan, USA and Europe. Large plants are almost always wild-collected. However, they may be pre Convention specimens. Recently, the description of some little distinctive populations at species- or subspecies level has started (*A. confusus*, *A. retusus* ssp. *scapharostroides*, ssp. *jarmilae*, ssp. *horaceki*, ssp. *panarottoi*) and this is likely to continue. These populations are subsequently heavily collected (plants and seeds) and illegally traded in conspicuous amounts as "novelties". Nurseries registered for artificial propagation (ssp. *retusus*): Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001 (also "*elongatus*", "*furfuraceus*", "*furfuraceus rostratus*" and ssp. *confusus*).

**Similar species:** *Ariocarpus retusus* ssp. *trigonus* differs by the yellowish or olive green, not greyish colour of its much elongated, distinctly incurved tubercles, which always lack a woolly areole near the tip and are not keeled below. The flowers are yellow, never white or pinkish. *Ariocarpus retusus* ssp. *confusus* is not separately illustrated here, as, though geographically isolated (valley of Aramberri, Nuevo León), it differs from ssp. *retusus* mainly by its flower colour (usually magenta, sometimes white), while the rather elongated tubercles are within the variability of the typical subspecies.

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# Ariocarpus scaphirostris

Bödeker 1930

- Common names:** esp.: Chaute, orejitas, orejas de conejo
- Scientific synonyms:** Originally published as '*scapharostrus*' by Bödeker  
→*Ariocarpus scapharostrus* var. *swobodae* Halda, Horacek & Panarotto 1998
- CITES category:** Appendix II since 01.07.1975, Appendix I since 06.06.1981 (Prop. US).



- Characteristics:** Rosette-like shape, prolonged, hard, greyish, ascending tubercles from a subterranean stem, the tips shaped like the bow of a boat (hence the species name), spines absent, some wool between the tubercles. Extremely cryptic in habitat, only the tips of the tubercles sticking out of the gravelly substrate, which they closely resemble.
- Roots:** Branched taproot from deep-seated, subterranean stem-base.
- Stem:** Solitary, turnip-shaped, 3-7 cm Ø, completely subterranean in habitat with just the tips of the tubercles above ground.
- Tubercles:** In a rosette, divergent, erect, prismatic-triangular, keeled below, bluntly pointed at the bow-shaped tip, slightly incurved, 2-4 cm long, 5-8 mm wide, dark grey-green, upper surface flat, without woolly areole, grooves or fissures, surface of whole tubercle roughly textured and distinctly, minutely pitted.

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**Areoles:** Woolly, in the axils (at the base) of the tubercles.  
**Spines:** Lacking in adult specimens.  
**Flowers:** From the centre of the stem apex, 3-4 cm Ø, magenta.  
**Fruits:** Greenish, 9-15 mm long, 4-8 mm Ø.  
**Seeds:** Black, tuberculate.  
**Juvenile plants:** Globular hypocotyl with slender, ascending, reddish to dark green tubercles raising from the apex, bearing a few weak spines at their tips.

**Distribution:** State of Nuevo León, Mexico



**Trade:** Strictly local endemic of the valley of Rayones, Nuevo León. Until recently, all mature plants in trade were field-collected and big, old specimens are very likely to have been illegally traded. They may however be pre Convention specimens. Traded now also as artificially propagated seedlings on own roots. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001. Presently also artificially propagated outdoors in South Africa.

**Similar species:** A plant called "soft *scapharostus*" or var. *swobodae* is distinguished by collectors. It grows further north of the originally known locality and is stated to have soft tubercles, small flowers (25 mm long) and smaller seeds, but hardly merits separation. *Ariocarpus agavoides* has an areolar woolly tuft near the tips of the tubercles, which are longer, more flaccid, curved outwards and usually fewer in number. *A. fissuratus* ssp. *bravoanus* has a circular woolly areole in the centre of the upper, distinctively palillate tubercle surface. *A. retusus* ssp. *trigonus* has smooth tubercles, but they are much bigger, yellowish coloured, very acute and more incurved.

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Hunt, D., ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition Royal Botanic Gardens, Kew, UK. [www.living-rocks.com](http://www.living-rocks.com)



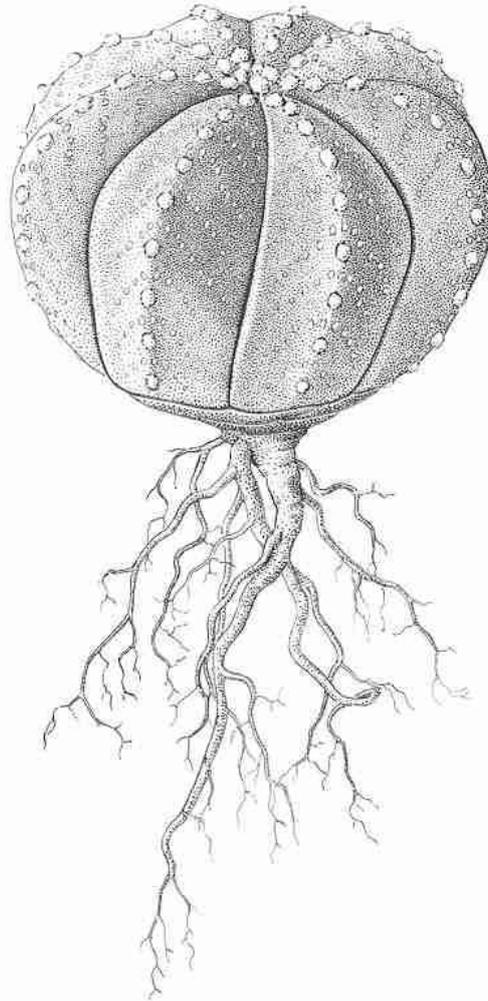
# Astrophytum asterias

(Zuccarini) Lemaire 1868

**Common names:** engl.: Star cactus, false peyote, sand dollar cactus, helmet cactus  
 esp.: Peyote  
 de.: Seeigelkaktus

**Scientific synonyms:** = *Echinocactus asterias* Karwinski ex Zuccarini 1845

**CITES category:** Appendix II since 01.07.1975, Appendix I since 22.10.1987 (Prop. United Kingdom).



**Characteristics:** Quite an outstanding species with a spineless, flat stem, divided into rounded ribs with woolly areoles, very distinctively adorned with tiny white wool flecks. Plants deeply sunken into the substrate in habitat, the apex level with the ground, quite cryptic.

**Roots:** Fibrous.

**Stem:** Flattened-globose, often barely rising above ground level in habitat, 5-10 (-15) cm Ø, greenish-yellow, with (7-) 8 (-10) low, rounded ribs, separated by narrow furrows, each rib bearing a regular, vertical row of rounded, tufted, woolly areoles and between the areoles much smaller, scattered white flecks, mostly arranged in one or several arches.

**Areoles:** Ca. 3 mm Ø, bearing short, persistent, white to grey wool.

**Spines:** Absent.

**Flowers:** Apical, shortly funnelform, yellow with red throat, 3.5-5 cm Ø. Pericarpel and tube woolly with acute, dark scales.

**Fruits:** Densely covered by white wool and acute scales, splitting open when ripe.

**Seeds:** Cup-shaped, distinctively hollow below, brown.

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**Distribution:** States of Tamaulipas and Nuevo León, Mexico



State of Texas, USA



**Trade:**

The species is officially classified as endangered in Mexico and USA. It has been exported from Mexico to the USA by the tens of thousands in the 1980s and was also collected in the USA for the cactus trade in unsustainable numbers, but is even more threatened through agriculture. The species has occurred on gentle slopes and flat lands of the lower Rio Grande Valley in both grassland and thorn scrub, then southward along the east side of the Sierra Madre Oriental, at elevations below 200 meters. Only one site in Starr County, Texas (Hook 1996) and another south of Ciudad Victoria, Tamaulipas (Kleszewski 1994; Anderson & al. 1994; Hook 1996) are still confirmed, whereas the species has disappeared from 3 reported localities in Texas and 5 known localities in Mexico (Hook 1996). However, in CITES document PC 11 Inf. 15, 6 populations are reported from the state of Tamaulipas alone. Collecting from the wild is still a problem (Glass 1998). The population in Texas is subject to a conservation program, but in Mexico, the last habitats are still threatened through land use. The species is widely propagated from seed, cultivation is rather easy. Especially in Japan, selected cultivars are much appreciated. They differ from the wild plants in distinctive arrangements of the white flecks. Today, Brazil is contributing substantially to the international trade in artificially propagated specimens. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Czech Republic P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:**

There might be some confusion with *Lophophora williamsii* (CITES App. II), because both species have spineless, flattened stems with woolly areoles and are commonly called "peyote" by local residents. *Lophophora* however tends to cluster and lacks the white flecks between the areoles and the areoles bear much more prominent woolly tufts. Further, the ribs are divided to varying extent into flat, diffuse tubercles in *Lophophora*. Flowers, fruits and seeds are much different in both species and can not be confounded.

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- <http://www.astrobases.de>



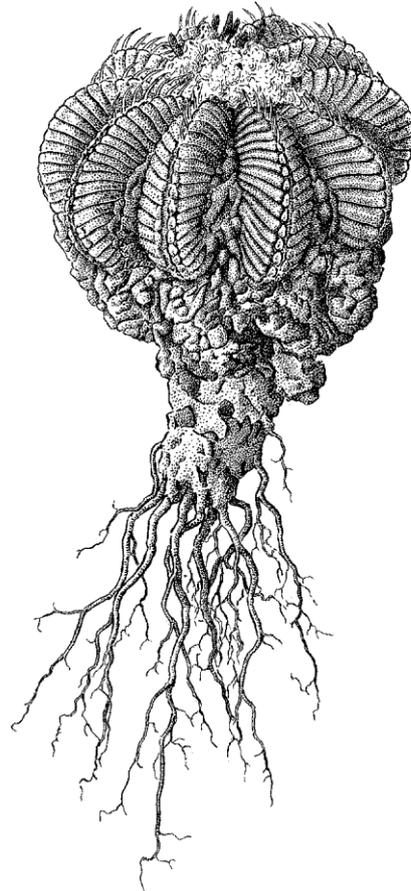
# Aztekium ritteri

(Bödeker) Bödeker 1929

**Common names:** engl.: Aztec cactus  
esp.: Peyote

**Scientific synonyms:** = *Echinocactus ritteri* Bödeker 1928

**CITES category:** Appendix II since 01.07.1975, Appendix I since 06.06.1981 (Prop. USA).



<b>Characteristics:</b>	Very unusual, small cactus, nearly spineless, of wrinkled appearance and very hard consistence. Stem forming small groups or clusters with age, divided into prominent ribs and smaller, strange, subsidiary ribs in-between. Inhabiting nearly vertical cliffs of canyons.
Roots:	Branched taproot from deep-seated, subterranean stem-base.
Stem:	Small, globose, 2-6 cm Ø, grey-green or greenish yellow, with 7-11 prominent ribs and often smaller, subsidiary ribs (lacking areoles) in-between them, frequently clustering and forming groups up to 10-15 cm wide.
Ribs:	Rounded, corrugated-wrinkled, with closely set areoles, 1 cm high, 8 mm broad.
Areoles:	Producing spines and wool, arranged along the length of each true rib and usually traversed by a lateral furrow.
Spines:	1-4 per areole, very short, 3-4 mm long, flattened, not pungent, white, later turning brown, deciduous (only present in young areoles).
Flowers:	White touched pink, ca. 1 cm Ø, with relatively long, distinct tube.
Fruits:	Appearing from the centre of the stem apex, pinkish, ca. 1 cm long.

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**Seeds:** Pyriform, only 0.5 mm long, testa black, prominently tuberculate.

**Distribution:** State of Nuevo León, Mexico



**Trade:** The species is classified as safe (Anderson & al. 1994), the only potential threat being collecting from the wild. It is an endemic of the Valley of Rayones, Nuevo Leon. The species is very sought after by collectors and was heavily exploited in the 1970s, 1980s and early 1990s and mainly exported to USA prior to App. I-listing. Probably tens of thousands of specimens were exported from Mexico to USA, Europe and Japan. For example 2'000-3'000 specimens have been observed in a US nursery in 1980 (U. S. Fish and Wildlife Service 1981) and in the early 1990s hundreds of plants still arrived in Belgium and were subsequently distributed in the European Union. Almost all adult plants have been removed in the 1980s from the originally exploited site. The age of large clumps is estimated at 90-120 years. Many of these plants died, as acclimatisation of wild-collected, adult specimens to cultivation is difficult. Hundreds of specimens have still been observed in 1992 in various US and European nurseries (A. Cattabriga, pers. corresp.). Some field-collected specimens may have pre Convention status. But the natural population has recently been estimated at several millions (Anderson & al. 1994) and locally the species is still abundant in its rather inaccessible habitat. Cultivation from seed is extremely slow and quite difficult, as the young seedlings are nearly microscopic in size. Maturity is reached after 12 or more years. Prices for artificially propagated specimens on own roots are therefore very high. Specimens with a diameter of only 1 cm have been offered for DM 200.-- in 1999 in Germany (A. Cattabriga, pers. corresp.). Artificially propagated specimens are mostly traded as grafted seedlings. This allows for faster growth, but strongly reduces the attractiveness of the plants. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** *Aztekium hintonii* (CITES Appendix II) lacks the smaller subsidiary ribs inserted between the quite acute main ribs of the stem, grows much bigger and has magenta flowers. Discovered in 1991, *A. hintonii* presently is in much higher demand than *A. ritteri* and illegally wild-collected specimens are repeatedly observed in trade today.

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# Bletilla striata

(Thunb.) Rchb.f.

**Family:** Orchidaceae**Synonyms:** *Bletilla hyacinthina* (R.Br.) Rchb.f.  
*Bletia hyacinthina* R.Br.**Vernacular names:**  
english: Common Bletilla  
french:  
spanish:  
german: Bletilla  
italian:**Geographical range:** China (from east Tibet and the provinces Gansu in the east and Yunnan and Jiangxi in the south) through the Republic of Korea to the south of Japan (Honshu, Shikoku, Kyushu, Ryukyu Islands).**Distribution by country:** China (including Hong Kong SAR), Japan, Republic of Korea.**Protection:** CITES Appendix II (#7), since 01.07.1975  
All species of the genus *Bletilla* are listed in CITES Appendix II.**Use:** Medicinal plant used in TEAM, horticultural plant.

## Botanical drugs in trade

**Plant parts used:** Root tubers.**Pharmaceutical names:**  
latin: Bletillae rhizoma, Tubera Bletillae, Bletillae tuber, Rhizoma Bletillae  
english: (Common) bletilla tuber, bletilla rhizome  
spanish:  
french:  
chinese: Bai Ji (Baiji), Pai-chi  
german: Bletilla-striata-Wurzelknollen  
italian:**Countries of export:** China (including Hong Kong SAR), Japan.**Source:** Artificially propagated and (less common) wild-collected.**Commodities in trade:** Mainly dried and sliced root tubers (cut drug); also dried, whole (crude drug) or powdered tubers (in horticultural trade: fresh, whole tubers).

**Characteristics:**

- Crude drug: Tuber irregularly shaped, often with 2-3 claw-shaped branches, hard, horny, does not break easily, 1.5-5 cm long and 0.5-1.5 cm thick, top presents a prominent shoot scar; surface with several concentric lines, often distinctly plicate to wrinkled, mainly grey-white, yellowish white to pale brown, occasionally darker brown, with small, brown, small-dotted root scars, sometimes with remainings of roots; fracture whitish, horny;
- Cut drug: (Fig. 1-3) Thin, up to about 5 mm thick, irregularly shaped, often semitranslucent slices of the root tuber; cut surface white or pale yellow, horny and with visible vascular bundles, which depending on the cut look like white, ±interrupted longitudinally stripes, or white dots;
- Odour: Faint;
- Taste: Bitter, mucilaginous when chewed.



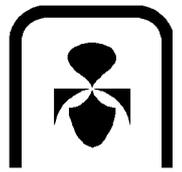
Figure 1. Cut drug, Bletillae rhizoma; species: *Bletilla striata*, (copyright BfN).



Figure 2. Cut drug, Bletillae rhizoma; upper right cover some whole roots; species: *Bletilla striata*, (copyright BfN).



Figure 3. Cut drug, Bletillae rhizoma; species: *Bletilla striata*, (copyright BfN).



# General notes to family Bromeliaceae

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The Bromeliaceae; The Pineapple Family

The inclusion of seven species of the genus *Tillandsia* in Appendix II of CITES in 1992 was a reaction to the rapid increase of trade in grey (atmospheric) tillandsias in the preceding years. In addition to the destruction of the native habitats, the commercial collecting of some sought-after species has contributed substantially to the decrease in numbers of these plants in their native habitats.

A very special difficulty for the implementation of CITES for *Tillandsia* is the fact that these species are traded in the vegetative stage. Unfortunately, in bromeliads the relevant taxonomic characteristics for species identification are nearly all found in the inflorescence and the floral parts. Identification of species of *Tillandsia* in the non-flowering stage is difficult, and in many cases not possible with sufficient reliability. The key for identification of the species, provided below, can therefore only be used to separate the CITES-listed species from other commonly traded *Tillandsia* species. For the hobbyists market, about ten times as many species are relevant, but the majority are traded in small quantities only. Because of the above-mentioned difficulties, a specialist should be consulted in case of doubt.

For the atmospheric tillandsias the differentiation between plants collected in the wild and those propagated in cultivation is also problematic. The usual criteria to separate these two groups (see the relevant chapter elsewhere in this ID Manual) can sometimes be applied, but the characteristic differences in the root system, which have been proven to be very helpful for Cactaceae, are of very limited use for atmospheric tillandsias. Their roots often are reduced and primarily serve as a holdfast. As is typical for the monocotyledons, the roots are adventitious (arising from the base of the stem) and usually have a simple, unbranched structure. Moreover, the individual roots rarely last more than two to three years. The need to distinguish between wild-collected and artificially propagated specimens will become increasingly important. Nurseries in Central America have started to artificially propagate native species on a large scale. It is extremely difficult to tell this artificially propagated material from plants collected in the wild, especially if offshoots ("Kindel") are collected from the wild and cultivated for a while before being traded.

The family Bromeliaceae comprises 50 genera with over 2500 species (Till, 1986a, 1986b; Luther, 1990; Smith & Spencer, 1992). Regularly, new species are being described, especially in the genus *Tillandsia*.

Similar to the Cactaceae, all bromeliads are native to the New World with one species, *Pitcairnia feliciana*, being native to tropical West Africa. In the Americas, the bromeliads are distributed from the southern USA in the north to Chile and Argentina in the south. The genus *Tillandsia* has a wide distribution, almost similar to that of the whole family.

For a long time, bromeliads have been cultivated as ornamentals. In Central Europe, *Billbergia nutans* is an old ornamental, as are a number of species from the genera *Aechmea*, *Guzmania* and *Vriesea* as well as *Tillandsia cyanea*. The specimens of these taxa, currently in trade, are all artificially propagated, and many man-made hybrids are known. However, the rapidly increasing demand for and trade in the small atmospheric tillandsias in the last decade led to a conservation problem. Although artificial propagation of atmospheric tillandsias from seeds is usually easy, the plants grow slowly, making the trade in plants collected from the wild more profitable. For some species of *Tillandsia* propagation through tissue culture has been practised successfully.

## Characteristics and classification of the family

The Bromeliaceae belong to the Monocotyledons (Monocotyledonae), subclass Commelinidae and are usually regarded as being related to the Poaceae (Grass family), Cyperaceae (Cypergrass family), Commelinaceae (Spiderwort family) and Zingiberaceae (Ginger family).

The flowers are rather similar in structure, but floral bracts, primary bracts and scape bracts (see Fig. on next page) as well as habit, life and growth form, display a considerable amount of variation.

Bromeliads are herbaceous, perennial plants, often with short stems, the leaves usually arranged in dense rosettes and the roots emanating from the base of the stems. The species are either terrestrial, or are epiphytic (growing on trees and rocks). The leaf blades normally are narrow and triangular, strap-shaped or less often bristle-like or having the form of a thread. The leaf margin can be entire ("smooth") or spiny ("armed"). In many species, the leaf sheaths (the basal parts of the leaf), being arranged in a rosette, are pressed tightly together forming a single, central, watertight chamber in which water is collected. In others, each individual leaf-base forms a separate water reservoir (these species are called "tank bromeliads").

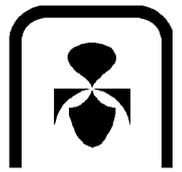
A characteristic feature of the family are the leaf-scales. These are umbrella-shaped or shield-shaped trichomes (hair-like structures), enabling the plant to take up water and mineral nutrients from the leaf surface. The indumentum of scales is the reason for the greyish-white (cinereous) colour of many *Tillandsia*- and *Vriesea*-species. Only when soaked with water, the dead shield-cells of the scales become translucent and the green colour of the leaf-blade apparent. Especially in many epiphytic bromeliads, the scales are highly developed and have overtaken the function of water absorption from the roots. The latter then often are reduced to a holdfast role. Few species have reduced the roots completely in adult plants. In terrestrial bromeliads the roots are usually normally developed and serve as organs for water absorption.

In by far the most bromeliad species, the inflorescence is terminal, thus terminating stem development (determinate growth). Less often, the inflorescence is produced laterally (*Tillandsia complanata*, *T. multicaulis*), thus enabling the stem to continue vegetative growth (indeterminate growth). Vegetative propagation is usually from buds in the leaf axils, from which new plants may develop.

The inflorescence may be sunken in the center of the rosette, or, if the scape (stalk of the inflorescence) is well developed, may be raised well above the leaves. Usually, the scape is covered by leaves with reduced leaf-blades (scape-bracts), upwards usually more and more reduced (see Fig. on next page).

The inflorescence may be simple or compound, the inflorescence types being principally panicle, raceme or spike. The scape-bracts are followed by the so-called primary bracts, these bearing the branches of the inflorescence (if compound). In the axil of the floral bracts, which often are brightly coloured, single flowers are found.

The morphology of the bromeliad flower displays little variation. In most bromeliads, the flowers are complete, consisting of an outer (petals) and inner whorl (sepals) of three floral leaves each, surrounding 2 whorls of 3 stamens each and the ovary. The latter may be superior, inferior (sunken into the flower stalk) or half inferior. The sepals are usually green, the two directed to the axis often keeled. Usually, the 3 petals are considerably larger than the sepals and more or less brightly coloured. The shape of style and stigma as well as the length of the style compared to the petals is of importance for identification. The superior ovary usually develops into a dry dehiscent (gaping open) capsule, releasing tiny seeds with membranous or hairy appendages, which are dispersed by the wind. The inferior ovary of the Bromelioideae develops into berries, which are dispersed by animals; the seeds lack hairy or membranous appendages.



# General notes to family Bromeliaceae

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The characters of flowers, fruits and seeds principally serve to separate 3 subfamilies within the Bromeliaceae

- Subfam. Pitcairnioideae: Ovary mostly superior; fruit usually a dry, dehiscent capsule; seeds winged, with membranous appendages or hairlike projections (not appendaged in *Navia*); leaf margins often armed.
- Subfam. Tillandsioideae: Ovary mostly superior, rarely half inferior; fruit a capsule; seeds plumose (with hairy appendages); leaf margins never armed.
- Subfam. Bromelioideae: Ovary usually inferior; fruit a berry; seeds without hairy or membranous appendages; leaf margins mostly armed.

## Acknowledgements

The author is thankful to Mrs. Renate Ehlers, Stuttgart; Dr. Elvira Groá, Heidelberg, Dr. Walter Till, Vienna and J. Barzdo and G. van Vliet of the CITES Secretariat for informations, corrections and amendments. Mr. Harry E. Luther, Sarasota, was so kind to allow use of his drawings for the identification manual.



# Byblis spp.

Common names:	engl.:	Rainbow Plant, Byblis
	esp.:	Byblis, Arco iris
	fr.:	Byblis
Scientific synonyms:	None	



*Byblis liniflora*

## Characteristics:

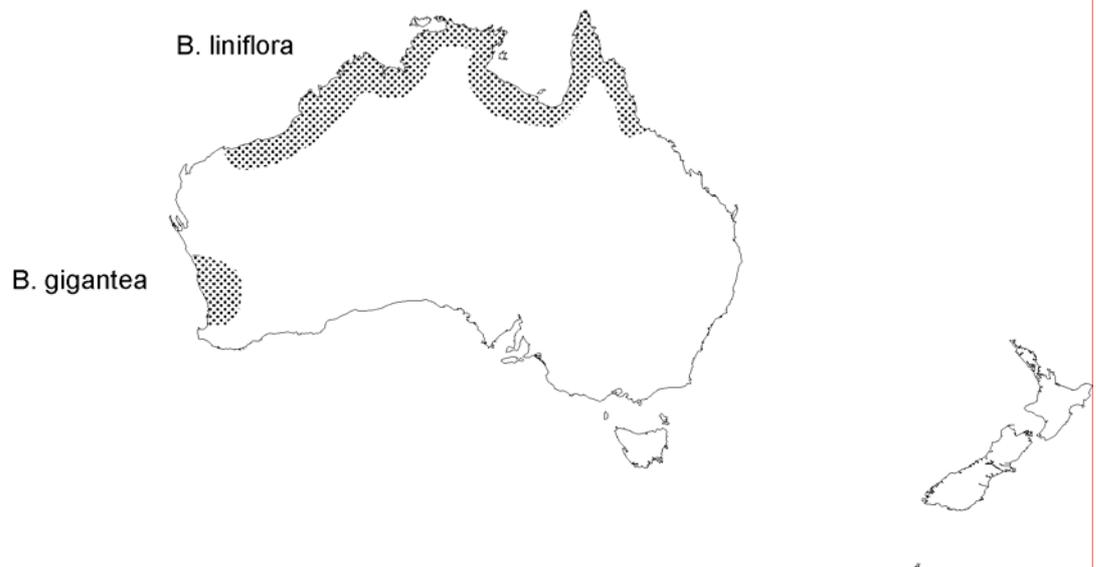
Plant:	Terrestrial, forming shrubs. <b><i>B. liniflora</i></b> : herbaceous; <b><i>B. gigantea</i></b> : semi-ligneous.
Size:	<b><i>B. liniflora</i></b> : 20-30 cm; <b><i>B. gigantea</i></b> : 50-70 cm.
Type of trap:	Passive, with glandular tentacles.
Traps:	Leaves long ( <b><i>B. liniflora</i></b> : shorter) and thin, yellowish-green on which are found peduncular glands secreting a sticky gum.
Inflorescence:	<b><i>B. liniflora</i></b> : small (diameter 1 cm), usually pale blue. <b><i>B. gigantea</i></b> : larger (diameter 4 cm. ), mauve or rarely white.
Prey:	Especially flying insects.
Digestion:	Tiny sessile glands ensuring digestion by enzymes.

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**Distribution:**

***B. liniflora***: Northern Australia (northern coast between Goldsworthy, W.A. and Mackay, Qld) and the Island of New Guinea (swamps near Merauke).

***B. gigantea***: Western Australia (limited to the area between Geraldton, Perth and Lake Moore).



**Climate:**

***B. liniflora***: tropical climate. ***B. gigantea***: Mediterranean climate.

**Habitat:**

***B. liniflora***: sandy soils, primarily in river banks.

***B. gigantea***: along the coast in sandy or gravel soils; or in temporary swamps wet in winter and dry in summer.

**Propagation:**

By seeds (***B. liniflora***: easy; ***B. gigantea***: the seeds must be prepared).

**Useful part:**

Whole plants as ornamentals.

**Trade:**

Probably little trade in live plants, more in seeds because the plants are very fragile.

**Number of species:**

2 species in the single genus in this family: *B. liniflora*, *B. gigantea*.

Recently, A. Lowrie and J.G. Conran (1998) published a revision of *B. liniflora*, recognizing three additional species in this complex:

*Byblis aquatica* Lowrie & Conran: Darwin to Berry Springs, Northern Territory.

*Byblis filifolia* Planch.: Port Hedland to the Little and Great Sandy Desert; Kimberley (Western Australia and adjoining territories of Northern Australia; Katherine Region to the Tanami Desert.

*Byblis liniflora* Salisb.: Northern regions of Western Australia, Northern Territory and Queensland.

*Byblis rorida* Lowrie and Conran: Scattered locations in northern West Australia, from Kimberley to the Tanami Desert.

The individual characteristics of these species are difficult to discern for the layman. A specialist should always be consulted.

Reference: Lowrie, A. & Conran, J.G. (1998) A taxonomic revision of the genus *Byblis* (Byblidaceae) in northern Australia. *Nuytsia* 12 (1) 59-74.

**Similar species:**

Because of the sessile glands and the five petals, this plant can be easily confused with *Drosera*, but the glands of *Byblis* are fixed and the ovaries, stamens and styles are different.

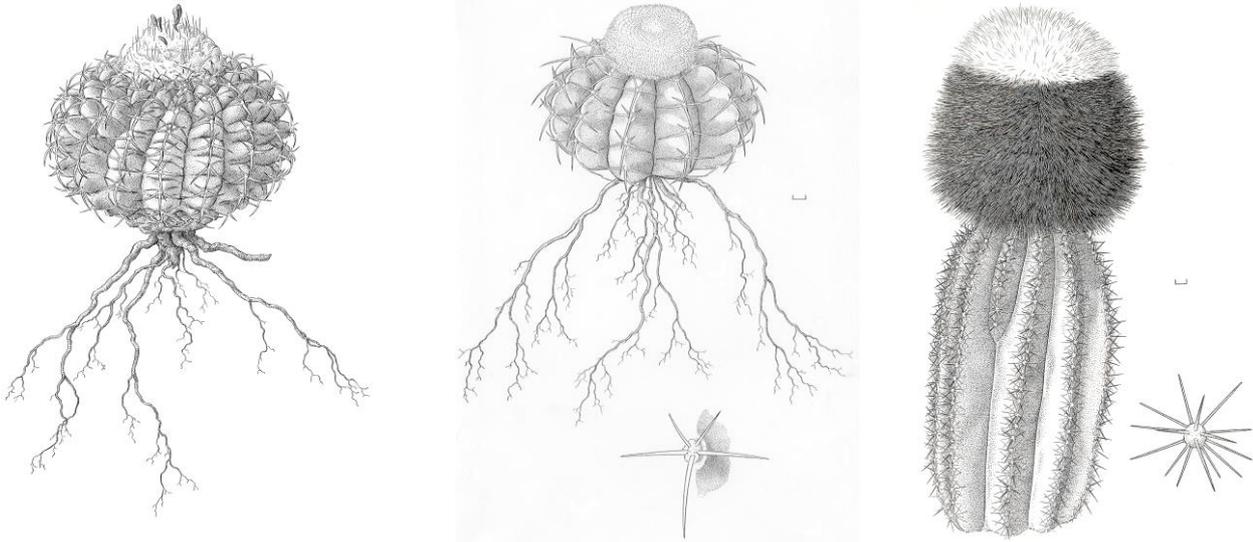
# Growth Forms & „Collectors Groups“

Jonas M. Lüthy

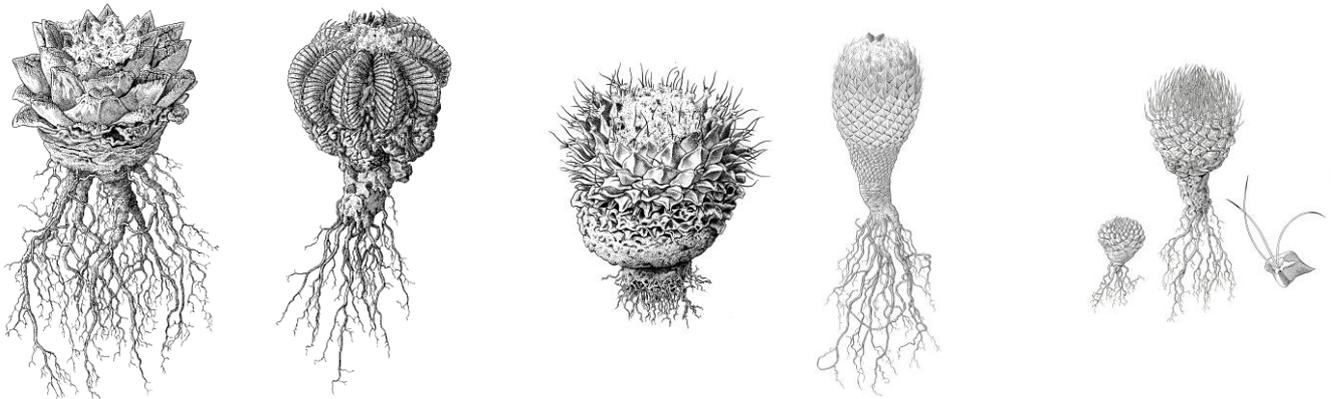


illustrated taxa underlined

**Cephalic cacti** (bearing a very distinctive, bristly flowering zone in the stem apex)  
see Discocactus spp., Melocactus spp., Pachycereus militaris

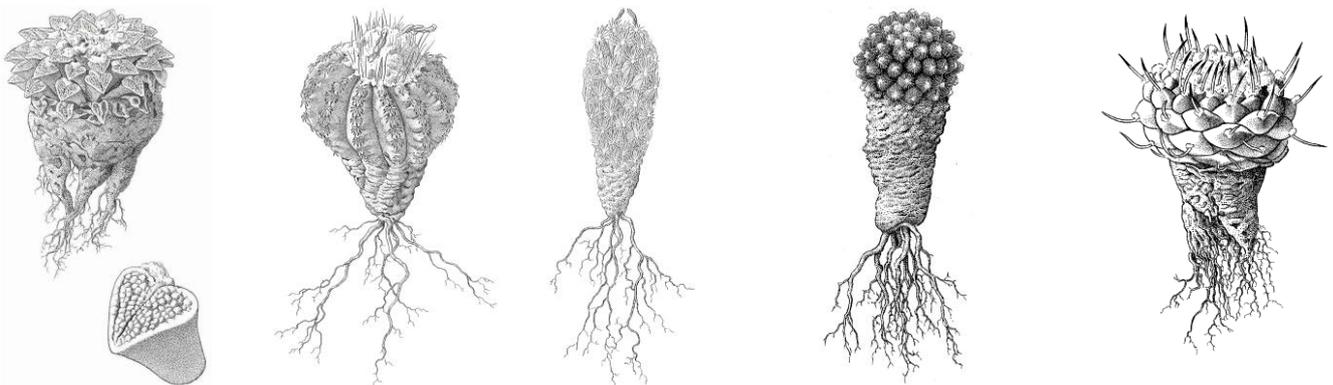


**Living rock cacti, „pine-cone“ & „artichoke“ cacti** (extremely hard-textured)  
see Ariocarpus spp., Aztekium ritteri, Obregonia denegrij, Pelecypora spp., Strombocactus spp.



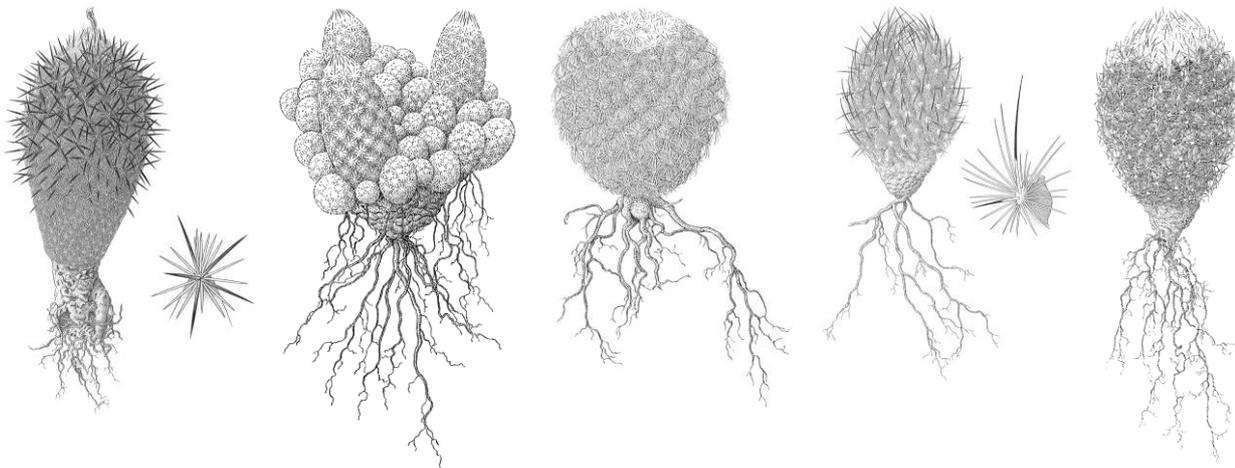
**Miniatures** (Ø 2-4 cm)

see Ariocarpus agavoides, A. kotschoubeyanus, Aztekium ritteri, Discocactus horstii, Escobaria minima, E. sneedii ssp. leei, Mammillaria pectinifera, M. solisioides, Pediocactus spp., Turbinicarpus spp.,



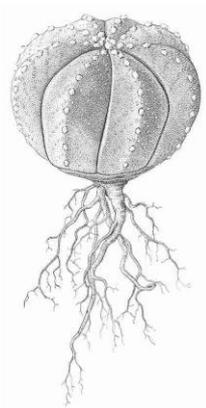
„White“ cacti (densely covered by white spines)

see Coryphantha werdermannii, Discocactus zehntneri, Echinocereus schmollii, Escobaria sneedii ssp. leei, Mammillaria pectinifera, M. solisioides, Sclerocactus mariposensis, Turbincarpus dickisoniae, T. mandragora ssp. beguinii, T. pseudopectinatus,



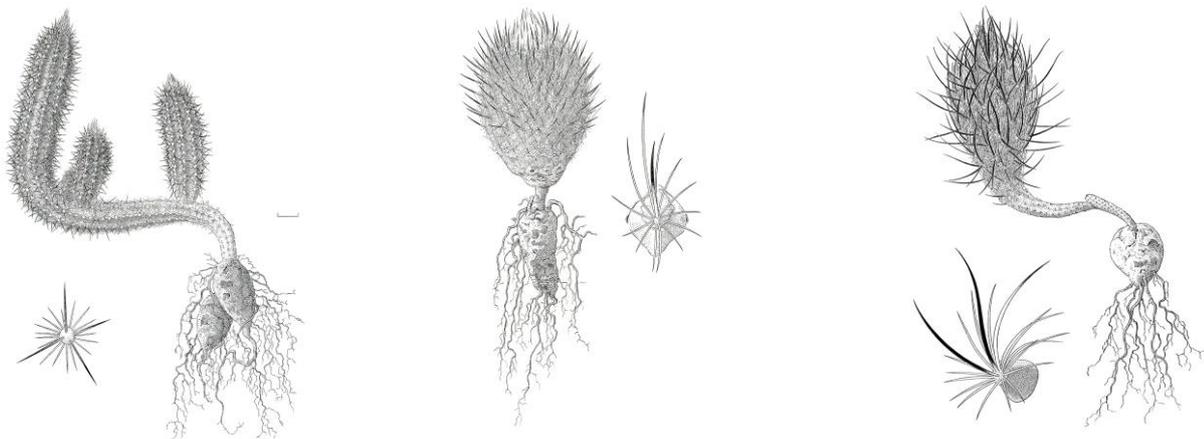
**Star cacti** (with geometrically arranged ribs)

see Astrophytum asterias



**Tuberous cacti, „lamb's tail“ cacti** (with subterranean tubers)

see Echinocereus schmollii, Turbincarpus mandragora ssp. mandragora, ssp. booleanus, ssp. subterraneus

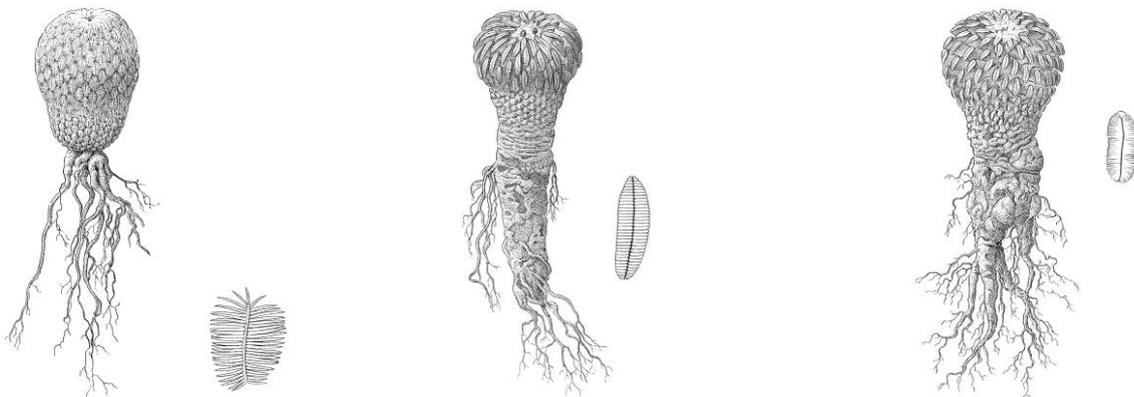


# Growth Forms & „Collectors Groups“

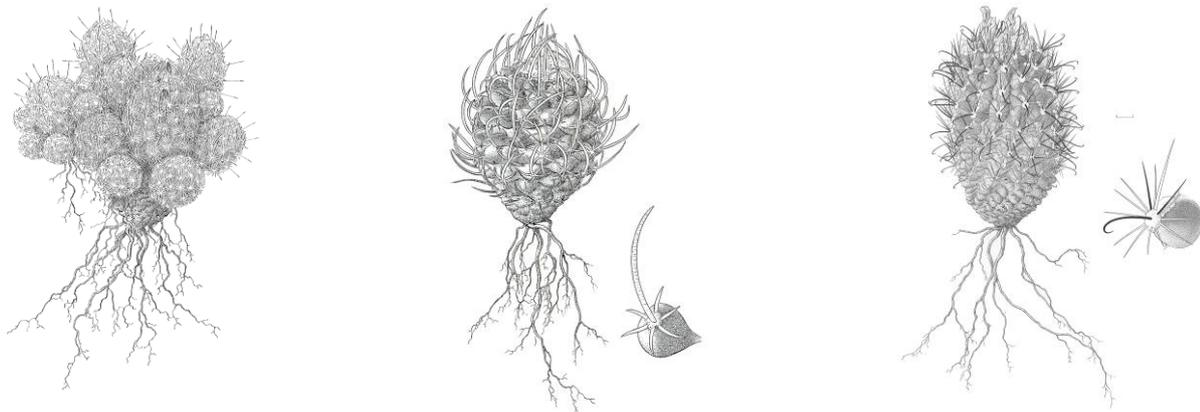
Jonas M. Lüthy



„**Pectinate**“ cacti (with elongated, linear areoles and spines arranged comb-like)  
see Mammillaria pectinifera, Pelecyphora aselliformis, Turbinicarpus pseudopectinatus

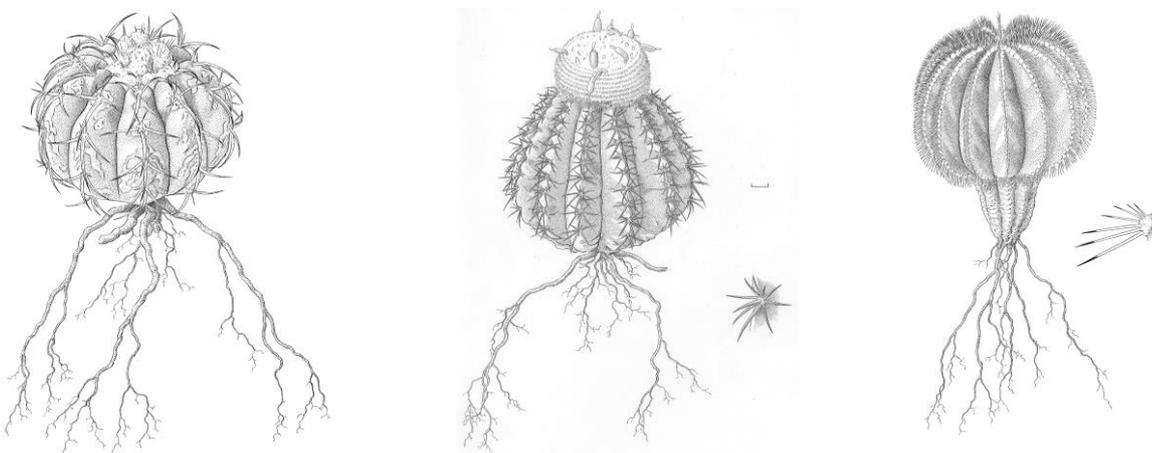


**Hardy cacti (USA)** (tolerant to temperatures below 0°C)  
see Escobaria sneedii, Pediocactus spp., Sclerocactus spp.



**Columnar cacti**  
see Pachycereus militaris (illustrated above)

„**Brazilians**“  
see Discocactus spp., Melocactus spp., Uebelmannia spp.







# Introduction

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During the course of evolution, various plants have adapted their survival strategy to deficient soils or to environments lacking in particular nutrients. Carnivorous plants successfully compensate for these conditions by a form of adaptation permitting them to meet their nutritive requirements using animal prey. In this way, they are able to occupy ecological niches that are of very little interest to other plants with which they would otherwise have difficulty in competing for available food resources.

This environmental adaptation has taken place in several distinct plant families, in several regions of the globe and in various very diverse forms.

The botanist John Ellis first pointed out the behaviour of these plants in 1768 by describing the Venus-flytrap (*Dionaea muscipula*). Other botanists, such as Linnaeus, refused to believe that a plant could trap prey for nourishment. Later, Charles Darwin provided conclusive proof, but it was only in 1978 that Heslop-Han'sson was able to confirm the assimilation of proteins by using carbon 14 dating.

Because of their surprising capabilities, carnivorous plants were the object of many legends and mysteries. There are even descriptions of these plants devouring human beings, and many works of science fiction describe monster plants hungry for human flesh.

Some of these plants also have medicinal properties or have been used as traditional utilitarian plants. *Drosera* has properties against the cough. *Pinguicula* was used to curdle milk. *Drosophyllum* is still used on windowsills to catch flies.

## Traps

There are several types of traps. *Dionaea* and *Aldrovanda* have traps with lids whose movement is rapid and clearly visible. *Byblis*, *Drosera*, *Drosophyllum*, *Ibicella*, *Pinguicula* and *Triphyophyllum* catch their prey using gum-tipped tentacles, either mobile or fixed, of various sizes and forms. Other genera, such as *Brocchinia*, *Catopsis*, *Cephalotus*, *Darlingtonia*, *Heliophora*, *Nepenthes* and *Sarracenia* attract their prey with odours or colours to a pitcher filled with a digestive liquid. *Genlisea* and *Utricularia* catch small microorganisms in tiny traps, and some mushrooms, such as *Dactyella*, *Pleurotus* and *Resupinatus*, capture with nooses or adhesive disks.

Prey is as varied as the species that traps them, but victims are usually small. Only a few, such as *Nepenthes rajah* from Borneo, have traps as large as a man's forearm capable of capturing small rats and birds.

As is often the case in the living world, there are some species that imitate carnivorous plants, but which do not directly assimilate their prey. For example, *Roridula* spp., catches insects in its sticky hairs, but these are not digested by the plant; they fall to the ground forming fertilizer that is assimilated by the roots. *Capsella bursa-pastoris* has seeds that entrap prey at the time of germination.

## Digestion

Digestive techniques are varied. *Darlingtonia* and *Heliophora* have bacteria that take over the digestion of prey in the traps. In the case of *Nepenthes*, the combined action of bacteria and enzymes produced by the plant consumes the prey. In most cases, however, plants produce enzymes such as esterase or protease.

## Definition

**Carnivorous plant:** a plant that not only captures prey but also digests and assimilates its prey's proteins.

## Threats

Main threat: destruction of habitat (drainage of swamps, excessive exploitation of peat bogs, enrichment of the soil by fertilizers).

Secondary threat: excessive collection of medicinal species (*Drosera*) or of ornamental plants (*Nepenthes* and *Sarracenia*).

**Trade**

In contrast to most orchids, the collection of wild carnivorous plants can be carried out before or after the flowering season because it is possible to identify species by their traps alone. There is no special period for trade in these plants with perhaps the exception of *Sarracenia* of which the pitcher leaves are used in floral arrangements and which are normally collected at the end of spring.

Because carnivorous plants prefer humid conditions, they are usually transported in water-tight containers carefully protected with sphagnum or another material that retains humidity. *Nepenthes* is found in the substrata shared with orchids.

**Artificial propagation**

Most carnivorous plants reproduce rather easily by propagation from cuttings of leaves or stalks (*Nepenthes*) or by division (*Darlingtonia*, *Dionaea* and *Sarracenia*). Under good growing conditions, the plants grow quickly and robustly, making it possible to obtain plants of a good size by vegetative reproduction rapidly.

Growing them from seeds, while longer, is also a sure means of obtaining healthy plant stock (*Nepenthes* and *Dionaea*). Some plants, *Byblis gigantea*, however, require brush fires to set off a germination mechanism in the seeds.

There are several very complete collections (*Drosera* and *Nepenthes*) grown in vitro that represent an invaluable bank of genetic resources.



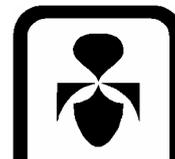
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The following references can be consulted for further details for identification. Some are general works dealing with most carnivorous species, others are more specific.

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- STAROSTA, P. & J.J. LABAT (1993) *L'univers des plantes carnivores*. 140 pp. Ed. du May, Paris. Describes numerous species, provides useful addresses and bibliography.

### Description and distribution of all genera of carnivorous plants

Family	Genus	no. sp.	no. sp. carn.	CITES Appendix	Distribution
<b>Nepenthaceae</b>	<b><i>Nepenthes</i></b>	~ 70	~ 70	<b>I(2) &amp; II</b>	<b>Madag., India (Khasi) &amp; SE Asia</b>
<b>Sarraceniaceae</b>	<b><i>Sarracenia</i></b>	~ 8	~ 8	<b>I(3) &amp; II</b>	<b>Eastern North America</b>
<b>Sarraceniaceae</b>	<b><i>Darlingtonia</i></b>	1	1	<b>II</b>	<b>Western USA</b>
Sarraceniaceae	<i>Heliamphora</i>	5	5	-	Venezuela, Guyana, Brazil (Tépuí)
<b>Byblidaceae</b>	<b><i>Byblis</i></b>	2	2	<b>II</b>	<b>Australia (SW &amp; NE-NW)</b>
<b>Cephalothaceae</b>	<b><i>Cephalotus</i></b>	1	1	<b>II</b>	<b>Australia (SW)</b>
<b>Droseraceae</b>	<b><i>Dionaea</i></b>	1	1	<b>II</b>	<b>Eastern USA</b>
Droseraceae	<i>Drosera</i>	>130	>130	-	Cosmopolitan
Droseraceae	<i>Aldrovanda</i>	1	1	-	Old World
Droseraceae	<i>Drosophyllum</i>	1	1	-	Western Mediterranean
Lentibulariaceae	<i>Pinguicula</i>	>50	>50	-	Mainly north. hemisph. & South America
Lentibulariaceae	<i>Utricularia</i>	>300	>300	-	Cosmopolitan
Lentibulariaceae	<i>Genlisea</i>	15	15	-	N South America & S Africa (tropical)
Lentibulariaceae	<i>Polypompholyx</i>	2	2	-	Southern Australia
Lentibulariaceae	<i>Biovularia</i>	?	?	-	Southern America?
Bromeliaceae	<i>Brocchinia</i>	5	2	-	Venezuela, Guyana (Tépuí)
Bromeliaceae	<i>Catopsis</i>	21	1	-	S USA. Centr. Am. & N South America
Dioncophyllaceae	<i>Triphyophyllum</i>	1	1	-	Western Africa
Eriocaulaceae	<i>Paepalanthus</i>	485	1	-	South America (endemic to Brazil)
Pedaliaceae	<i>Ibicella</i>	2	1	-	South America (Brazil) [introd. Australia]
<b>Total</b>		<b>&gt;614</b>	<b>&gt;591</b>	<b>5I &amp; ~ 80II</b>	
In bold: Taxa included in CITES Appendices ~: The number of species varies with their taxonomic interpretation.					



## Taxa included in CITES Appendices

Family	Genus	Appendix I	Appendix II
Nepenthaceae	<i>Nepenthes</i>	<i>N. rajah</i> <i>N. kashiana</i>	all other species
Sarraceniaceae	<i>Sarracenia</i>	<i>S. oreophila</i> <i>S. jonesii</i> (= <i>S. rubra</i> ssp. <i>jonesii</i> ) <i>S. alabamensis</i> (= <i>S. rubra</i> ssp. <i>alabamensis</i> )	<i>S. alata</i> <i>S. flava</i> <i>S. leucophylla</i> <i>S. minor</i> <i>S. psittacina</i> <i>S. purpurea</i> <i>S. rubra</i>
Sarraceniaceae	<i>Darlingtonia</i>		<i>D. californica</i>
Byblidaceae	<i>Byblis</i>		<i>B. gigantea</i> <i>B. liniflora</i>
Cephalotaceae	<i>Cephalotus</i>		<i>C. follicularis</i>
Droseraceae	<i>Dionaea</i>		<i>D. muscipula</i>

## Information on the Internet

<a href="http://www.hpl.hp.com/bot/cp_home">http://www.hpl.hp.com/bot/cp_home</a>	"the CP Database": pictures, discussion group, exchange buy/sell, CP society.
<a href="http://www.hpl.hp.com/botany/public_html/cp/html/schlauer.htm">http://www.hpl.hp.com/botany/public_html/cp/html/schlauer.htm</a>	List of carnivorous plants compiled by Jan Schlauer.
<a href="http://www.flytrap.demon.co.uk">http://www.flytrap.demon.co.uk</a>	Peter Cole presents discussion archives on CP, information on names of CP and their origin, numerous photographs, sources for seeds in the United Kingdom.
<a href="http://www.algonet.se/~murevarn">www.algonet.se/~murevarn</a>	Excellent images.
<a href="http://www.schwaben.de/home/schmidt/">http://www.schwaben.de/home/schmidt/</a>	Excellent photos of <i>Nepenthes</i> and other CP in their habitat.
<a href="http://home.t-online.de/home/johannes.marabini@t-online.de/index.htm">http://home.t-online.de/home/johannes.marabini@t-online.de/index.htm</a>	"Johannes Marabini's CP Homepage". <i>Nepenthes</i> , <i>Pinguicula</i> , <i>Utricularia</i> , <i>Drosera et al.</i>
<a href="http://www.indirect.com/www/bazza/cps/cp.html">http://www.indirect.com/www/bazza/cps/cp.html</a>	Barry Meyers-Rice presents a very complete site with photographs "Galleria Carnivora", animation etc.
<a href="http://www.wistuba.com">http://www.wistuba.com</a>	Andreas Wistuba is a nurseryman specialized in <i>Nepenthes</i> and <i>Heliophora</i> . Numerous pictures.
<a href="http://www.geocities.com/RainForest/Vines/2632/cp.htm">http://www.geocities.com/RainForest/Vines/2632/cp.htm</a>	Lee Gentry: in particular information on the cultivation and trade.
<a href="http://www.primenet.com/~tjohns/index.htm">http://www.primenet.com/~tjohns/index.htm</a>	Tom Johnson presents the list of seeds in the seed bank of the ICPS.
<a href="http://ucsu.colorado.EDU/~shaferj/Home.html">http://ucsu.colorado.EDU/~shaferj/Home.html</a>	Jeff Shafer presents pictures of <i>Nepenthes</i> and tips on propagation.
<a href="http://www.csd.tamu.edu/FLORA/flynnbog/FB1.HTML">http://www.csd.tamu.edu/FLORA/flynnbog/FB1.HTML</a>	A tour of Flynn Bog, Leon County, TX Follow the link to "Roadside Seep" for CP photos.

Furthermore, the majority of sites present numerous links to web pages of collectors and producers of plants and seeds.

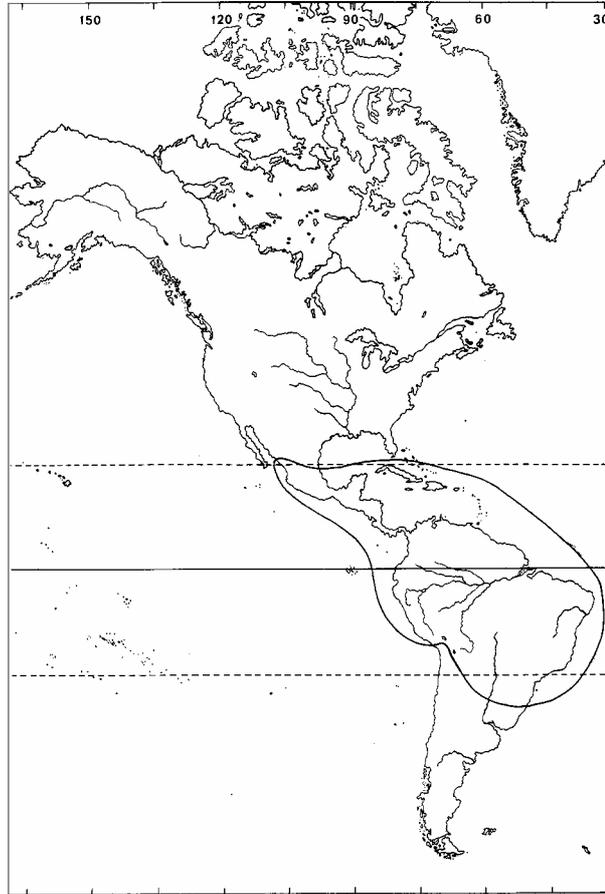
CP = Carnivorous plants



<b>Commercial names:</b>	engl.: Central American Cedar, South American Cedar, Honduras Cedar, Spanish Cedar, West Indian Cedar, Cigarbox Cedar esp.: Cedro fr.: Cedrela, Cedre d'Amérique centrale
<b>Common name</b>	Central American Cedar, Spanish Cedar
<b>Scientific synonyms:</b>	<i>Cedrela guianensis</i> Adr. Juss. <i>Cedrela mexicana</i> M.J. Roemer <i>Cedrela glaziovii</i> C.DC
<b>Subject to CITES control:</b>	Included in Appendix III.
<b>Macroscopic characteristics of the wood:</b>	Heartwood pale pinkish to reddish brown, sometimes with a purplish tinge, sapwood much lighter, creamy yellow or yellowish-brown. Wood semi-ring porous to diffuse-porous, growth rings distinct, lined with large earlywood vessels and initial parenchyma. Vessels often occluded with dark deposits. Grain straight to interlocked. Texture moderately coarse. Wood moderately to highly lustrous and with a pleasant odour (typical cigarbox smell). Hardness: soft Specific weight: 0.36-0.53 g/cm <sup>3</sup> (at 12% relative humidity).
<b>Microscopic characters of the wood:</b>	Wood semi-ring porous to diffuse porous. Growth rings usually distinct, marked by earlywood vessels and initial, marginal parenchyma. Vessels solitary and in radial multiples of 2-3(--8), 1-3/sq.mm, tangential diameter of the wider pores 130-300 microns (average diameter of all pores 130-160 microns), perforations simple. Intervascular pits alternate, nonvestured, 5-8 microns. Vessels with brown deposits; tyloses absent. Parenchyma paratracheal, vasicentric and in broad initial, marginal bands. Rays heterogeneous with usually one row of upright marginal cells, 1-5 cells wide, 4-12/mm. Libriform fibres thin-walled, non-septate, 0.8-1.5 mm long. Large, prismatic crystals occasionally present in parenchyma cells.
<b>Characteristics of the trees:</b>	<i>C. odorata</i> is a medium-sized to fairly large, deciduous tree up to 40 m tall, with a straight, cylindrical bole. Without or with small buttresses (up to 2 m high). Bark surface deeply fissured.

**Distribution:**

New World from Mexico to N. Argentina, all countries except Chile.

**Characteristics of the trade:**

Although native in the New World tropics, Central American Cedar is planted in all tropical regions. Traditional supply regions are the West Indies, the Guianas, Brazil and Peru. Timber plantations have been established in Costa Rica, Uganda, Tanzania, Madagascar, South Africa and Southeast Asia, largely for domestic use.

**Use:**

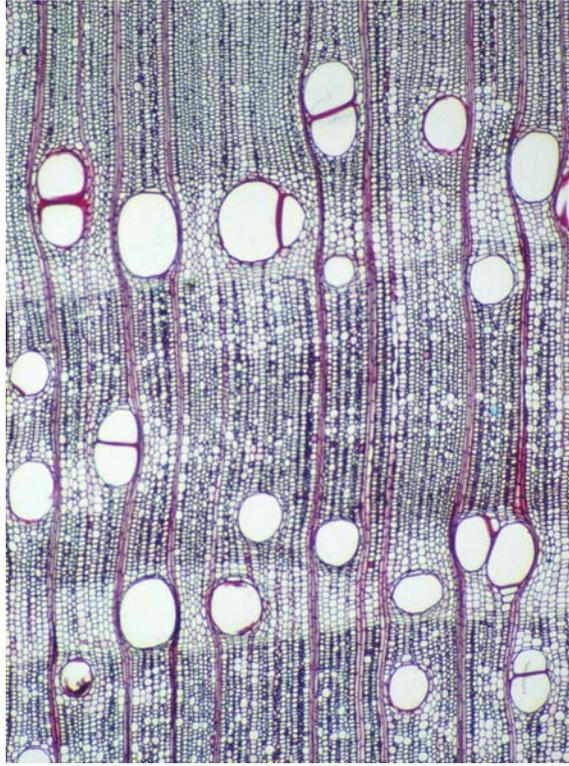
Cigar boxes, light construction, mouldings, joinery, cabinets, furniture, panelling, boat building (hulls of light racing boats), clothing chests and wardrobes, veneer and plywood, musical instruments (sounding boards). *Cedrela* trees are also sometimes planted for shade and as ornamental roadside trees.

**Similar species:**

The genus *Cedrela* numbers about 8 species which are anatomically indistinguishable from each other. Possibly confused with: American Mahogany (*Swietenia macrophylla* – which can, however, easily be told apart by absence of fragrance, and its greater hardness and finer texture, and microscopically by its septate fibres). Wood of the Asiatic and Australian tree genus *Toona* is very similar to that of *Cedrela*, and shares the cedar-like fragrance. There are no absolute distinguishing characters between the wood of *Toona* and *Cedrela*.

	Distribution	Common name
<i>Swietenia macrophylla</i>	Tropical America	American Mahogany
<i>Toona spp.</i>	Malesian region; Australia	Toon, Surian

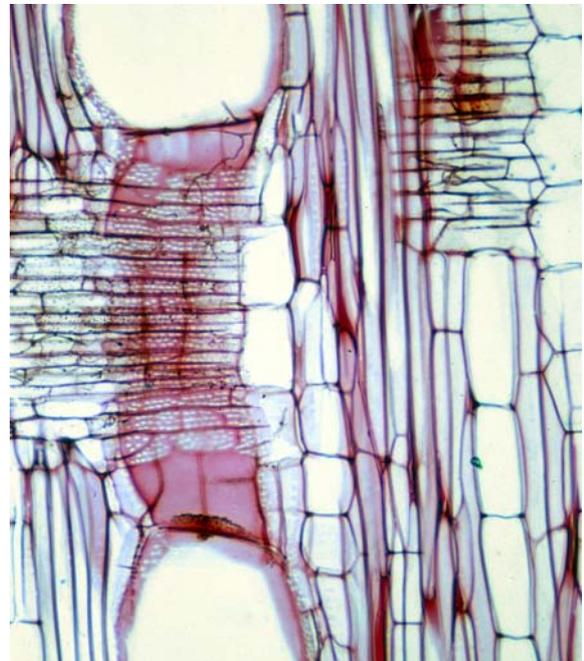




transverse section



tangential section



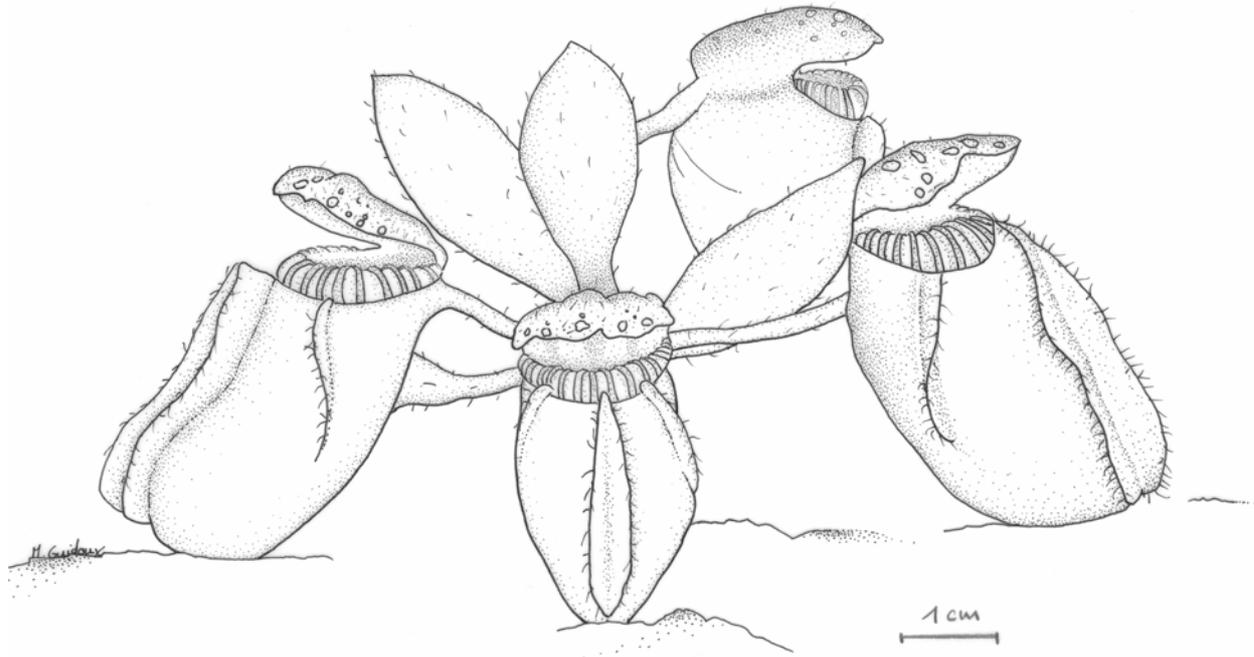
radial section

# Cephalotus follicularis

Labill.



<b>Common names:</b>	engl.:	Western Australian Pitcher Plant, Cephalotus
	esp.:	Jarra, Atrapamoscas
	fr.:	Cephalotus
<b>Scientific synonyms:</b>	None	

**Characteristics:**

Plant:	Herbaceous with a ligneous stem, having two types of leaves.
Size:	A few centimetres (5-10).
Type of trap:	Passive, pitchers.
Traps:	In the form of pitchers arranged in rosettes and resting on the ground. The trap has a fixed cover and many hairs guide the prey towards the pitcher's opening.
Leaves:	Green and tough. The leaves grow in autumn in order to collect more solar energy.
Inflorescence:	Flowers are grouped in inflorescences at the tip of a long peduncle. They are small and white.
Prey:	Primarily ants, but also other ground insects.
Digestion:	Bacteria and enzymes.

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**Distribution:**

South-west Australia. In a limited area between the cities of Bunbury and Albany.

**Climate:**

Mediterranean type, rather humid.

**Habitat:**

Close to boggy coastal marshes.

**Propagation:**

Possible by division of the plant in the spring (sometimes from seeds).

**Useful part:**

The whole plant is used as an ornamental.

**Trade:**

Primarily in plants that are artificially propagated by amateurs or specialized plant nurseries.

**Number of species:**

Only one species in the single genus in this family (monotypic family).

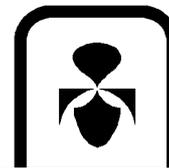
**Similar species:**

None.

**Comments:**

This plant is rather difficult to grow. It requires very light soil and high ambient humidity.

This plant is also considered a myrmecophile; it harbours ant colonies in its tissues (symbiosis).



<b>Family:</b>	Dicksoniaceae
<b>Synonyms:</b>	–
<b>Vernacular names:</b>	<p>english: Dog fern, golden-haired dog fern, golden moss, lamb of Tartary, Scythian lamb, vegetable lamb</p> <p>french:</p> <p>spanish:</p> <p>chinese: Gou Ji (Gouji)</p> <p>german: Vegetabilisches Lamm</p> <p>italian: Cibozio</p>
<b>Geographical range:</b>	From north India through south China to Japan (Ryukyu Islands) and to the southeast through Viet Nam and Thailand to Papua New Guinea.
<b>Distribution by country:</b>	China, (including Hong Kong SAR and Province of Taiwan), India, Indonesia, Japan, Malaysia, Myanmar, Papua New Guinea, Philippines, Thailand, Viet Nam.
<b>Protection:</b>	CITES Appendix II (#1), since 01.07.1975
<b>Use:</b>	Medicinal plant used in TEAM and homeopathy, horticultural plant.

## Botanical drugs in trade

**Plant parts used:** Mainly the rootstock; in addition also the hairs (=fimbrias) of the rootstock.

### Rootstock

<b>Pharmaceutical names:</b>	latin: Cibotii rhizoma, Rhizoma Cibotii, Cibotii barometz rhizoma
	english: Chain fern rhizome, cibot rhizome, cibota, cibotum
	french:
	spanish:
	chinese: Gou Ji (Gouji), Jingouji, Shenggoujipian, Shougoujipian, Tanggouji
	german: Cibotium-Wurzelstock
	italian: Rizoma di cibozio

**Countries of export:** China (including Hong Kong SAR), Viet Nam.

**Source:** Mainly wild collection.

**Commodities in trade:** Mainly dried, sliced rootstocks (cut drug); in addition the whole, dried rootstock (crude drug).

**Characteristics:**

Crude drug:	(Fig. 1) Pieces irregular, 10-30 cm long and 2-10 cm in diameter, hard, solid, not easy to break; surface dark brown, with thick, dense tomentum of golden-yellow, velvety hairs (shape of the rootstock resembles a dog with golden hairs!); at top with one to several red-brown, woody leaf stalks or attachments of leaves or fronds (inrolled), and with fine, dark brown to black adventitious roots at bottom;
Cut drug:	(Fig. 2, 3) 1.5-20(30) mm thick, irregularly shaped and sized, sometimes alveolate slices of the rootstock; external surface often with remains of the golden yellow, velvety hair-covering; pieces brittle, in particular the thinner ones easy to break, fracture powdery; cut surface light brown or black-brown, flat, smooth, with a clearly visible yellow-brown or reddish brown, often protruding, arched or straight line at a distance of 2-6 mm from the border;
Odour:	Scentless;
Taste:	Weak, slightly astringent.

**Rootstock hairs (fimbrias)**

<b>Pharmaceutical names:</b>	latin:	Paleae haemostaticae, Paleae stypticae, Penghawar Djambi, Penawar Djambi, Pili stypticae, Pili Cibotii
	english:	Cibotium hairs, golden moss, Penawar Djambe
	french:	Poils cibotium
	spanish:	
	german:	Affenhaar, Blutstillende Spreuhaare, Farnhaare, Farnkrautwolle
	italian:	Seta di felce, lana di felce, peli emostatici, peli stittici

**Countries of export:** China (including Hong Kong SAR), Viet Nam.

**Source:** Mainly wild-collection.

**Commodities in trade:** Dried, not diminished hairs (=fimbrias) of the rootstock (crude drug).

**Characteristics:**

Crude drug:	(Fig. 4) Fimbrias (hairs) yellow-brown, golden-yellow to golden-brown, very soft, silky-woolly, often lumpy; singular hairs 2-7 cm long, multicellular, compressed and sometimes spirally rolled (stereoscopic microscope or light microscope!); hairs interspersed with singular, short, dark brown to black root fragments;
Odour:	Scentless;
Taste:	–

**Similar drugs/  
adulterations:**

The same trade names are also used for other fern species, such as other *Cibotium* species and species of the genus *Dicksonia*. However, only the fimbrias of *Cibotium barometz* and those of *Dicksonia* indigenous to America are subject to CITES.



Figure 1. Crude drug, Cibotii rhizoma; species: *Cibotium barometz*, (copyright BfN).



Figure 2. Cut drug, Cibotii rhizoma; species: *Cibotium barometz*, (copyright BfN).



Figure 3. Cut drug, Cibotii rhizoma; species: *Cibotium barometz*, (copyright BfN).



Figure 4. Crude drug of hairs (fimbrias), Penghawar Djambi; species: *Cibotium barometz*, (copyright BfN).

# Cistanche deserticola

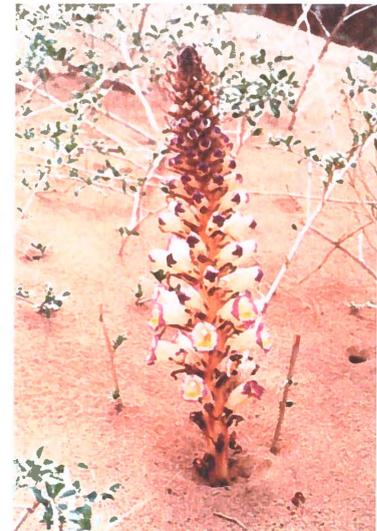
Ma



**Common names:**  
 english: Desert-living Cistanche  
 french:  
 spanish:  
 chinese: Roucongong

**Scientific synonyms:** *Cistanche ambigua* (Bunge) G. Beck

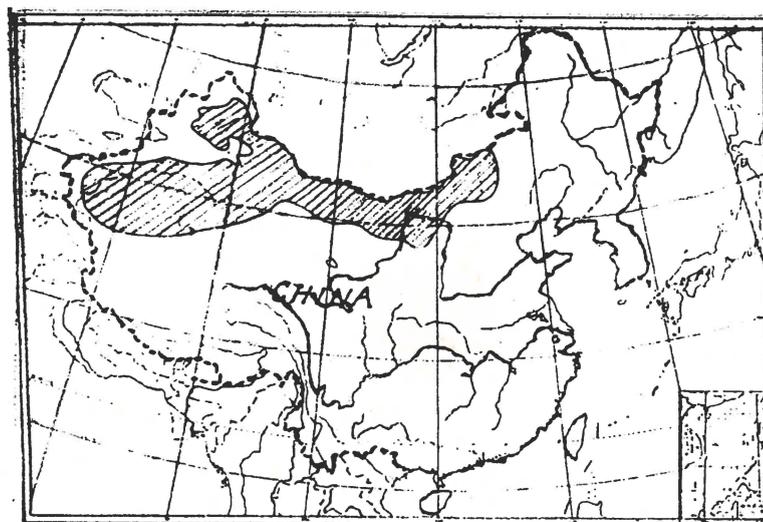
**Characteristics:** Perennial parasitic herb. Stems fleshy, yellow, 10-45 cm high, vascular bundles (on cross section) arranged in corrugated circle. Leaves scale-like, yellow-brown and imbricated on the lower part; ovate or ovate-lanceolate, higher up the leaves. Spikes 5-20 cm long; flowers pale yellowish white, perianth tubular-campanulate, 5-lobed at apex; 4 stamens, anthers pointed at base. Capsules elliptic, 2-lobed.



**Population in the wild:** Because of overexploitation, the population of this species has gradually diminished and its distribution area has shrunk dramatically. In addition, only wild specimens are being collected. It is now difficult to find the herb within 20 km around residential areas. More and more people know of its medicinal virtues, and the demand for the international market has grown quickly in recent years.

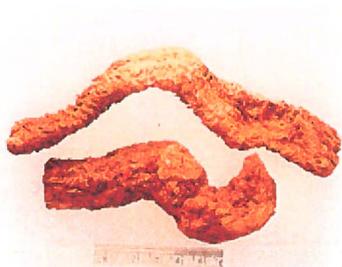
**Trade:** The annual domestic trade is stable at 300-400 tons, and volumes for international trade have increased to 120 tons.

**Distribution:** This species is a parasitic herb, distributed in China in Gansu and Shaanxi provinces, Xingjiang Uygur Autonomous Region, Ningxia Hui Autonomous Region and the Inner Mongolia Autonomous. The species parasitizes on the roots of *Haloxylon ammodendron* (C. A. Mey) Bunge and *H. persicum* Bunge ex Boiss. (Family Chenopodiaceae).

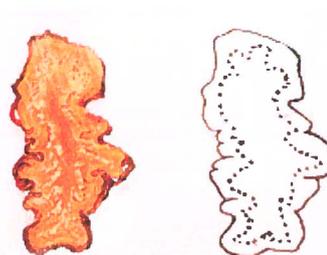


**Similar species:**

Living plants of *Cistanche tubulosa* are similar to *Cistanche deserticola*, but *Cistanche tubulosa* parasitizes on the roots of *Tamarix* spp., has anthers with an obtuse base, and scattered vascular bundles in cross-sections of stem.



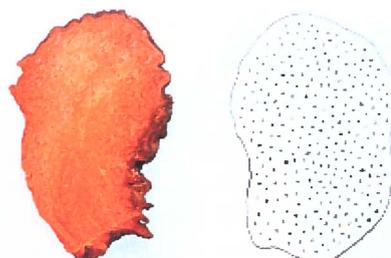
Crude drug



Cross-section and its diagram

***Cistanche deserticola* Ma**

Crude drug



Cross-section and its diagram

***Cistanche tubulosa* R. Wight****Remarks:**

No record of artificial propagation.

**References:**

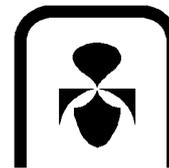
Delectis Florae Reipublicae Popularis Sinicae Agendae Academiae Sinicae Edita, 1990, Flora Republicae Popularis Sinicae, Tomus, 69, 83-89.

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Xuwenhao Qiu shengxiang, Shen Linchong et al 1995, Comparison of the chemical constituents and pharmacological effects between Roucongong and Yanshengroucongong, Chinese Traditional and Herbal Drugs Vol. 26: 143-147

Tupengfei, He yanping and Lonzhicen 1994, Survey and Protection of medicinal resource of Desertliving cistanche (*Cistanche deserticola*) Traditional and Herbal Drugs Vol, 25: 205-208



# Commonly traded but unlisted species

Short descriptions of the more commonly traded *Tillandsia*-species, which are not listed in the CITES appendices.

## *Tillandsia balbisiana* Schultes fil.

- Habit:** Stemless; leaves spirally arranged, usually recurved, forming a rosette; outer leaves with reduced blades; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Inflated.
- Leaf-blades:** Narrowly triangular, filiform-tapered, channeled; covered with grey scales; 20-40cm long, to 1cm wide at base, twisted.
- Size:** Rosette 10-60cm tall, diameter 20-50cm; pseudobulb ca. 12cm tall.

## *Tillandsia brachycaulos* Schlechtendal

- Habit:** Stemless; numerous, spirally arranged leaves in a spreading rosette. Leaf-sheaths: Ovate, brownish, covered with scales, distinct from the blade.
- Leaf-blades:** Narrowly triangular, filiform-tapered, flat or channeled, densely covered with appressed scales, green, often tinged with red; to 25cm long and 0.8-2.5cm wide at base.
- Size:** Rosette to 15cm tall, diameter ca. 30cm.

## *Tillandsia bulbosa* Hooker

- Habit:** Stemless; few, spirally arranged, erect leaves in a dense rosette, leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Inflated, with red margins, covered with grey scales.
- Leaf-blades:** Narrowly triangular, tapered, channeled, twisted, green, sometimes with marginal red stripes; to 30cm long and 0.2-0.7cm wide at base.
- Size:** Rosette 7-30cm tall, diameter ca. 15cm; pseudobulb ca. 2.5cm tall.

## *Tillandsia butzii* Mez

- Habit:** Stemless; few spirally arranged leaves in a dense rosette; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Inflated, with brown spots below.
- Leaf-blades:** Linear, acute-tapered, channeled, twisted, usually recurved, with red-brown spots, covered with grey scales; to 50cm long and 0.4cm wide.
- Size:** Rosette 18(-30)cm tall, diameter ca. 35cm; pseudobulb to 4cm tall.

## *Tillandsia caput-medusae* E. Morren

- Habit:** Stemless; spirally arranged leaves in a dense rosette; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Inflated, merging into the blades.
- Leaf-blades:** Narrowly triangular, acute-tapered, channeled, twisted to curled, densely covered with grey spreading scales; to 1.5cm wide at base.
- Size:** Rosette 15-30cm tall, diameter to 30cm; pseudobulb 2-5(-10)cm tall.

## *Tillandsia fasciculata* Swartz

- Habit:** Stemless; numerous spirally arranged leaves in a dense, spreading rosette.
- Leaf-sheaths:** Flat, dark castaneous, covered with grey scales.

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**Leaf-blades:** Narrowly triangular, tapered, channeled to folded, rigid, densely covered with grey scales; 30-70cm long, 2-4cm wide at base.

**Size:** Rosette 20-90cm tall, diameter 40-90cm (?).

***Tillandsia filifolia*** Schlechtendal & Chamisso

**Habit:** Stemless; numerous spirally arranged leaves in a dense rosette; leaf-sheaths forming a pseudobulb.

**Leaf-sheaths:** Thick, brown lepidote.

**Leaf-blades:** Filiform, acute, covered with grey appressed scales; to 30cm long and 1mm wide at base.

**Size:** Rosette to 30cm tall, diameter ca. 10-30cm; pseudobulb to 3-5cm tall.

***Tillandsia fuchsii*** W. Till

**Habit:** Stemless (or with short stem); numerous spirally arranged, spreading leaves in a dense rosette; leaf-sheaths forming a pseudobulb.

**Leaf-sheaths:** Thick, more or less triangular.

**Leaf-blades:** Filiform, acute, more or less rigid, covered with silvery-white scales; 6-9cm long and 0.1-0.2cm wide at base.

**Size:** Rosette ca. 15cm tall, diameter 15cm; bulb ca. 5cm tall.

***Tillandsia ionantha*** Planchet

**Habit:** Stemless; numerous spirally arranged leaves in a dense rosette; outer leaves spreading to recurved, the inner ones more or less erect. A very variable species!

**Leaf-sheaths:** Elliptic.

**Leaf-blades:** Narrowly triangular, strap-shaped, tapered, erect, spreading at apex, channeled, rigid, densely covered with grey scales; 3-8cm long, to 0.5cm wide at base; central ones frequently red-tinged.

**Size:** Rosette 4-12cm tall, diameter ca. 4-10cm.

***Tillandsia juncea*** (Ruiz & Pavon) Poiret

**Habit:** Stemless; numerous spirally arranged, spreading to recurved leaves in a dense rosette.

**Leaf-sheaths:** Ovate, ferruginous.

**Leaf-blades:** Linear to strap-shaped, tapered, channeled, covered with grey scales, rigid; 25-40cm long, to 0.5cm wide at base.

**Size:** Rosette to 40cm tall, diameter 25-30cm.

***Tillandsia magnusiana*** Wittmack

**Habit:** Stemless; numerous spirally arranged leaves in a dense rosette; outer leaves recurved, inner ones erect to spreading; leaf-sheaths forming a (more or less conspicuous) pseudobulb.

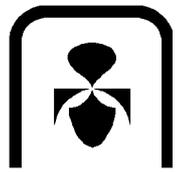
**Leaf-sheaths:** Elliptic.

**Leaf-blades:** Very narrowly triangular, filiform-tapered, channeled, covered with grey scales; to 11cm long, 0.3-0.5cm wide at base.

**Size:** Rosette to 15cm tall, diameter 20cm; pseudobulb ca. 5cm tall.

***Tillandsia paucifolia*** Baker

**Habit:** Stemless; few spirally arranged, more or less recurved leaves in a dense rosette; outer leaves with reduced blades; leaf-sheaths forming a pseudobulb.



## Species name

- Leaf-sheaths:** Inflated, broadly ovate, merging into the blades.
- Leaf-blades:** Linear to strap-shaped, deeply channeled, pungent, contorted, covered with grey scales; to 20cm long, 0.3-0.7cm wide at base.
- Size:** Rosette 10-40cm tall, diameter ca. 15cm; pseudobulb 5-15cm tall.
- Tillandsia plagiotropica*** Rohweder
- Habit:** Stemless or with short stem; numerous, spirally arranged, spreading, leaves more or less to one side in a dense rosette.
- Leaf-sheaths:** Obscure.
- Leaf-blades:** Narrowly triangular, long tapered, channeled, rigid, densely covered with grey scales; to 10cm long, to 1.5cm wide at base.
- Size:** Rosette 8-10cm tall, diameter 10-15cm.
- Tillandsia pruinosa*** Swartz
- Habit:** Stemless; leaves spirally arranged, more or less recurved, in a dense rosette; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Elliptic, inflated, castaneous, distinct from the blades.
- Leaf-blades:** Linear, filiform-tapered, recurved and more or less twisted, channeled, densely covered with ferruginous, spreading scales; to 15cm long, 0.2-0.4cm wide at base.
- Size:** Rosette 8-20cm tall, diameter to 20cm; pseudobulb ca. 5-10cm tall.
- Tillandsia pseudobaileyi*** S. Gardner
- Habit:** Stemless; few spirally arranged, more or less recurved leaves in a subdense rosette, outer leaves with reduced blades; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Broad elliptic, inflated, brownish, distinct from the blades.
- Leaf-blades:** Narrowly linear, deeply channeled, twisted; to 30cm long and 0.5cm wide at base.
- Size:** Rosette 30cm tall, diameter ca. 20cm; pseudobulb 3-10cm tall.
- Tillandsia punctulata*** Schlechtendal & Chamisso
- Habit:** Stemless; numerous spirally arranged, spreading to recurved leaves in a dense rosette; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Broadly ovate, inflated, dark castaneous.
- Leaf-blades:** Narrowly linear, filiform-tapered, channeled; 20-30cm long, 0.5-1cm wide at base.
- Size:** Rosette 20-45cm tall, diameter ca. 50cm; pseudobulb 5-15cm tall.
- Tillandsia seleriana*** Mez
- Habit:** Stemless; few spirally arranged, erect to recurved blades in a dense rosette, the outer leaves with reduced blades; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Broadly ovate, inflated.
- Leaf-blades:** Very narrowly triangular, tapered, channeled, contorted, covered with grey lepidote with spreading scales; to 20cm long and 1cm wide at base.
- Size:** Rosette 20-30cm tall, diameter ca. 15cm; pseudobulb 7-12cm tall.
- Tillandsia streptophylla*** Scheidweiler ex Morren

- Habit:** Stemless; numerous spirally arranged, recurved leaves in a large dense rosette; leaf-sheaths forming a pseudobulb.
- Leaf-sheaths:** Broadly elliptic, inflated.
- Leaf-blades:** Narrowly triangular, tapered, more or less flat, curved to spirally recurved, twisted, more or less rigid, densely covered with grey coarse, spreading scales; to 40cm long, 2-5cm wide at base.
- Size:** Rosette to 30cm tall, diameter ca. 30cm; pseudobulb to 8cm tall.

***Tillandsia tricolor*** Schlechtendal & Chamisso

- Habit:** Stemless; numerous spirally arranged, spreading leaves in a dense rosette.
- Leaf-sheaths:** Broadly elliptic.
- Leaf-blades:** Narrowly triangular to linear, long-tapered, channeled, green or rarely tinged with red, not densely covered with scales; 25-30cm long, 1-1.5cm wide at base.
- Size:** Rosette ca. 25cm tall, diameter 30-40cm.

***Tillandsia usneoides*** (L.) L.

- Habit:** With stem, growing pendent strands of several meters long, stems about 1mm in diameter; leaves in two, opposite rows, separated by conspicuous internodes.
- Leaf-sheaths:** Elliptic.
- Leaf-blades:** Filiform, thin, soft, densely cinereous-lepidote; to 5cm long and ca. 1mm wide.
- Size:** Strands up to 8m long.

***Tillandsia vicentina*** Standley

- Habit:** Stemless; numerous spirally arranged, spreading to recurved leaves in a dense rosette.
- Leaf-sheaths:** Ovate, dark brown.
- Leaf-blades:** Narrowly triangular, tapered, flat; 25-35cm long, 0.6-0.8cm wide at base.
- Size:** Rosette 25-30cm tall, diameter ca. 50cm.



# Coryphantha werdermannii

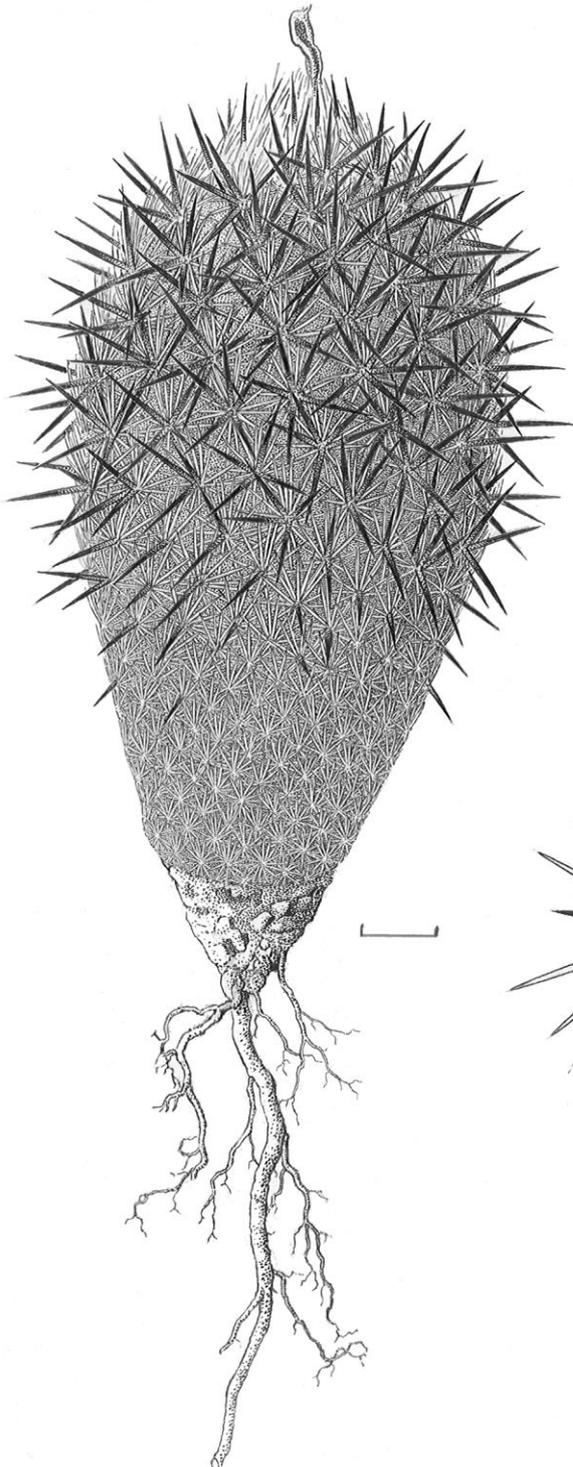
Bödeker 1929

**Common names:** none

**Scientific synonyms:** none

**Excluded taxa:** *Coryphantha densispina* Werdermann 1932 is sometimes incorrectly cited as a synonym of *C. werdermannii*, but has to be referred to *C. difficilis* (Quehl) Orcutt. The identity of *C. werdermannii* ssp. *uncinata* Halda & al. 2000 is unclear.

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Distribution:** State of Coahuila, Mexico.



bar = 1 cm

- 
- Characteristics:** Shortly columnar to elongated, solitary cactus with a predominantly white, strikingly dimorphic spination. Juvenile specimens with a smooth aspect, densely covered only with radiating radial spines, adult specimens additionally with 4 or more strong, protruding, darker central spines per areole.
- Roots:** Fibrous.
- Stem:** Single, ovate, becoming columnar with age, 6 cm Ø, 10 cm (up to ca. 30 cm) high, greyish-green, composed of tubercles, densely covered with predominantly white, appressed spines.
- Tubercles:** 15 mm long, 7 mm wide at base, ascending, with median longitudinal groove on upper (adaxial) side in adult specimens. Lacking axillary glands.
- Spines:**
- Radial spines:** In juvenile specimens 15-20, horizontally spreading or appressed, hence non pungent, in adult specimens 25-30, apically slightly bundled, up to 20 mm long, acicular, greyish white, hiding the stem, the upper ones with dark tips.
- Central spines:** Only in areoles produced after the specimen has reached maturity (therefore in most adult individuals observed only in the apex or in the upper part of the stem). First a single central spine, later 1 prorect and 2 laterally ascending, finally usually 1 lower prorect and 3 (-4) ascending, sometimes with 2 or more ascending subcentrals; most frequently 4 centrals arranged crosswise, up to 22 mm long, stronger than the radials, acicular, straight to slightly curved downwards (especially the lower one), reddish-brown in new growth, later greyish.
- Flowers:** Several appearing simultaneously in August in the centre of the stem apex, 5-6 cm Ø, yellow.
- Fruits:** Ovoid, naked, greenish or yellowish, juicy, indehiscent.
- Seeds:** 1.5 mm long, kidney-shaped, reddish-brown, with reticulate surface structure.
- Juvenile plants:** Globular, densely covered with uniform, short, horizontally spreading radial spines only, no central spines, tubercles lacking a groove.
- Trade:** Reported from south of Cuatro Ciénegas towards San Pedro de las Colonias in various localities, where it grows widely scattered on flat alluvial terrain as well as on gravelly slopes and rarely also on limestone rocks. Not frequently found in international trade, demand moderate. Some shipments of probably wild-collected specimens originating from Mexico and re-exported from USA have been reported. Today, mainly seed exports from USA are registered. The species is very abundant in habitat, even in places that formerly had been stripped for the extraction of gravel (pers. observ. 1997). It can be classified as safe (Lüthy 2001). Extremely slow growing and attaining adult stage after many years of cultivation from seeds. Sometimes grafted to speed up development. Today probably only sought after by many cactus collectors because of its status of a CITES Appendix I-species. Nurseries registered for artificial propagation: Czech Republic P-CZ-1002, Switzerland P-CH-1001.
- Similar species:** There is much confusion with an extreme form of *Coryphantha difficilis* (CITES App. II) originating from El Hundido in the state of Coahuila, which grows sympatrically with *C. werdermannii*. This very densely spined form of *C. difficilis* is in fact confusingly similar to *C. werdermannii* and has been described as *C. densispina*. This name is erroneously treated as a synonym of *C. werdermannii* by some authors. But the look-alike has the characteristically ascending, slightly bigger tubercles of *C. difficilis*. As there are morphological transitions between "typical" *C. difficilis* and *C. densispina*, the latter probably can't be treated as a separate taxon (Adrian Lüthy, pers. comm.). Juvenile plants of *C. werdermannii* superficially resemble certain white spined species of *Mammillaria* which lack central spines, eg. *M. lasiacantha* or juvenile specimens of members of *Mammillaria* section *Leucocephalae* (all CITES App. II). Adult specimens resemble another, predominantly white spined species of *Coryphantha*, *C. echinus* (CITES App. II), but the latter has no strict dimorphism in spination. The identity of the recently described *C. werdermannii* ssp. *uncinata* Halda & al. is still not clear. It could be the plant in trade as "*C. werdermannii* var. nov. El Hundido", which differs from typical *C. werdermannii* by lack of the clear dimorphism of spination.
- Bibliography:** Bravo-Hollis, H. y H. Sanchez-Mejorada (1991): Las Cactáceas de México. Vol. II.  
Dicht, R. & A. Lüthy (2001): New conspectus of the genus *Coryphantha*. *Cactaceae Systematics Initiatives* 11: 5-21.  
Hunt, D., (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Zimmermann, A. D. (1985, ined.): Systematics of the genus *Coryphantha* (Cactaceae). Ph.D. thesis. The University of Texas at Austin.  
*Coryphantha* homepage: <http://mypage.bluewin.ch/retodicht/>
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<b>Commercial names:</b>	engl.: Bahia rosewood, Palisander, Rio rosewood esp.: Palisandro de Brasil, Jacarandá fr.: Palissandre du Brésil
<b>Common names:</b>	esp.: Jacarandá de Bahía, Jacarandá de indios, Jacarandá negro, Palisandro de Río.  port.: Cebeuna, Cabiuna, Cabiuna do mato, Cabiuna rajada, Camboriuna, Caviuva, Gabiuna, Graúna, Jacaranda, Jacaranda-caviuna, acaranda preto, Jacarandazinho, Pau preto, Pau rosa, Urauna.
<b>Subject to CITES control:</b>	All parts and derivatives.
<b>Macroscopic characteristics of the wood:</b>	Wood of varying darkness, diffuse porous. Growth rings poorly visible in transverse section. Sapwood and heartwood easily recognisable. Sapwood yellowish white, sometimes with tones ranging from greenish to brown, heartwood varies from dark reddish brown to violet brown with black streaks; it smells like roses, the characteristic that has given its commercial name; this smell is apparent just after cutting and when the wood is burned. Fibres straight, sometimes wavy. Hardness: very hard and heavy Grain: very fine; the surface appears oily to the touch. Specific weight: between 0.85 and 1.10 g/cm <sup>3</sup>
<b>Microscopic characteristics of the wood:</b>	Wood diffuse porous. Growth rings distinct because of the marginal parenchyma. Vessels usually solitary sometimes in radial multiples or in groups, 5 to 20/mm <sup>2</sup> ; tangential diameter (90 –) 170 (– 260) µm, perforation plates simple. Intervascular pits bordered and vested. Vessels frequently contain gum or other deposits. Parenchyma predominantly apotracheal and diffuse, sometimes marginal, rarely aliform with short wings, very infrequently confluent, layered (storied) in tangential section. Rays homogenous with a tendency to become heterogenous, 3-seriate, up to 10 cells high, distributed in layers (storied) with a frequency of 3 to 11/ mm <sup>2</sup> . Libriform fibres with dark contents, (1130 –) 1350 – (1600) µm long; crystals present in septate fibres.
<b>Characteristics of the trees:</b>	This tree can grow to 40 metres in height and 1.2 metres in diameter, although it normally grows to 15 – 20 metres and up to 0.8 metres in diameter. The trunk is rather cylindrical, although there are buttress roots at the base. The tree has a rough bark.
<b>Characteristics of trade:</b>	A large number of species are sold under the name palisander or rosewood and have characteristics similar to <i>Dalbergia nigra</i> , although usually the name of the country of origin is added.

**Distribution:** Brazil (in the states of Río de Janeiro and Espírito Santo)



**Use:** Expensive furniture, general furniture making, lath work, (handles for tableware and tools), musical instruments, guitars, castanets, mandolins, pianos, violins, flooring, sculptures, marquetry, doors and carvings.

**Similar species:** There are about 100 species of trees, shrubs and lianas in this genus, occurring throughout all tropical regions.

	Distribution	Common name
<i>Dalbergia bariensis</i>	Asia	Asian rosewood
<i>D. cearensis</i>	Brazil	Violetwood
<i>D. cochinchinensis</i>	Asia	Asian rosewood
<i>D. cubilquitzensis</i> (syn. <i>D. tucurensis</i> )	Central America	Guatemala rosewood
<i>D. frutescens</i>	South America	Sebastiao de Arruda
<i>D. latifolia</i>	Asia	Indian rosewood
<i>D. oliveri</i>	Myanmar	Burma palisander
<i>D. retusa</i>	South America	Cocobolo
<i>D. sissoo</i>	Himalaya	Sissoo
<i>D. spruceana</i>	Amazon	Amazon rosewood
<i>D. stevensonii</i>	Brazil, Venezuela	Honduras rosewood
<i>Machaerium villosum</i>	South America	Jacaranda pardo

Because *D. nigra* is often confused with *D. latifolia*, it must be pointed out that *D. latifolia* (Indian palisander) has a pinkish violet tinge, which can be quite dark, while *D. nigra* is brown and usually has a more clear grain pattern.



Species → Characteristics ↓	<i>D. nigra</i> , <i>D. cubilquitzensis</i> , <i>D. spruceana</i>	<i>D. bariensis</i> , <i>D. oliveri</i>	<i>D. cearensis</i>	<i>D. cochinchinensis</i>	<i>D. frutescens</i>	<i>D. latifolia</i> , <i>D. sissoo</i>	<i>D. stevensonii</i>	<i>D. retusa</i>	<i>Machaerium villosum</i>
Colour sapwood	yellowish white	white	off-white	yellowish	off-white	light	yellow	yellow white	light
Colour heartwood	pink to violet, brown with black streaks	bright pink	violet with dark streaks	violet brown	pink with violet streaks	purplish brown with black purple lines	purple brown	pale pink to red	violet brown
Grain	very fine	medium	fine	medium to fine	fine	rather thick, but uniform	medium to fine	fine	thick
Fibres	straight, sometimes interlocked	variable	straight	straight	straight	straight, sometimes interlocked	straight	straight	wavy
Hardness	very hard	very hard	very hard	very hard	hard	very hard	very hard	very hard	very hard
Specific weight	0.85 - 1.1 g/cm <sup>3</sup>	1.0 g/cm <sup>3</sup>	0.70 - 1.1 g/cm <sup>3</sup>	0.87 - 0.95 g/cm <sup>3</sup>	0.70 - 0.90 g/cm <sup>3</sup>	0.85 g/cm <sup>3</sup>	0.95 g/cm <sup>3</sup>	0.99 - 1.22 g/cm <sup>3</sup>	0.85 g/cm <sup>3</sup>

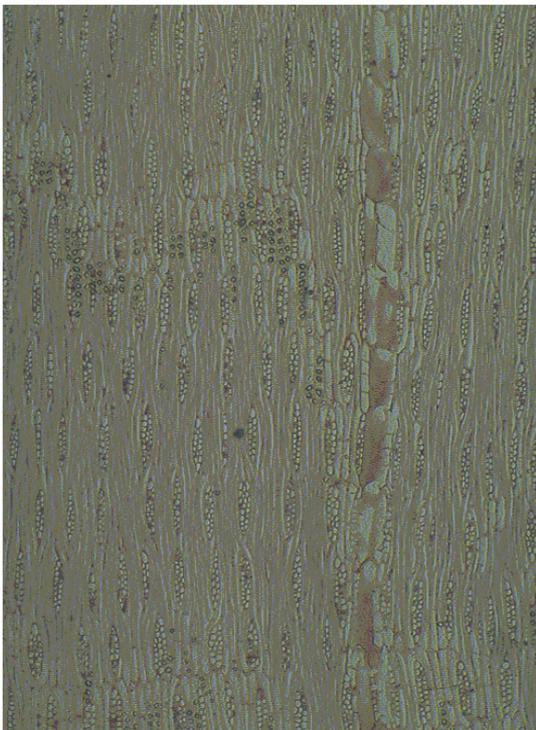


# Dalbergia nigra

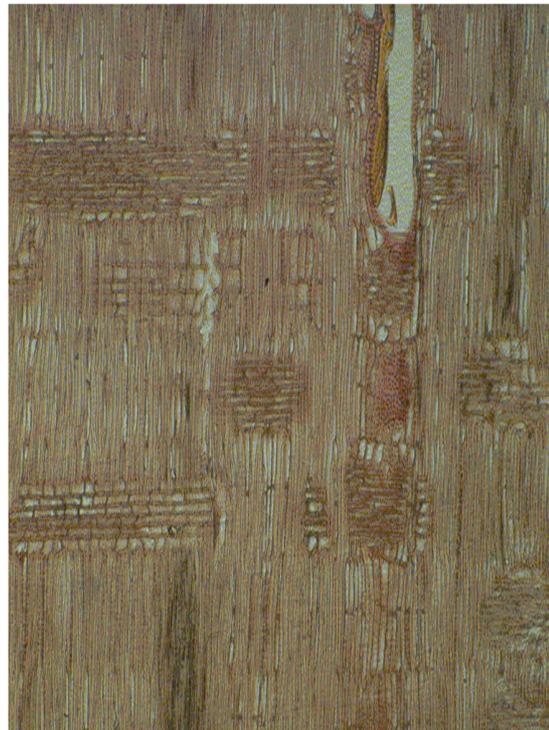




transverse section



tangential section



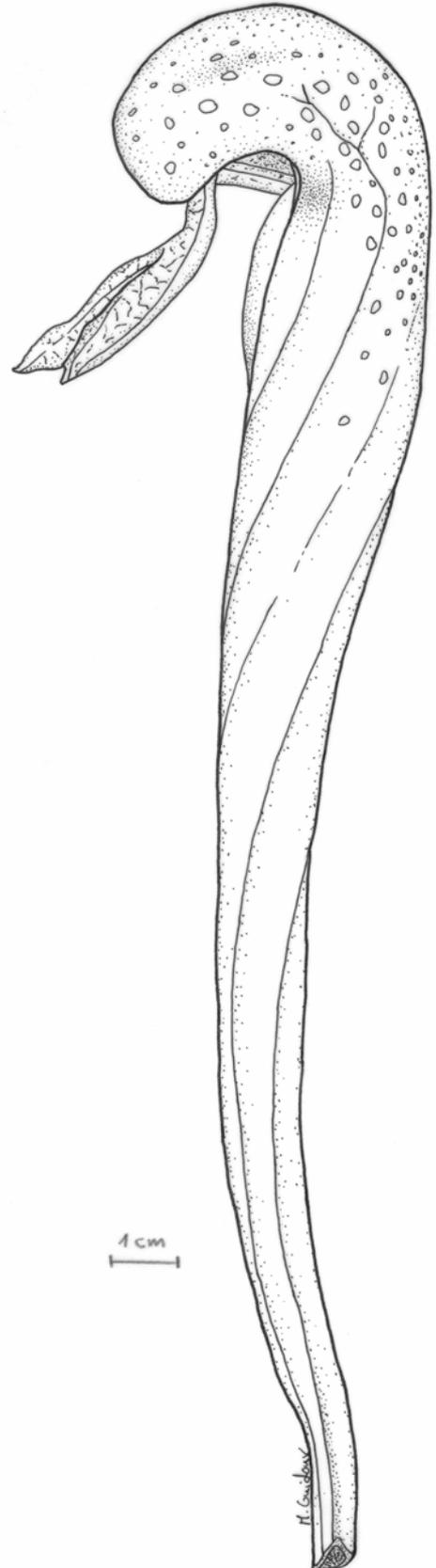
radial section

# Darlingtonia californica

Torr.



<b>Common names:</b>	engl.:	Cobra Lily, California Pitcher Plant
	esp.:	Lirio cobra, Jarra, Cántaros
	fr.	Darlingtonia
<b>Scientific synonyms:</b>	Chrysamphora californica (invalid)	

**Characteristics:**

Plant:	Herbaceous, terrestrial.
Size:	A few dozens of centimetres in height up to 1 metre.
Type of trap:	Passive, the pitchers have the characteristic form of a cobra about to strike.
Traps:	At the base, several traps form a narrow and open green funnel, but the adult trap is topped by a hood and has two "moustaches" that serve as a landing platform for insects. The entrance is under the dome. Transparent parts of the dome fool insects when they take off, throwing them off balance and sending them to the bottom of the pitcher.
Inflorescence:	Rather large at the end of a long peduncle. Brown petals, green sepals.
Prey:	Primarily flying insects.
Digestion:	Only bacteria.

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**Distribution:**

USA, West Coast (from Oregon to northern California, in a 160-km wide band between Roseburg and Santa Rosa). Between sea level and 2800 metres.

**Climate:**

Rather humid and cool.

**Habitat:**

Varied both in altitude and site. One prevalent factor seems to be serpentine soil and proximity to running water (or subterranean water).

**Propagation:**

Possible by separation of stolons in the spring (sometimes by seeds).

**Useful part:**

The pitchers are used for decoration and the whole plants are used as ornamentals.

**Trade:**

Little reported trade in wild plants.

**Number of species:**

Only one species in this genus.

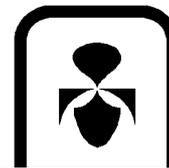
**Similar species:**

None.

**Comments:**

The plant is rather resistant when grown, but suffers from the accumulation of warm water.

# Dendrobium spp.



**Family:** Orchidaceae

**Preliminary remark:** Several species of the genus *Dendrobium* (in all 37 species) are used as *Dendrobium caulis* or Shihu. *Dendrobium nobile* is reported to be the most important source, however, there is no real proof for this. In many cases the drug is not derived from this particular species. The *Dendrobium* species most commonly used are summarized in the table below.

*Dendrobium caulis* is produced in many parts of the distribution range of the genus *Dendrobium*. A species-specific identification by the stems is difficult and in many cases not possible. Since all species are covered by CITES this differentiation is not necessary. The following details therefore refer to the genus *Dendrobium* or to the commodity *Dendrobium caulis*.

**Geographical range:** From India and Sri Lanka eastwards to Japan and in southeast Asia through Malaysia, Indonesia, Papua New Guinea to Australia and through the Pacific islands to New Zealand.

**Vernacular names:**

english:	Dendrobium
french:	
spanish:	
chinese:	Shi Hu (Shihu)
german:	Dendrobium
italian:	Dendrobio

### *Dendrobium* species most commonly traded as *Dendrobium caulis*

Scientific name	Synonyms	Distribution
<i>Dendrobium candidum</i> Wall. ex Lindl.	<i>Dendrobium spathaceum</i> Lindl.	China
<i>Dendrobium chrysanthum</i> Wall.	<i>Callista chrysantha</i> (Lindl.) Kuntze	Bhutan, China, India, Lao PDR, Myanmar, Nepal, Thailand, Viet Nam
<i>Dendrobium fimbriatum</i> Hook.	<i>Dendrobium fimbriatum</i> Hook. var. <i>oculatum</i> Hook. <i>Dendrobium hawkesii</i> Heller <i>Dendrobium paxtonii</i> Paxton <i>Dendrobium vagans</i> Gagnep. <i>Callista oculata</i> (Hook.) Kuntze	Bhutan, China, India, Lao PDR, Malaysia, Myanmar, Nepal, Thailand, Viet Nam
<i>Dendrobium loddigesii</i> Rolfe	<i>Callista loddigesii</i> (Rolfe) Kuntze	China, Lao PDR, Viet Nam
<i>Dendrobium nobile</i> Lindl.	<i>Dendrobium chlorostylum</i> Gagnep. <i>Dendrobium coerulescens</i> Wall. <i>Dendrobium lindleyanum</i> Griff. <i>Dendrobium formosanum</i> (Rchb.f.) Masamune <i>Callista nobilis</i> (Lindl.) Kuntze	Bhutan, China, India, Lao PDR, Myanmar, Nepal, Thailand, Taiwan (province of China), Viet Nam

**Protection:** CITES Appendix II (#7), since 01.07.1975

One species of the genus *Dendrobium*, *D. cruentum*, is included in CITES Appendix I, all the other species are listed in Appendix II.

**Use:** Medicinal plant used in TEAM, horticultural plant (*Dendrobium nobile* is the main species in cultivation, but many others are used for hybridizing).

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## Botanical drugs in trade

<b>Plant parts used:</b>	Stems (without leaves).
<b>Pharmaceutical names:</b>	latin: Dendrobii caulis, Caulis Dendrobii, Dendrobii herba, Herba Dendrobii english: Dendrobium stem french: spanish: chinese: Shi Hu (Shihu), Erhuanshihu, Huosan Shihu, Jin-chai Shi-hu, Da Huang Cao, Chong Huang Cao, Xiao Huang Cao german: Dendrobium-Kraut
<b>Countries of export:</b>	China (including Hong Kong SAR and the Province of Taiwan), India, Indonesia, Japan, Myanmar, Nepal, Thailand, Viet Nam.
<b>Source:</b>	Mainly wild collection.
<b>Commodities in trade:</b>	Dried, stems cut into long pieces (crude drug) or the same minutely cut (cut drug); in addition dried stems or stem pieces rolled into small springs or spheres or spirally rolled ('spiral drug'; huosan shihu) and also fresh stems.
<b>Characteristics:</b>	
Crude drug:	(Fig. 1-4) Stem pieces, if not cut, 15-120 cm long, often bent, sometimes several stems branching from one rootstock, root attachments visible; stems mainly cut into ca. (2-)4-10 cm-long pieces, straight or slightly curved, sometimes split, supple, (1-)4-8mm in diameter, without leaves, easy to break and then a loose, fibrous interior is revealed; surface golden-yellow, yellow-green to dark ochre-yellow, shining, mainly longitudinally grooved, always with conspicuous darker coloured, brown transverse line at the nodes; nodes at 1-4,5 cm intervals, sometimes with scraps of transparent, membranous leaf sheaths; cut surface see "Cut drug";
Cut drug:	(Fig. 5) Stems cut into short pieces; length of the fragments about 5-20mm, in most cases uniform within a sample; cut surface even, grey to cream-coloured, ribbed and therefore star-shaped in outline; characters of the external surface of the stem pieces see "Crude drug";
"Spiral drug":	(Fig. 6) Springs or spheres variably sized, less than 5mm to more than 20mm in diameter, made up of narrowly inrolled stems or stem pieces; characters of the stems see "Crude drug";
Odour:	Odourless to weak.
Taste:	Slightly bitter with sweet after-taste, mucilaginous when chewed;
Remark:	The drugs sourced from different <i>Dendrobium</i> species may be distinguished by the length of the stem internodes, the stem diameter and the length of the whole stems.
<b>Similar drugs/ adulterations:</b>	Stems of other orchid species, for example <i>Flickingeria lonchophylla</i> (Hook.f.) A.D. Hawkes, <i>Bulbophyllum</i> spp. or <i>Pholidota</i> spp. are traded as Shihu (e.g. Shihu Cao, Yougua Shihu, Jin Shihu, Chuan Shihu, or Huosan shihu). In these cases, not only the stems, but also the thickened pseudobulbs of the stem basis are used. All mentioned parts are subject to CITES.



Figure 1. Crude drug, with stems of variable length, *Dendrobii caulis*; species: *Dendrobium* spp., (copyright BfN).



Figure 2. Crude drug of stems, *Dendrobii caulis*; species: *Dendrobium* spp., (copyright BfN).



Figure 3. Comparison of crude drugs of stems from several samples, *Dendrobii caulis*; species: *Dendrobium* spp., (copyright BfN).



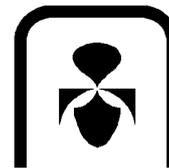
Figure 4. Comparison of crude drugs of stems from several samples, *Dendrobii caulis*; species: *Dendrobium* spp., (copyright BfN).



Figure 5. Cut drug, *Dendrobium caulis*; species: *Dendrobium* spp., (copyright BfN).



Figure 6. Crude drug, spirally arranged stems, *Dendrobium caulis*; species: *Dendrobium* spp., (copyright BfN).



# Determination key to *Tillandsia* species

The key below is designed to only separate the species of *Tillandsia* listed in Appendix II of CITES from those species of atmospheric tillandsias traded more commonly (see also Gr"ger, 1991). The latter species are listed at the end of the chapter on Bromeliaceae, with a short description as recommended by H.E. Luther. Only characteristics of full-grown plants in the vegetative stage have been taken into consideration. The figures given for the size of the plants refer to non-flowering rosettes.

The number of species traded among *Tillandsia*-hobbyists is considerably larger (more or less 200 species according to Gr"ger, 1991); the identification of these species using exclusively characters of the vegetative stage seems hardly possible and is not practicable.

\* Note: Before being packed for shipment, Tillandsias are often dried slightly. As a result, the leaf blades are often increasingly recurved towards the base and the leaf becomes more channeled or folded.

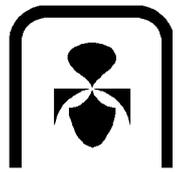
1	Leaves in spirals.	2
1*	Leaves in two opposite rows ( <i>T. usneoides</i> ). no CITES-species	
2	Plant stemless; leaves in rosettes, their leaf-sheaths inflated and forming a bulb or pseudobulb.	3
2*	Plant with or without stems; leaves not forming a bulb or pseudobulb if in a rosette.	5
3	Diameter of rosette 40-90cm; leaf-blades 2-6cm wide at base	4
3*	Diameter of rosette not more than 40cm; leaf-blades usually less than 2cm wide at base.	no CITES-species
4	Plant densely covered with silvery-white, appressed scales.	<i>T. xerographica</i>
4*	Plant densely covered with greyish, coarse, spreading scales ( <i>T. streptophylla</i> ).	no CITES-species
5	Plant with a stem.	6
5*	Plant stemless.	8
6	Plant small, 5-7cm tall, diameter of rosette 4-6cm; leaves directed to one side only, the blades deeply channeled, 3-5cm long and 0.5-0.8cm wide at base.	<i>T. sucrei</i>
6*	Plant over 10cm tall, diameter of rosette more than 10cm	7
7	Stem up to 30, rarely up to 80cm long; diameter of rosette 18-35cm; leaf-blades 10-15cm long and up to 1.5cm wide at base, channeled, recurved, slightly directed to one side, covered with silvery-white scales (in vegetative stage not separable from <i>T. hondurensis</i> ).	<i>T. harrisii</i>
7*	Plant not as above.	no CITES-species
8	Plant comparatively small, 4-10cm tall; leaf-blades 3-10cm long	9
8*	Plant 10-90cm high; leaf-blades 10-70cm long.	no CITES-species
9	Leaf-blades narrowly-triangular, not red.	10
9*	Leaf-blades linear to narrowly-triangular, the inner ones often red ( <i>T. ionantha</i> ).	no CITES-species

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- |     |   |                        |
|-----|---|------------------------|
| 10  | Diameter of rosette 3-8cm; leaves more or less directed to one side only.   | 11                     |
| 10* | Diameter of rosette 10-15cm; leaves not directed to one side.   | 12                     |
| 11  | Scales large, coarse, with spreading margins, easily detachable, individually recognizable in apical part of the leaf-blade; surface of leaf-blades not shining.<br><br>Note: nearly stemless specimens of <i>T. sucrei</i> differ from <i>T. sprengeliana</i> in having deeply channeled to folded leaf blades and a less dense covering of scales on the undersurface of the top part of the leaves (compare descriptions of the two species; see also nos 3 and 4 in the key below). | <i>T. sprengeliana</i> |
| 11* | Scales with appressed margins, not easily detachable; not individually recognizable; surface of leaf-blades shining blueish-grey.   | <i>T. kautskyi</i>     |
| 12  | Leaf-blades thick, more or less triangular in transection, the abaxial surface slightly keeled.   | <i>T. mauryana</i>     |
| 12* | Leaf-blades thin, the abaxial surface not keeled. <i>T. kammii</i>  |                        |

Key to **only** the species in CITES Appendix II

- |    |  |                        |
|----|--|------------------------|
| 1  | Plants with inflated leaf-sheaths, these forming a pseudobulb; diameter of rosette 50-90cm; leaf-blades usually recurved and contorted.                              | <i>T. xerographica</i> |
| 1* | Plants not with inflated leaf-sheaths forming a pseudobulb; diameter of rosette up to 40cm.  | 2                      |
| 2  | Rosette up to 10cm in diameter; leaf-blades soft, thin and more or less directed to one side.  | 3                      |
| 2* | Rosette more than 10cm in diameter; leaf-blades of various consistency, not directed to one side.  | 5                      |
| 3  | Scales coarse and spreading, through incomplete coverage in the apical part of leaf individually recognizable, easily detachable; surface of leaf-blade not shining. | <i>T. sprengeliana</i> |
| 3* | Scales more or less spreading, through complete coverage not individually recognizable; leaf-blade surface shining or not.   | 4                      |
| 4  | Leaves conspicuously directed to one side, leaf-blades channeled, not shining.   | <i>T. sucrei</i>       |
| 4* | Leaves more or less directed to one side, slightly channeled, shining.   | <i>T. kautskyi</i>     |
| 5  | Leaves 11-19cm long; diameter of rosette 18-35cm.  | <i>T. harrisii</i>     |
| 5* | Leaves 4-9cm long; diameter of rosette 11-15cm.  | 6                      |
| 6  | Leaf-blades slightly succulent, the underside slightly keeled.   | <i>T. mauryana</i>     |
| 6* | Leaf-blades thin, not keeled.  | <i>T. kammii</i>       |
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# Determination key to *Tillandsia* species



List of more commonly traded *Tillandsia*-species (after Gr"ger, 1991, and pers. comm. from Ehlers, 1993) and their geographical distribution.

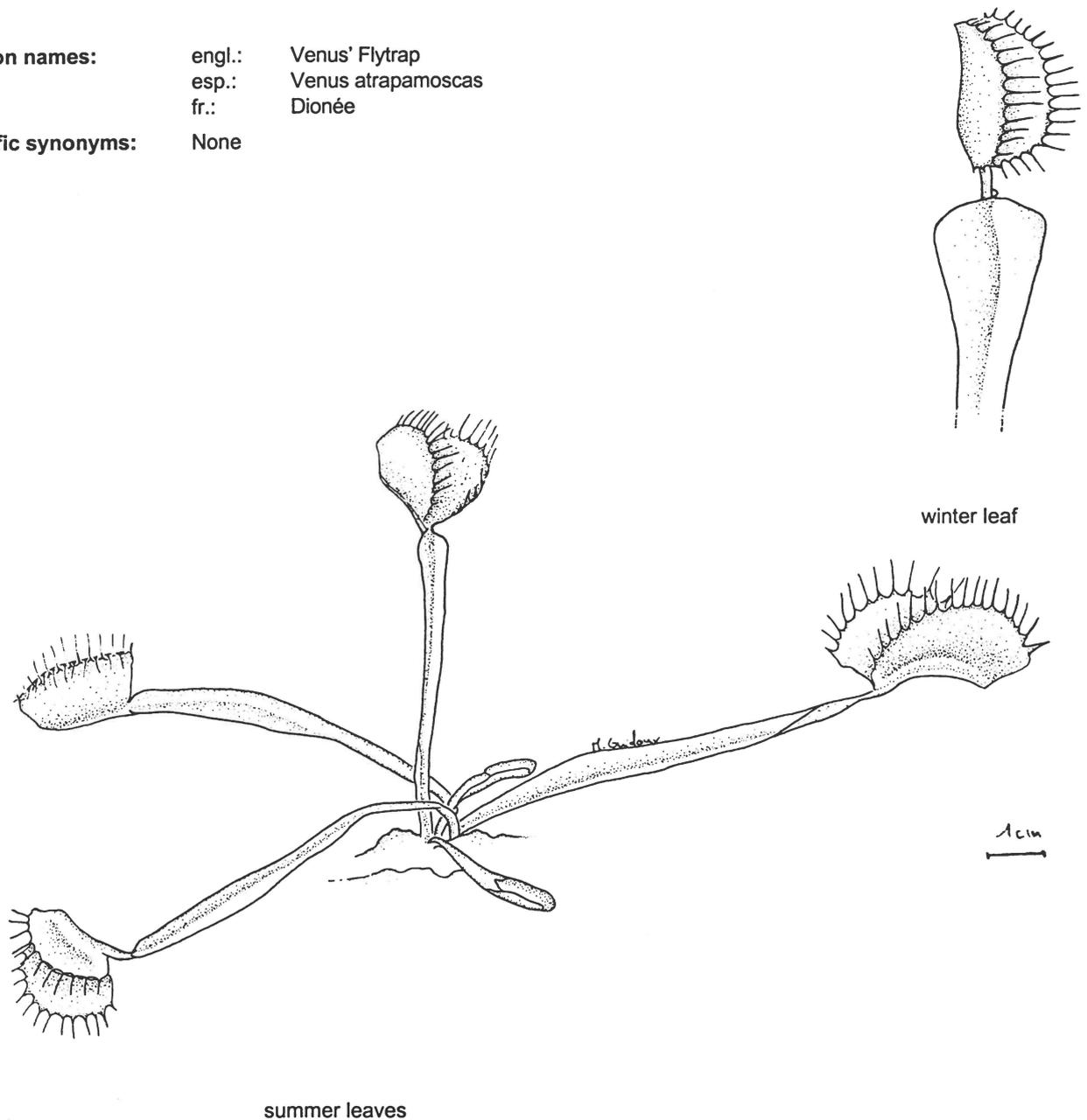
- T. balbisiana* (Mexico, Central America, northern South America)
- T. brachycaulos* (Mexico, Central America)
- T. bulbosa* (Mexico, Central America, South America)
- T. butzii* (Mexico, Central America)
- T. caput-medusae* (Mexico, Central America)
- T. fasciculata* (Mexico, Central America, northern South America)
- T. filifolia* (Mexico, Central America)
- T. fuchsii* (Mexico, Guatemala)
- T. harrisii* (Guatemala)
- T. ionantha* (Mexico, Central America)
- T. juncea* (Mexico, Central America, northern South America)
- T. magnusiana* (Mexico, Central America)
- T. paucifolia* (Mexico, Central America, northern South America)
- T. plagiotropica* (El Salvador)
- T. pruinosa* (USA [Florida], Mexico, Central America, South America)
- T. pseudobaileyi* (Mexico, Guatemala)
- T. punctulata* (Mexico, Central America)
- T. seleriana* (Mexico, Central America)
- T. streptophylla* (Mexico, Central America)
- T. tricolor* (Mexico, Central America)
- T. usneoides* (southern USA, Mexico, Central America, South America)
- T. vicentina* (Mexico, Central America)
- T. xerographica* (Mexico, Central America)

# Dionaea muscipula

Ellis



Common names:	engl.:	Venus' Flytrap
	esp.:	Venus atrapamoscas
	fr.:	Dionée
Scientific synonyms:	None	

**Characteristics:**

Plant:	Terrestrial, perennial and herbaceous forming a rosette on the ground.
Size:	10-15 cm in diameter.
Type of trap:	Active. This is by far the best known of all the carnivorous plants.
Traps:	A sort of muzzle located at the tip of the leaf. It closes in less than one second when the prey touches one of the three trigger-hairs inside the trap.
Leaves:	The part holding the trap is long and thin in the summer; shorter and heart-shaped when the days become shorter (less light).
Inflorescence:	The flowers are grouped in umbels (1-15 flowers) at the tip of a long floral stem. They are white and rather large.
Prey:	Numerous insects both terrestrial and flying; also spiders, molluscs and small amphibians.
Digestion:	Enzymes released in the trap when it is closed.

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**Distribution:**

USA, East Coast. North Carolina and South Carolina (on an axis between Greenville and Georgetown, 30 and 100 km to the east and west).



**Climate:**

Hot in summer and cold in winter. High rainfall.

**Habitat:**

Sandy grasslands with a low content of organic material.

**Propagation:**

By division of the pseudobulb or from seeds.

**Useful part:**

Whole plants as ornamentals.

**Trade:**

Primarily as the pseudobulb.

**Number of species:**

Only a single species in this genus.

**Similar species:**

None owing to the unique form of the traps. The pseudobulb can be confused with other small bulbous plants (*Crocus*, *Galanthus*), but is recognizable owing to "scales".

# Discocactus bahiensis

## ssp. bahiensis (incl. ssp. gracilis)

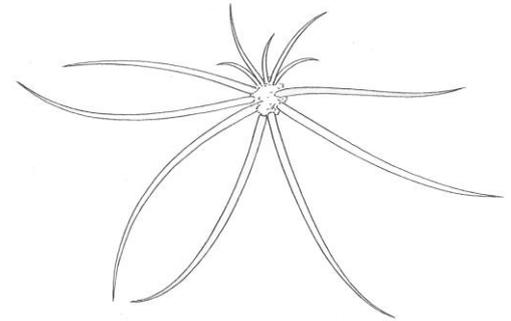
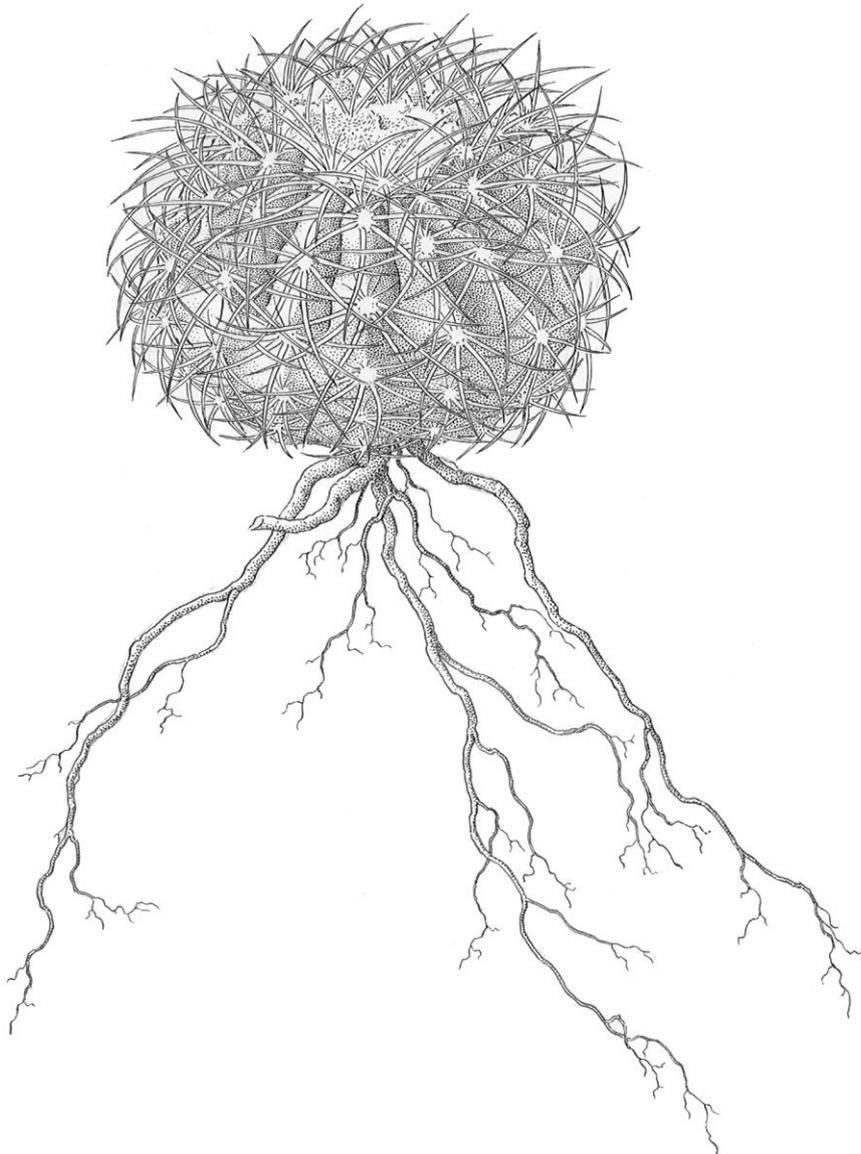
Britton &amp; Rose 1922



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** →*D. bahiensis* ssp. *gracilis* Braun & Esteves 2001

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



**Distribution:** State of Bahia, Brazil.



- Characteristics:** Robust, flat-globular, middle-sized, green, ribbed cactus with relatively numerous and long, curved, sometimes interwoven spines. Stem sunken into the substrate, with a napiform subterranean base. Solitary or branching at the base and forming small groups. Adult specimens with a small, whitish, woolly cephalic zone in the centre of the stem apex, with only a few bristles.
- Roots:** Carrot-like root, branching later on, from a shortly conical (up to 4 cm) stem base.
- Stem:** Flat-globular, up to 4.5-5 cm high (without cephalium), up to 15 cm Ø, green, with rather prominent ribs, solitary or branching from the subterranean, conical stem base and forming groups.
- Cephalium:** Very small (in comparison with other spp.), flat-globular, 1 cm high, 3 cm Ø, covered with white wool, bristles almost lacking, only a few along the margin, dark brown.
- Ribs:** Up to 12, only weakly dissolved into tubercles, slightly depressed (ca. 1 cm) between the areoles and these saddles rather acute, broadened and rounded around the areoles, ca. 3 cm broad and 2 cm protruding.

- 
- Areoles:** Oval, about 7 mm long, 5 mm wide, first covered with light brown wool, later naked, about 2 cm apart on the ribs,  $\pm$  5 areoles per rib.
- Spines:** 7-9 radial spines, spreading and recurved, 1.1-1.5 mm thick at the base, slightly flattened, the longest one descending, 3-3.4 cm long, the lateral in pairs, 1-5-3 cm long, the lower longest, first dark brown or horn-coloured to light horn-coloured, becoming greyish-pink to grey, with darker transverse bands and tips, 1-4 small secondary spines in the upper part of the areole, 10-12 mm long.
- Flowers:** Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal and notably scented, white with brown outer perianth segments and an elongated, slender tube with numerous spreading to recurved, long perianth segments, funnelform, 4.7-7.2 cm long, 3-5.4 cm  $\varnothing$ .
- Fruits:** Clavate, 2.5-4 cm long, 8-10 mm  $\varnothing$ , with persistent floral remnant, white, dehiscent lengthwise at the side.
- Seeds:** Helmet-shaped, 1.6-1.8 mm long, 1.5-1.9 mm wide, 1.2-1.5 mm high, surface shining black, with mamillalike tubercles.

**Trade:** *D. bahiensis* ssp. *bahiensis* is an endemic with only two known, disjunct sites and small populations and it is consequently classified as endangered (Taylor & Zappi 2001). The major threat is reported to be agricultural development (Machado 1999 in lit.). *D. bahiensis* ssp. *bahiensis*, discovered by Dr. Leo Zehntner and given to Dr. Rose around 1915, was rediscovered 1974 by Buining & Horst. Only a few specimens were collected (HU 437). The Brazilian trader Leopoldo Horst never really exploited this taxon commercially and thus it remained little known. Only in 1978, Horst and the Swiss trader Werner Uebelmann collected a similar, but smaller plant near São Rafael (HU 485). These plants were exported to Europe in big quantities between 1978 and 1982 and are now distributed in collections as *D. bahiensis*. They are easy to propagate, as they strongly branch when grafted. The original *D. bahiensis* (HU 437) remains little distributed in collections. Now the smaller impostor (HU 485) was finally described as ssp. *gracilis* (Braun & Esteves 2001). Ssp. *bahiensis* is distributed east of the Serra São Francisco, between 400-500 m altitude, in the drainage system of Rio Salitre (9 sites are indicated) and more to the southwest, near the Serra Azul. Ssp. *subviridigriseus* is distributed in the region of Sobradinho. Ssp. *gracilis* is only known from a single population near Verada do Romão, São Rafael (Braun & Esteves 2001). The genus *Discocactus* is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in "cephalic cacti" create a certain demand, which has been much stimulated by the description of "new species" in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation (*D. bahiensis* and *D. subviridigriseus*): Germany P-DE-1001.

**Similar species:** *D. bahiensis* ssp. *bahiensis*, ssp. *gracilis* and ssp. *subviridigriseus* are characterized by a very small cephalium with only very few bristles, compared with other species, brown outer perianth segments and a conical subterranean stem base with a napiform taproot. The spines are rather long and may overlap. The acute saddles on the ribs, between the areoles are another quite characteristic feature. Ssp. *bahiensis* has distinctively more spines (up to 13 vs. 5-7) and rather a smaller stem than ssp. *subviridigriseus*, with fewer ribs (up to 12 vs. 13-15), but the two are reported to intergrade (Nigel Taylor 2001 in lit.). Ssp. *gracilis* is described with a smaller, more strongly branching stem and thinner spines. Ssp. *bahiensis* bears some similarity to *Discocactus zehntneri*, due to its numerous, long, slightly interwoven spines, but the latter has ribs completely dissolved into rounded tubercles. Immature specimens of *D. bahiensis*, still lacking the cephalium, could even be confounded with some of the coarsely spined species of the genus *Gymnocalycium*. Ssp. *subviridigriseus* is specifically compared with *Gymnocalycium spegazzinii* Britton & Rose (Braun & Esteves 2001). Mature *Discocactus* of the "green" taxa in general could be confounded with mature *Melocactus*, the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.

**Bibliography:** Braun, P. J. & E. Esteves Pereira (2001): *Discocactus bahiensis* subsp. *gracilis* P. J. Braun & Esteves aus Bahia, Brasilien. *Kakt. and. Sukk.* 52 (11): 286-290.  
Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. In: *The Cactus and Succulent Journal*

Family Cactaceae

# **Discocactus bahiensis**

## **ssp. bahiensis (incl. ssp. gracilis)**

Britton & Rose 1922



of Great Britain. Vol. 43 (2/3), p. 37-40.  
Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

# Discocactus bahiensis

## ssp. subviridigriseus

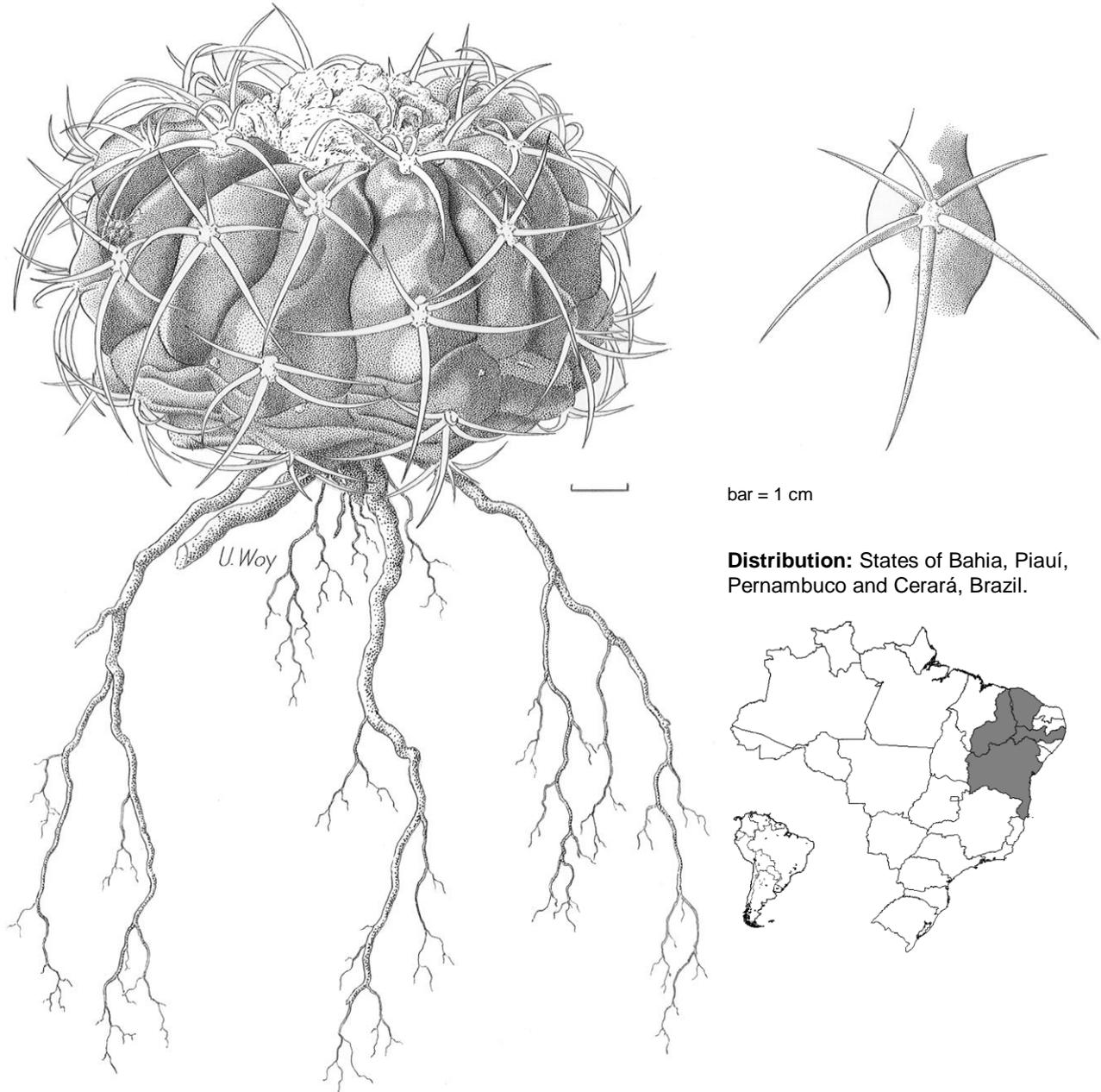
(Buin. &amp; Bred.) Braun &amp; Esteves 1993



**Common names:** bras.: frade de cavalo, coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** = *Discocactus subviridigriseus* Buining & al. 1977

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** States of Bahia, Piauí, Pernambuco and Ceará, Brazil.

- Characteristics:** Robust, flat-globular, middle-sized, green, ribbed cactus, stem sunken into the substrate, with relatively few long, curved spines and a napiform subterranean base, solitary or forming groups. Adult specimens with a small, whitish, woolly cephalic zone in the centre of the stem apex, with only a few bristles.
- Roots:** Stem base conical, napiform, with a few, carrot-like roots.
- Stem:** Flat-globular, up to 6-7 cm high (without cephalium), 16-18 cm Ø, greyish green, with rather prominent ribs, solitary or branching from the subterranean stem base and forming groups.
- Cephalium:** Very small (in comparison with other spp.), flat-globular, 1 cm high, 3-3.5 cm Ø, covered with

- 
- Ribs: white wool, bristles almost lacking, only a few along the margin, dark brown. 13-15, only weakly dissolved into tubercles, slightly depressed (ca. 1 cm) between the areoles and these saddles rather acute, broadened and rounded around the areoles, ca. 3.5 cm broad and 2 cm protruding.
- Areoles: Oval, about 10 mm long, 8 mm wide, first covered with light brown wool, later naked, about 2-2.3 cm apart on the ribs, ca. 3 areoles per rib above the substrate.
- Spines: 5 (-7) strong radial spines, not obscuring the stem, spreading and recurved, up to 2.5 mm thick at the base, slightly flattened, first flesh-coloured, later greyish to dark grey, the longest one descending, up to 35 mm long, 2 (-3) lateral in pairs, 25-35 mm long and (1-) 2 (-3) shorter and weaker, sometimes strongly curved, ascending secondary spines in the upper part of the areole, up to 10 mm long.
- Flowers: Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal and notably scented, white with brown outer perianth segments and an elongated, slender tube with numerous spreading to recurved, long perianth segments, funnellform, 4.7-7.2 cm long, 3-5.4 cm Ø.
- Fruits: Clavate, 2.5 cm long, 8-10 mm Ø, with persistent floral remnant, white, dehiscent lengthwise at the side.
- Seeds: Helmet-shaped, 1.5-1.7 mm long, 1.2-1.5 mm high, surface shining black, with mamillalike tubercles.
- Trade:** *D. bahiensis* ssp. *subviridigriseus* was already reported to be specifically threatened by dam construction and flooding of habitats in 1980 (Buining) and the supporting statement of the App. I listing proposal (1992) says, that much of the habitat has disappeared since, beneath a great dam lake, Represa de Sobradinho. A single site with a few hundred individuals at most seemed all that was left. Today, it is known to have a much wider distribution, as indicated above (Taylor & Zappi 2001). Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in "cephalic cacti" create a certain demand, which has been much stimulated by the description of "new species" in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation (as *D. subviridigriseus*): Germany P-DE-1001.
- Similar species:** *D. bahiensis* ssp. *bahiensis*, ssp. *gracilis* and ssp. *subviridigriseus* are characterized by a very small cephalium with only very few bristles, compared with other species, brown outer perianth segments and a conical subterranean stem base with a napiform taproot. The spines are rather long and may overlap. The acute saddles on the ribs, between the areoles are another quite characteristic feature. Ssp. *bahiensis* has distinctively more spines (up to 13 vs. 5-7) and rather a smaller stem than ssp. *subviridigriseus*, with fewer ribs (up to 12 vs. 13-15), but the two are reported to intergrade (Nigel Taylor 2001 in lit.). Ssp. *gracilis* is described with a smaller, more strongly branching stem and thinner spines. Ssp. *bahiensis* bears some similarity to *Discocactus zehntneri*, due to its numerous, long, slightly interwoven spines, but the latter has ribs completely dissolved into rounded tubercles. Immature specimens of *D. bahiensis*, still lacking the cephalium, could even be confounded with some of the coarsely spined species of the genus *Gymnocalycium*. Ssp. *subviridigriseus* is specifically compared with *Gymnocalycium spegazzinii* Britton & Rose (Braun & Esteves 2001). Mature *Discocactus* of the "green" taxa in general could be confounded with mature *Melocactus*, the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
- Bibliography:** Braun, P. J. & E. Esteves Pereira (2001): *Discocactus bahiensis* subsp. *gracilis* P. J. Braun & Esteves aus Bahia, Brasilien. *Kakt. and. Sukk.* 52 (11): 286-290.  
Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands  
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Taylor, N. P. & D. Zappi (2001): *Cacti of Eastern Brazil*. Royal Botanic Gardens Kew, UK.
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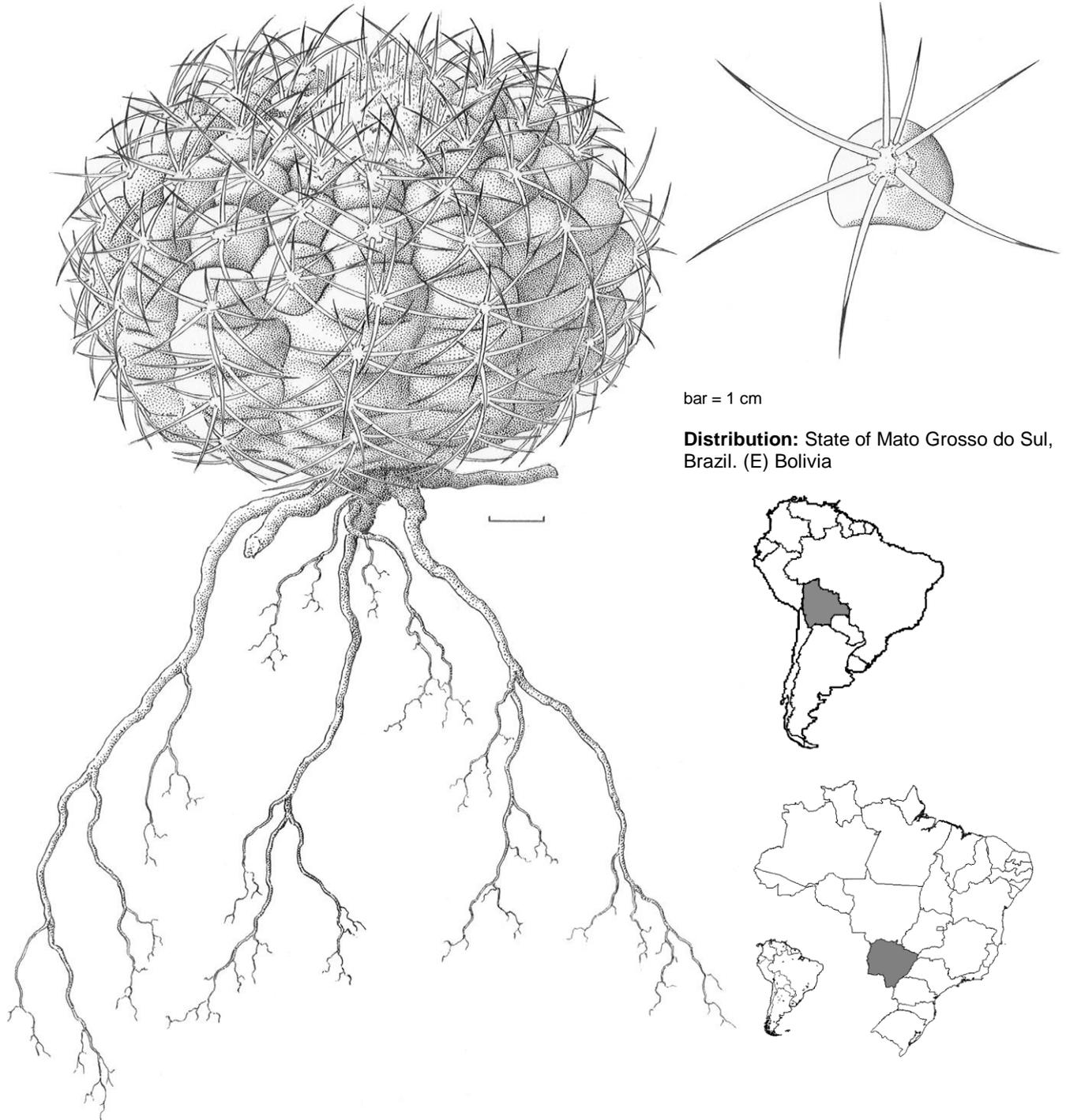
# Discocactus ferricola

Buining &amp; Brederoo 1975

**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** none

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** State of Mato Grosso do Sul, Brazil. (E) Bolivia

**Characteristics:**

Robust, (flat-) globular, middle-sized, green, tuberculate cactus with rather few and thin, acicular, curved radial spines. Tubercles arranged in spirals rather than in vertical ribs. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex, with a conspicuous amount of very long, distinctly curved, dark bristles. Normally branching and forming groups.

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Roots:	Fibrous, long, ramified, from the centre of the stem base.
Stem:	Flat-globular to globular, 8-9 cm high (without cephalium), 20-25 cm Ø, shining dark green, strongly tuberculate, normally producing offsets at the base and forming small groups with the time.
Cephalium:	Ca. 7 cm high, 6.5 cm Ø, with white wool and numerous dark grey to black, up to 5 cm long, distinctly curved bristles.
Tubercles:	Arranged in 14 spirals, round, flattened, 1.5 cm high x up to 3.5 cm wide.
Areoles:	Oval, up to 15mm long x 7 mm wide, first covered with whitish felt, later naked, somewhat sunken into the tubercle.
Spines:	5-8 radiating, ± terete, recurved, first dark to black-brown, later on becoming grey: 1 descending, 4.5-5 cm long, and 4-7 spreading laterally, descending to ascending, 2-3.5 cm long, additionally sometimes 1 porrect central spine in the upper part of the areole, 3-3.5 cm long.
Flowers:	Several appearing simultaneously from the centre of the cephalic zone on mature specimens, scentless, white, with an elongated, slender tube with rather few spreading perianth segments, funnellform, 5.5 cm long, 3.5 cm Ø.
Fruits:	Clavate, 3-4 cm long, 5-9 mm Ø, with persistent floral remnant, whitish, dehiscent lengthwise at the side.
Seeds:	Globose to helmet-shaped, 1.5 mm long and wide, surface shining black, with short, mamillalike tubercles.
<b>Trade:</b>	<i>D. ferricola</i> is reported from the surroundings of Corumba in the Brazilian state of Mato Grosso and from Cerro Mutun on the Bolivian side of the border. It has been shipped repeatedly to Europe and USA by the trader Knize in Peru under the name <i>D. heptacanthus</i> (Braun 2001 in lit.). Generally, a considerable international trade in wild-collected <i>Discocactus</i> spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of <i>D. horstii</i> ), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. <i>Discocactus</i> spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation: None.
<b>Similar species:</b>	<i>D. ferricola</i> is morphologically quite well separated from the rest of the genus, has never been formally combined with another species and is now provisionally accepted as a good species (Hunt 1999). In Taylor (1981), it had been listed however under <i>D. heptacanthus</i> . The more or less spirally arranged tubercles, the acicular, curved, quite uniform and regularly radiating spines, the usually very long, curved bristles of the cephalium and the nearly naked flower tube are quite distinctive characters. However, there is some superficial similarity with the clustering <i>D. boliviensis</i> , which is treated under <i>D. heptacanthus</i> in Hunt (1999). <i>D. boliviensis</i> has notably fewer spines than <i>D. ferricola</i> . It shows the typical spine arrangement of <i>D. heptacanthus</i> with broad, flattened spines, the uppermost in the areole much weaker if present and also the characteristic shape of the tubercles. Immature specimens of <i>D. ferricola</i> , still lacking the cephalium, could be confounded with some of the coarsely spined species of the genus <i>Gymnocalycium</i> . Mature <i>Discocactus</i> of the “green” taxa in general could be confounded with mature <i>Melocactus</i> , the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
<b>Bibliography:</b>	Buining, A.F.H. (1980): The genus <i>Discocactus</i> Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2 <sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK. Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.). Taylor, N. P. (1981): Reconsolidation of <i>Discocactus</i> Pfeiff. In: The Cactus and Succulent Journal of Great Britain. Vol. 43 (2/3), p. 37-40.

# Discocactus heptacanthus ssp. catingicola

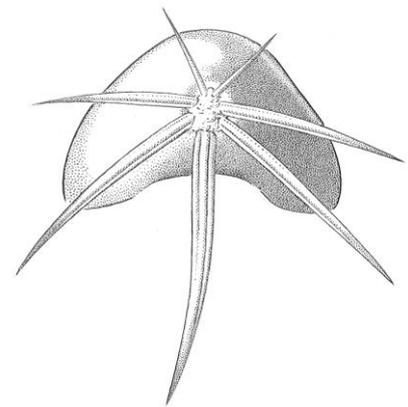
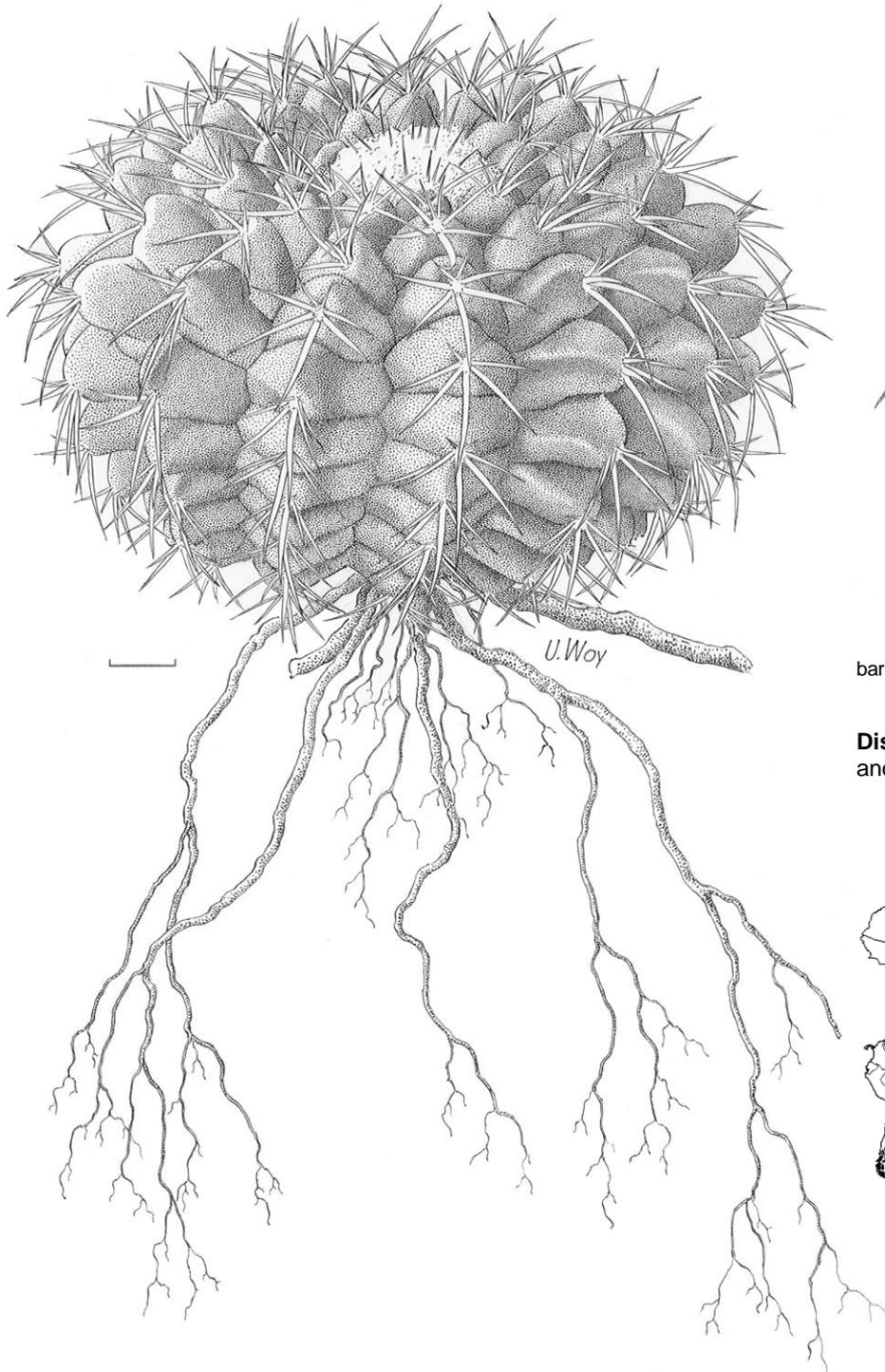
(Buin. & Bred.) N. P. Taylor & D. Zappi 1997



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** = *Discocactus catingicola* Buining & Brederoo 1974  
→ *Discocactus catingicola* var. *nigrisaetosus* (Buining & Brederoo) Braun & Esteves 1993  
= *Discocactus nigrisaetosus* Buining & Brederoo 1977  
→ *Discocactus piauiensis* Braun & Esteves 1995  
→ *Discocactus spinosior* Buining & Brederoo 1977

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1cm

**Distribution:** States of (W) Bahia, Piauí and Minas Gerais, Brazil.



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<b>Characteristics:</b>	Robust, flat-globular, middle-sized, pale green cactus, with ribs dissolved into large, broad, rounded tubercles. Bearing rather few but long and solid, curved spines, typically 5 strong lower (1 descending and 4 lateral) and 2-4 weaker upper, ascending ones. Spines quite protruding. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex, with a conspicuous amount of dark bristles (hence the name " <i>nigrisaetosus</i> ").
Roots:	Fibrous, long, ramified, from the centre of the stem base.
Stem:	Simple, flat-globular, 4-5 cm high (without cephalium), about 11-17 cm Ø, pale green ( <i>D. nigrisaetosus</i> up to 8.9 cm high and 20 cm Ø).
Cephalium:	Ca. 3-4.3 cm Ø and 2-4.9 cm high, with cream-coloured wool and ca. 3.5 cm long, light yellow, dark tipped bristles in the centre or dark brown bristles along the margin (in <i>D. nigrisaetosus</i> cephalium up to 7.5 cm Ø, bristles black-reddish, quite hard and 4-4.5 cm long, rising 2 cm above the wool).
Ribs:	(9-) 10-12, divided into flat, mamillalike tubercles.
Tubercles:	4-5 per rib, 2.2–3.5 cm wide at base (up to 4 cm in <i>D. nigrisaetosus</i> ), 1.5-2.5 cm protruding, connected by sinuses and forming ribs, but still quite independent, basally ± pentagonal, ascending.
Areoles:	Oval, 4-9 mm long and 3-7 mm wide, ± sunken into the tip of the tubercle, with white or light cream-coloured wool, later naked, 1.5-3 cm apart on the rib.
Spines	5 strong radials, straight to somewhat recurved, flattened, 1.25-2.8 mm broad at the base, sometimes twisted, partly notably protruding, first horn-coloured, later light to dark grey, the lower one descending, 3-4.2 cm long, 2 lateral pairs 2-3.8 cm long, directed ± sideways, 2-4 additional, weaker, ascending spines in the upper part of the areole, 1.0-1.2 cm long. Rarely 1 central spine (in <i>D. nigrisaetosus</i> and <i>D. spinosior</i> ), up to 2.0 cm long, porrect to ascending.
Flowers:	Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal and notably scented, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 5-7.6 cm long and up to 7 cm Ø.
Fruits:	Clavate, 4-4.5 cm long, 8-13 mm Ø, with persistent floral remnant, white, apically brownish white to pinkish, dehiscent lengthwise at the side.
Seeds:	Helmet-shaped, 1.5-2 mm long and wide, surface shining black, with mamillalike tubercles.
<b>Trade:</b>	<i>D. heptacanthus</i> ssp. <i>catingicola</i> is classified as vulnerable due to the fragmented nature of its distribution and small population size (Taylor & Zappi 2001). One sub-population ( <i>D. piawaiensis</i> ) is reported to occupy a small habitat in low numbers and to be seriously threatened (Braun 2001 in lit.). A considerable international trade in wild-collected <i>Discocactus</i> spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. The genus is generally not really popular with cactus collectors (with the exception of <i>D. horstii</i> ), and is not well represented in cultivation, for its need of more elevated temperatures in winter. Demand has been stimulated by the description of "new" species in the 1970s and 1980s. Nurseries registered for artificial propagation ( <i>D. catingicola</i> ): Germany P-DE-1001.
<b>Similar species:</b>	The species <i>D. heptacanthus</i> , as treated here (following Hunt 1999), is the most widely distributed in the genus and is quite variable, including many populations that have been described as separate taxa. These are mainly defined by geographical isolation and quantitative characters. <i>D. heptacanthus</i> is characterised by broadly rounded ribs that are conspicuously dissolved into relatively large, rather ascending tubercles. Ssp. <i>catingicola</i> can be confused with ssp. <i>magnimammus</i> , which has a higher number of ribs and shorter, terete spines and with ssp. <i>heptacanthus</i> , which has rather a lower number of less protruding spines, which lend it a less "spiny" habit. Ssp. <i>catingicola</i> further tends to be of a paler colour. Confusion could be with <i>D. bahiensis</i> ssp. <i>subviridigriseus</i> , which is quite similar in stem colour and spination, but has quite acute ribs. Further confusion could be with <i>D. ferricola</i> , which shows spirally arranged tubercles and more uniform, acicular spines. Immature specimens of <i>D. heptacanthus</i> , still lacking the cephalium, could even be confounded with some of the coarsely spined species of the genus <i>Gymnocalycium</i> . Mature <i>Discocactus</i> of the "green" taxa in general could be confounded with mature <i>Melocactus</i> , the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
<b>Bibliography:</b>	Buining, A.F.H. (1980): The genus <i>Discocactus</i> Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands Hunt, D. (1999): CITES Cactaceae Checklist, 2 <sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK. Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.). Taylor, N. P. (1981): Reconsolidation of <i>Discocactus</i> Pfeiff. In: The Cactus and Succulent Journal

Family Cactaceae

**Discocactus heptacanthus**  
**ssp. catingicola**

(Buin. & Bred.) N. P. Taylor & D. Zappi 1997



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of Great Britain. Vol. 43 (2/3), p. 37-40.  
Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

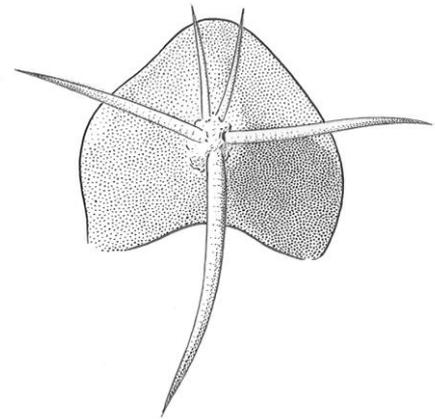
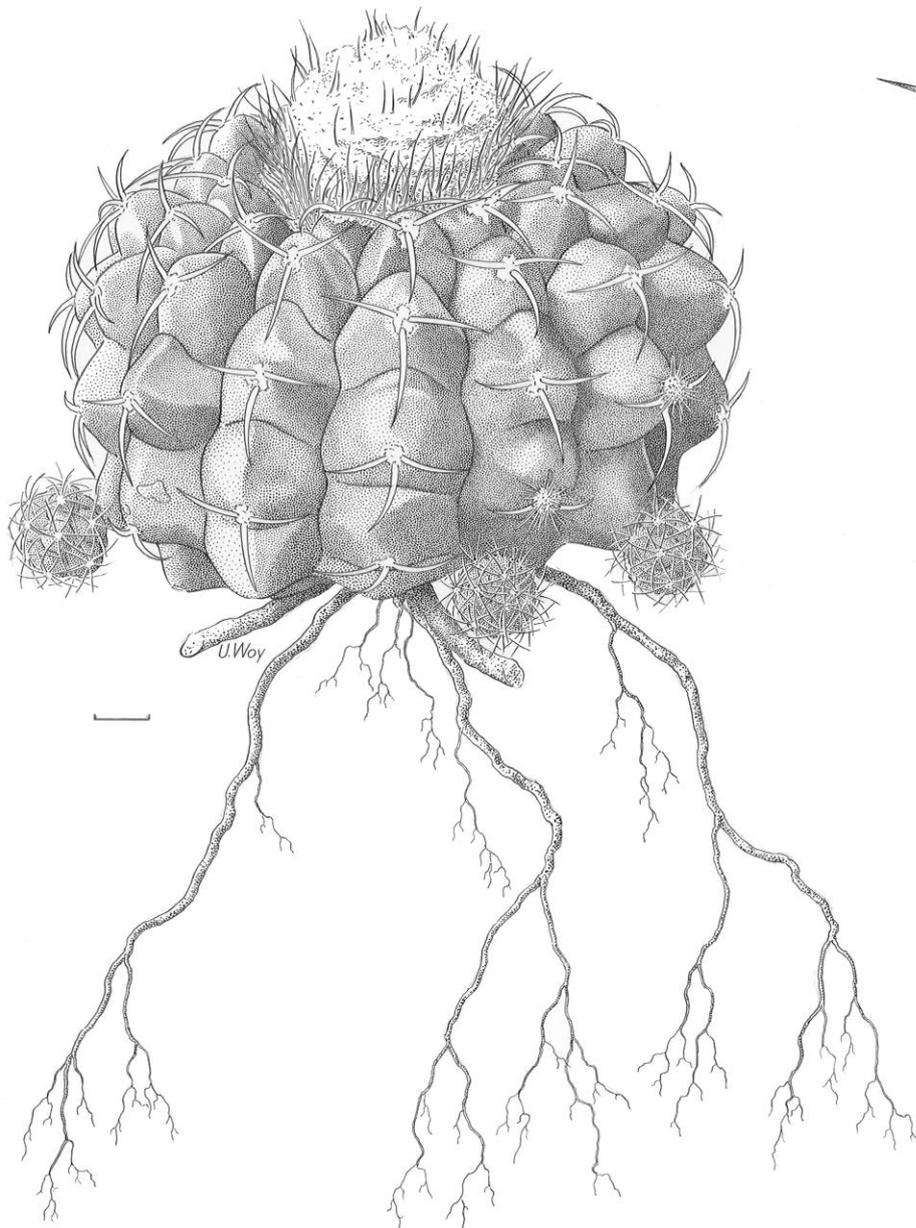
# Discocactus heptacanthus ssp. heptacanthus „boliviensis“



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific** *Discocactus boliviensis* Backeberg ex Buining et al. 1977

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** (Eastern) Bolivia.



**Characteristics:** Robust, flat-globular, middle-sized, green cactus, with ribs dissolved into large, broad, rounded tubercles. Bearing rather few but solid, curved spines, typically 3 strong lower (1 descending and 2 lateral) and 2 weak upper, ascending ones. Adult specimens with a white, woolly and bristly cephalic zone in the centre of the stem apex. Normally offsetting from the base, forming groups.

**Roots:** Fibrous, long, ramified, from the centre of the stem base.

**Stem:** Somewhat flat-globular, up to 15 cm high (without cephalium), 25-29 cm Ø, dark green with faintly bluish bloom.

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- Cephalium:** 2.5-7 cm high, 5.5-6 cm Ø, with white wool and long, yellow to brown bristles, especially around the margin.
- Ribs:** 12-13, divided into mamillalike tubercles in old specimens.
- Tubercles:** Normally 4 (-5) per rib, rounded, 3.5-4 cm wide x 3 cm long at base, to 2.5 cm protruding, first connected by sinuses and forming ribs, older plants with more independent, ± pentagonal tubercles.
- Areoles:** Oval, 8 mm long and 6 mm wide, ± sunken into the tip of the tubercle, with cream-coloured wool, becoming dark grey, later naked, 3-4.5 cm apart on the ribs.
- Spines:** Usually 3 strong, dagger-shaped radial spines, one descending, ca. 3.5 cm long and 2 ± horizontally spreading, opposed in a pair, ca. 2.7 cm long, recurved towards the stem. In the upper part of the areole 2 additional, thinner, straight spines, directed upwards, 1.6 cm long and additionally in older areoles up to 8 much smaller, spreading to ascending spines. Spines first horn-coloured, becoming light to dark grey to grey-black with age.
- Flowers:** Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal and notably scented, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 3.8-6 cm long, 4.3-5.5 cm Ø.
- Fruits:** Clavate, 2.8-3.0 cm long, up to 0.9 cm wide, with some narrow scales and persistent floral remnant, light brown red, dehiscent lengthwise at one side.
- Seeds:** Helmet-shaped, 1.7-2.2 mm long, 1.7-2 mm wide, surface shiny black with closely set mamillalike tubercles.
- Trade:** Reported from San Cyrilo, Bolivia, west of the road from Porto Suarez to Cerro Mutun, on the borders of Bolivia and Brazil, on and between slopes of a rocky terrain forming quite a large open area in a woody landscape. A considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. There are no specific records on trade in *D. boliviensis*. 2 specimens of *Discocactus* originating from Bolivia were reportedly reexported from neighbouring Peru to England in 1976-1977 and 101 specimens of *Discocactus*, which possibly contained *D. boliviensis*, have been exported 1978-83 from Peru to the United Kingdom and USA. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation (*D. boliviensis*): Germany P-DE-1002.
- Similar species:** The species *D. heptacanthus*, as treated here (following Hunt 1999), is the most widely distributed in the genus and is quite variable, including many populations that have been described as separate taxa. These are mainly defined by geographical isolation and quantitative characters. *D. heptacanthus* ssp. *heptacanthus* is characterized by broadly rounded ribs that are conspicuously dissolved into relatively large, rather ascending tubercles. It can be confused with ssp. *magnimammus*, which has a higher number of ribs and shorter, terete spines and with ssp. *catingicola*, which has rather a higher number of more protruding spines, which lend it a “spinier” habit. Specifically *D. boliviensis* could be confounded with the similarly clustering *D. ferricola*, which however shows spirally arranged tubercles and more uniform, acicular spines. Immature specimens of *D. heptacanthus*, still lacking the cephalium, could even be confounded with some of the coarsely spined species of the genus *Gymnocalycium*. Mature *Discocactus* of the “green” taxa in general could be confounded with mature *Melocactus*, the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
- Bibliography:** Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds - Succulenta, Venlo, Netherlands.  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. *Cact. and Succ. J (GB)* 43: 37-40.

# Discocactus heptacanthus ssp. heptacanthus „cephaliaciculosus“



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

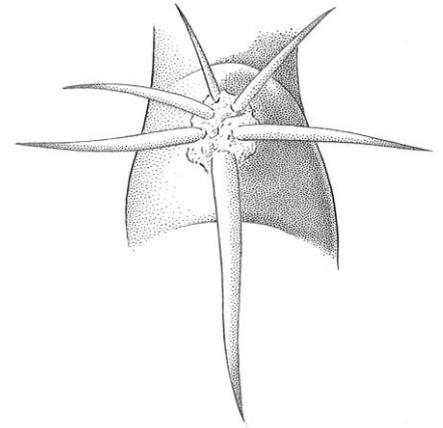
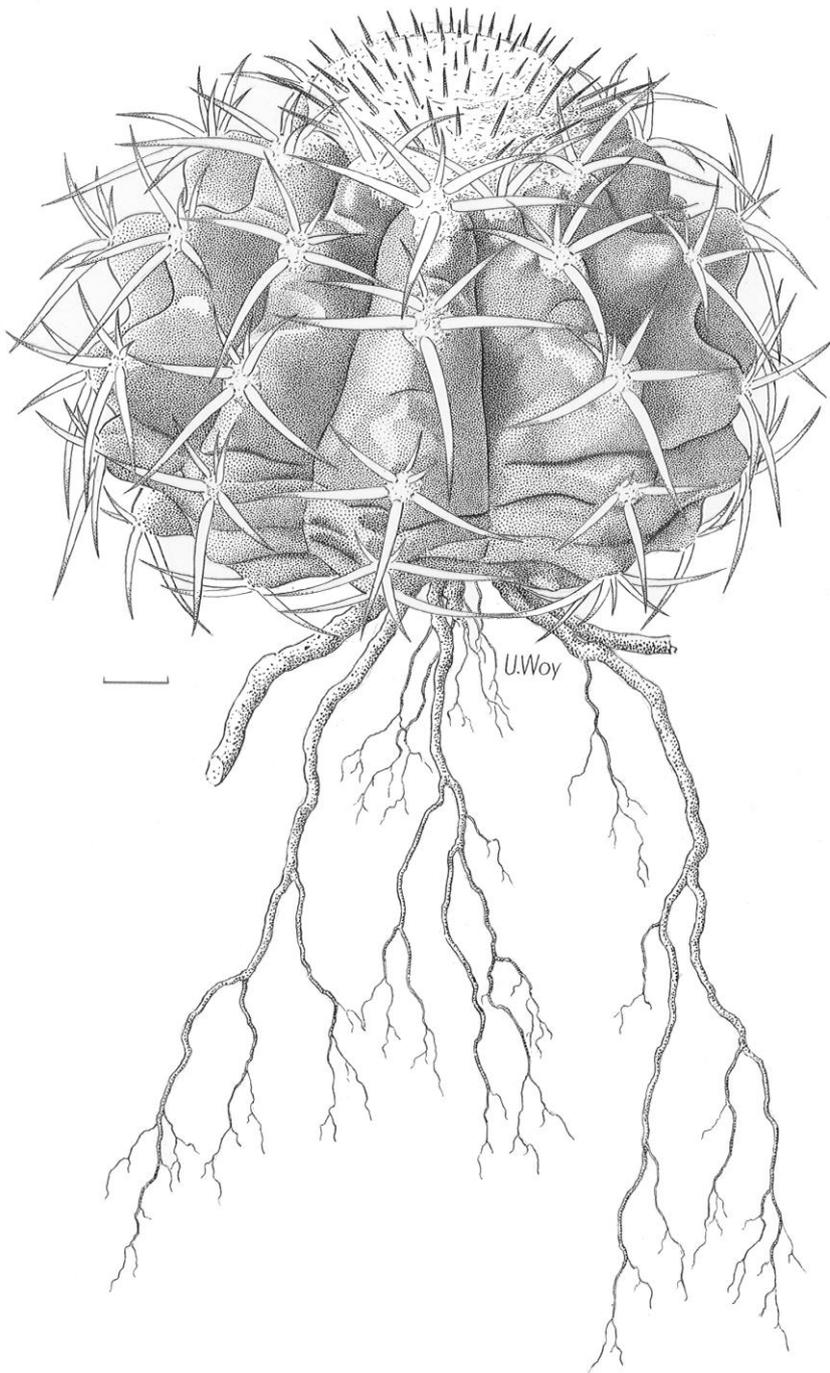
**Scientific synonyms:** *D. cephaliaciculosus* Buin. & Bred. 1975

= *D. cephaliaciculosus* Braun & Esteves 1995

→ *D. cephaliaciculosus* ssp. *nudicephalus* Braun & Esteves 1992 (nom. inval.)

= *D. cephaliaciculosus* ssp. *nudicephalus* Braun & Esteves 1995

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** State of Goiás, Brazil.



**Characteristics:** Robust, flat-globular, middle-sized, green cactus, with ribs dissolved into large, broad, rounded tubercles. Bearing rather few but solid, curved spines, typically 3-5 strong lower (1 descending and 2-4 lateral) and 1-3 shorter upper, ascending ones, sometimes with 1 porrect central spine. Adult

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- specimens with a whitish, woolly cephalic zone in the centre of the stem apex, typically containing numerous strong, dark red spines (hence the scientific name), looking like a pincushion.
- Roots:** Fibrous, long, ramified, from the centre of the stem base.
- Stem:** Somewhat flat-globular, up to 13 cm high (without cephalium), 20-26 cm Ø, green.
- Cephalium:** 0.5-3.5 cm high, 5-7 cm Ø, with white wool and typically with characteristic, single, strong, straight, dark red spines, extending up to 3 cm above the wool.
- Ribs:** 13-18, 3-5 cm high, divided into mamilla-like tubercles, separated by 1.5-2 cm deep notches.
- Tubercles:** 3-5 (-6) per rib (above the substrate), 2.5- 3 cm apart, rounded, lower ones 3-5 cm wide x 3 cm long at base, 3-5 cm protruding, upper ones 2.5-3.5 cm Ø at base, connected by sinuses and forming ribs, ± pentagonal, ascending.
- Areoles:** Oval, 12 mm long and 8-9 mm wide, ± sunken into the tip of the tubercle, with white wool, becoming naked.
- Spines:** Usually 3 (-5) strong, dagger-shaped radial spines, one descending, up to 3.7 cm long and 2 (-4) ± horizontally spreading, opposed in pairs, 2.4-3.3 cm long, 3-4 mm thick at the base, recurved towards the stem. In the upper part of the areole 1 strong, ascending spine, up to 2.4 cm long or 1-3 straight spines, 1.0-1.5 cm long, directed upwards. Sometimes 1 central spine, porrect, up to 2.5 cm long. Spines first light grey, later turning grey-black.
- Flowers:** Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal and notably scented, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 3.5-4.0 cm long, 3.0-3.2 cm Ø.
- Fruits:** Clavate, 2.5-3.5 cm long, up to 1.3 cm wide, with some narrow scales and persistent floral remnant, whitish, dehiscent lengthwise at one side.
- Seeds:** Helmet-shaped, 1.2 mm long and wide, dull black, covered with short tubercles.
- Trade:** Found between Rio Maranhão (Rio Tocantins) and Rio Parana. Only little trade in plants and seeds of this taxon is reported. *D. cephaliaciculosus* is reported to be safe, whereas *D. cephaliaciculosus* ssp. *nudicephalus* is known from a single, small habitat and is reported to be extremely threatened (Braun 2001 in lit.). Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation (*D. cephaliaciculosus*): Germany P-DE-1001.
- Similar species:** The species *D. heptacanthus*, as treated here (following Hunt 1999), is the most widely distributed in the genus and is quite variable, including many populations that have been described as separate taxa. These are mainly defined by geographical isolation and quantitative characters. *D. heptacanthus* ssp. *heptacanthus* (incl. *D. cephaliaciculosus*) is characterized by broadly rounded ribs that are conspicuously dissolved into relatively large, rather ascending tubercles. It can be confused with ssp. *magnimammus*, which has a higher number of ribs and shorter, terete spines and with ssp. *catingicola*, which has rather a higher number of more protruding spines, which lend it a “spinier” habit. Further confusion could be with *D. ferricola*, which shows similar, but spirally arranged tubercles and more uniform, acicular spines. The most distinctive feature of *D. cephaliaciculosus* are the robust spines of the cephalium, compared with bristles in other taxa, but this character is not always present (*D. cephaliaciculosus* ssp. *nudicephalus*), rendering identification quite problematical. Immature specimens of *D. heptacanthus*, still lacking the cephalium, could even be confounded with some of the coarsely spined species of the genus *Gymnocalycium*. Mature *Discocactus* of the “green” taxa in general could be confounded with mature *Melocactus*, the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
- Bibliography:** Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds - Succulenta, Venlo, Netherlands.  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. *Cact. and Succ. J (GB)* 43: 37-40.
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# Discocactus heptacanthus

## ssp. heptacanthus

(Rodr.) Britton &amp; Rose 1922



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

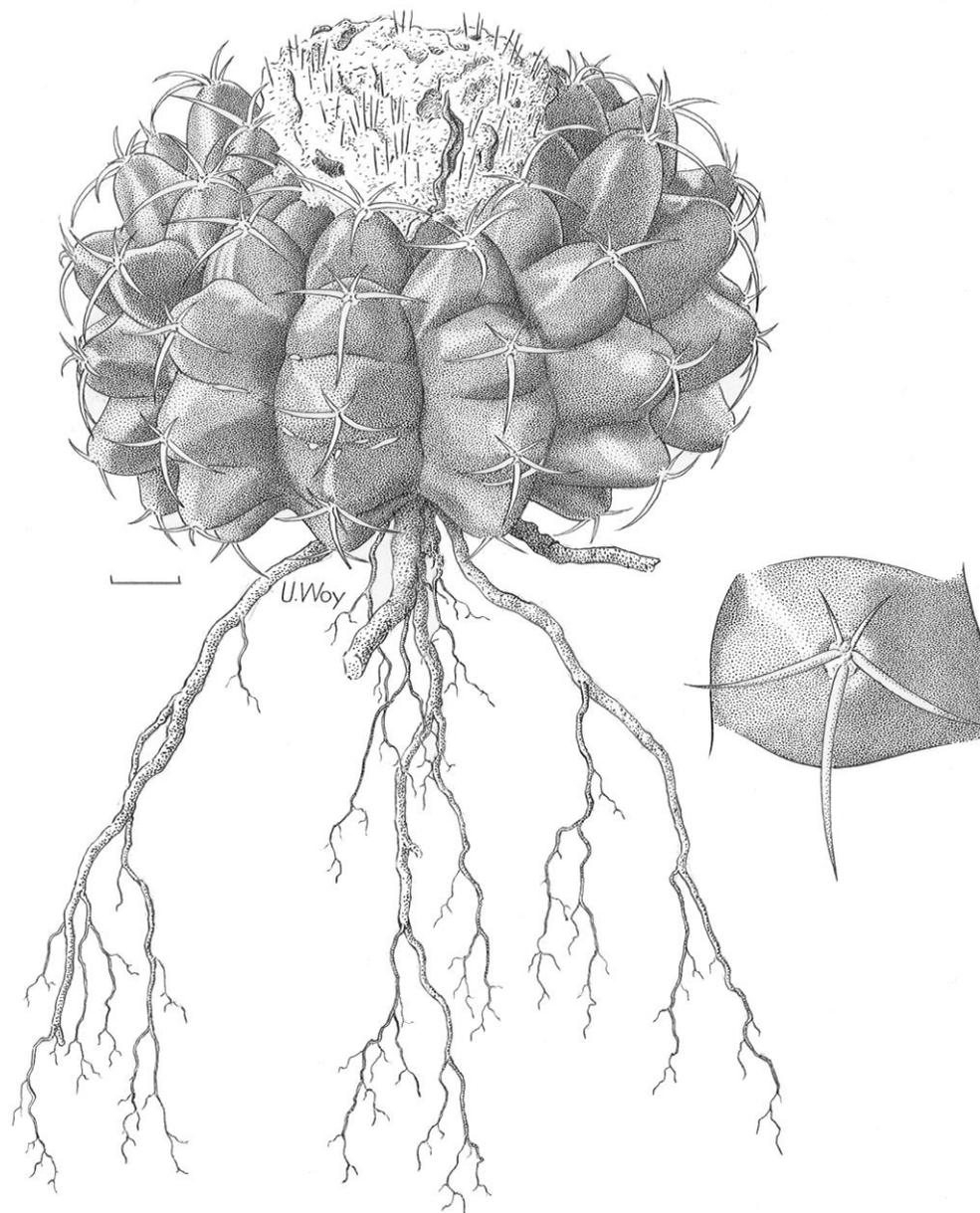
### Scientific synonyms:

- *D. cangaensis* Diers & Esteves 1980
- *D. crassispinus* Braun & Esteves 1994
- *D. crassispinus* ssp. *araguaiensis* Braun & Esteves 1996
- *D. diersianus* Esteves 1979
- *D. estevesii* Diers 1978
- *D. flavispinus* Buining & al. 1977
- *D. goianus* Diers & Esteves 1980
- = *D. diersianus* var. *goianus* (Diers & Esteves) Braun & Esteves 1993
- = *D. diersianus* ssp. *goianus* (Diers & Esteves) Braun & Esteves 1995
- *D. griseus* Buining & Bred. 1975
- = *D. catingicola* var. *griseus* (Buining & Bred.) Braun & Esteves 1993
- = *D. catingicola* ssp. *griseus* (Buining & Bred.) Braun & Esteves 1995
- *D. hartmannii* ssp. *setosiflorus* Braun & Esteves 1994
- *D. melanochlorus* Buining & al. 1977
- = *D. heptacanthus* ssp. *melanochlorus* (Buin. & Bred.) Braun & Esteves 1993
- *D. lindianus* Diers & Esteves 1981
- = *D. lindianus* Diers & Esteves
- *D. prominentigibbus* Diers & Esteves 1988
- *D. rapirhizus* Buining & Bred. 1975
- = *D. catingicola* ssp. *rapirhizus* (Buining & Bred.) Braun & Esteves 1993
- *D. semicampaniflorus* Buining & Bred. 1975
- = *D. heptacanthus* var. *semicampaniflorus* (Buining & Bred.) Braun & Esteves 1993
- *D. silvicola* Buin. & Bred. 1975
- *D. silvaticus* Buining & al. 1977
- *D. squamibaccatus* Buining & al. 1977
- *D. squamibaccatus* var. *longiflorus* Braun & Esteves 1998 (nom. Inval.)
- *D. subterraneo-proliferans* Diers & Esteves 1980
- *D. heptacanthus* var. *riomortensis* Braun & Esteves 1998 (nom. Inval.)

### Separately treated:

- *D. boliviensis* Buining et. al. 1977
- *D. cephaliaciculosus* Buin. & Bred. 1975
- = *D. cephaliaciculosus* Braun & Esteves 1995
- *D. cephaliaciculosus* ssp. *nudicephalus* Braun & Esteves 1992 (nom. inval.)
- = *D. cephaliaciculosus* ssp. *nudicephalus* Braun & Esteves 1995

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



**Distribution:** States of Mato Grosso, Mato Grosso do Sul, Minas Gerais, Goiás, Tocantins, Brazil.



bar = 1 cm

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- Characteristics:** Robust, flat-globular, middle-sized, green cactus, with ribs dissolved into large, broad, rounded tubercles. Bearing rather few but solid, curved spines, typically 3-5 strong lower (1 descending and 2-4 lateral) and 2 weak upper, ascending ones. Adult specimens show a whitish, woolly and bristly cephalic zone in the centre of the stem apex. Old specimens sometimes offsetting from the base, or even forming underground shoots (*D. squamibaccatus*, *D. subterraneo-proliferans*).
- Roots:** Fibrous, long, ramified, from the centre of the stem base.
- Stem:** Somewhat flat-globular, up to 15 cm high (without cephalium), 20-25 cm Ø, dark (olive-) green with faintly bluish bloom or dull greyish-green.
- Cephalium:** (0.3-) 2.5-7 cm high, (2.5-) 5.5-6 cm Ø, with white wool and long, dark to black-brown bristles, especially around the margin, which surmount the wool by 2-3 cm.
- Ribs:** 9-13, divided into mamilla-like tubercles.
- Tubercles:** Normally 4 (-6) per rib (3-4 per rib in *D. squamibaccatus*, 5-6 per rib *D. silvaticus*). Rounded, (2-) 3.5-4 cm wide x 3 cm long at base, to 2.5 cm protruding, connected by sinuses and forming ribs, but still quite independent, basally ± pentagonal, often ascending.
- Areoles:** Oval, (7-) 8-12 mm long and (5-) 6-9 mm wide, ± sunken into the tip of the tubercle, with white or light cream-coloured wool, becoming dark grey, later naked, 2.5-4.5 cm apart on the rib.
- Spines:** Usually 3 (-5) strong, dagger-shaped radial spines, one descending and 2 (-4) ± horizontally spreading, opposed in pairs, ca. 2.7- 3.5 cm long, 3-4 mm thick at the base, recurved towards the stem. In the upper part of the areole (1-) 2 (-3) additional, much thinner, straight spines, directed upwards, 1.6 cm long. Spines first horn-coloured, pale yellow to white or light brown to flesh-coloured with dark brown tip, becoming light to dark grey to grey-black to brown with darker transverse bands and tips with age.
- Flowers:** Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal and notably scented, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 3.8-6 (-7) cm long, (3-) 4.3-5.5 cm Ø.
- Fruits:** Clavate, 2.5-3.5 cm long, up to 1.3 cm wide, with some narrow scales and persistent floral remnant, whitish to light brown-red, dehiscent lengthwise at one side.
- Seeds:** Helmet-shaped, 1.1-2.2 mm long, 1.1-2 mm wide, surface shiny black with closely set mamillalike tubercles. (blunt tubercles in *D. squamibaccatus*).
- Trade:** Most sub-populations are small and thus very vulnerable (Machado 1999 in lit.) and some are reported to be extinct or strongly impacted by agriculture and habitat destruction as well as immoderate collecting in some cases (Braun 2001 in lit.): *D. subterraneo-proliferans* is reported to be extinct and *D. cangaensis*, *D. crassispinus* ssp. *araguaiensis*, *D. diersianus* ssp. *goianus*, *D. estevesii*, *D. hartmannii* ssp. *patuliflorus*, *D. pachythele*, *D. prominentigibbus* and *D. squamibaccatus* are all reported to be nearly extinct. A considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*) and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation of *D. heptacanthus* in a broad sense: Germany P-DE-1001 (*D. heptacanthus*, *D. catingicola*, *D. cephaliaciculosus*, *D. estevesii*, *D. hartmannii*, *D. pachythele*, *D. silicicola*), P-DE-1002 (*D. boliviensis*).
- Similar species:** The species *D. heptacanthus*, as treated here (following Hunt 1999), is the most widely distributed in the genus and is quite variable, including many populations that have been described as separate taxa. These are mainly defined by geographical isolation and quantitative characters. *D. heptacanthus* ssp. *heptacanthus* is characterized by broadly rounded ribs that are conspicuously dissolved into relatively large, rather ascending tubercles. It can be confused with ssp. *magnimammus*, which has a higher number of ribs and shorter, terete spines and with ssp. *catingicola*, which has rather a higher number of more protruding spines, which lend it a “spiniar” habit. Further confusion could be with *D. ferricola*, which shows similar, but spirally arranged tubercles and more uniform, acicular spines. Immature specimens of *D. heptacanthus*, still lacking the cephalium, could even be confounded with some of the coarsely spined species of the genus *Gymnocalycium*. Mature *Discocactus* of the “green” taxa in general could be confounded with mature *Melocactus*, the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
- Bibliography:** Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds - Succulenta, Venlo, Netherlands.  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. Cact. and Succ. J (GB) 43: 37-40.
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# Discocactus heptacanthus ssp. magnimammus

(Buin. & Bred.) N. P. Taylor & D. Zappi 1991

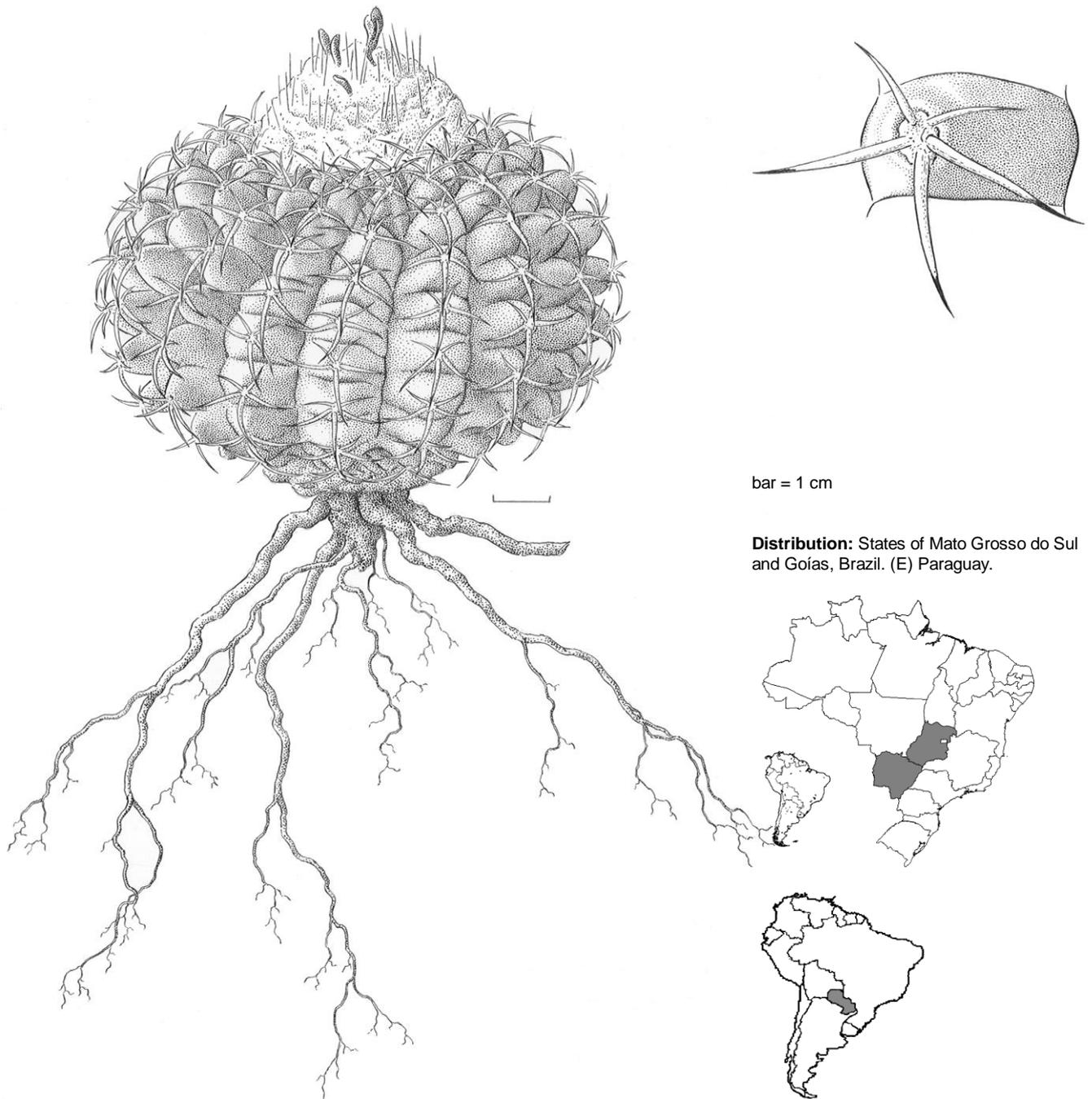


**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:**

- = *Discocactus magnimammus* Buining & Brederoo 1974
- = *Discocactus hartmannii* var. *magnimammus* (Buining & Brederoo) P. J. Braun 1984
- = *Discocactus hartmannii* ssp. *magnimammus* (Buining & Brederoo) Braun & Esteves 1995
- *Discocactus hartmannii* (K. Schumann) Britton & Rose 1922
- *Discocactus hartmannii* ssp. *giganteus* Braun & Esteves 1996
- *Discocactus mamillosus* Buining & Brederoo 1974
- = *Discocactus hartmannii* var. *mamillosus* (Buining & Brederoo) P. J. Braun 1984
- *Discocactus patulifolius* Buining & Brederoo 1974
- = *Discocactus hartmannii* var. *patulifolius* (Buining & Brederoo) P. J. Braun 1984
- = *Discocactus hartmannii* ssp. *patulifolius* (Buining & Brederoo) Braun & Esteves 1995
- *Discocactus pachytele* Buining & Brederoo 1975
- *Discocactus magnimammus* ssp. *bonitoensis* Buining & Brederoo 1977
- = *Discocactus hartmannii* var. *bonitoensis* (Buining & Brederoo) P. J. Braun 1984

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** States of Mato Grosso do Sul and Goiás, Brazil. (E) Paraguay.

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<b>Characteristics:</b>	Robust, (flat-) globular, middle-sized, shiny green, tuberculate cactus with notably ascending, relatively small, well pronounced tubercles, densely arranged in numerous ribs, and rather few and short spines. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex.
Roots:	Fibrous, ramified, from the centre of the stem base, quite long (>50 cm).
Stem:	Simple, flat-globular to globular, 4-9 cm high (without cephalium), 15-22 cm Ø, shiny green to dark green.
Cephalium:	2-3.5 cm high, 3-6 cm Ø, with greyish-white or white to cream-coloured wool and numerous brown bristles, especially along the margin, rising 2-2.5 cm above the wool.
Ribs:	13-16 (-22 in <i>D. mamillosus</i> ), nearly completely broken up into tubercles.
Tubercles:	5-7 per rib, 1.2-2 cm apart, mamilla-like, densely arranged in vertical rows, with ± pentagonal base, ca. 1.8-2.5 wide x 1.3-2.5 cm long at base and 2.5 cm high, measured from between the ribs (11-12 mm high, measured from the transverse groove, separating the tubercles on the same rib).
Areoles:	Oval, 4-6 mm long, 2-4 mm wide, first covered with light greyish felt, soon becoming naked, somewhat sunken into the apices of the tubercles. Areoles may die off gradually and lose the spine cushion.
Spines:	3 (-5) radial spines 0.5-1.5 mm thick, terete, ± recurved towards the stem, 1 descending, 16-20 mm long, 2 (-4) ± horizontally spreading, opposed in pairs, 10-20 mm long, first yellowish to bright brown or light greyish-brown to light horn-coloured, later turning grey, often with a darker tip. In the upper part of the areole one or few weaker, ascending, straight additional spines, 3-5 (-15) mm long. A single ascending central spine, ca. 1 cm long, may occur.
Flowers:	Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal and strongly scented, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, ca. 7 (-11 in <i>D. pachytele</i> ) cm long, 4.2-5.5 (-7 in <i>D. pachytele</i> ) cm Ø.
Fruits:	Clavate, 2.8-4 cm long, 0.7-1 cm wide, with some narrow scales and persistent floral remnant, visible part above wool light pink or reddish to cream-coloured or green-brown, lower part white, the ripe fruit dehiscent lengthwise at one side.
Seeds:	Helmet-shaped to globose, about 1.8 mm long, 1.5-1.8 mm wide, surface shining black, with mamillalike, closely set tubercles.
<b>Trade:</b>	Up to the Appendix I-listing in 1992, 24 shipments with 189 plants have been reported in international trade. Some sub-populations are reported to be threatened (Braun 2001 in lit.): <i>D. hartmannii</i> ssp. <i>patuliflorus</i> was heavily collected in the 1960s and early 1970s; it is nearly extinct today because of conversion of habitats into pastures. <i>D. pachytele</i> is nearly extinct and has been rediscovered in a single locality in 1988. Generally a considerable international trade in wild-collected <i>Discocactus</i> spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is not really popular with cactus collectors (with the exception of <i>D. horstii</i> ), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in "cephalic cacti" create a certain demand, which has been much stimulated by the description of "new species" in the 1970s and 1980s. <i>Discocactus</i> spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation ( <i>hartmannii</i> , <i>D. pachytele</i> ): Germany P-DE-1001.
<b>Similar species:</b>	The species <i>D. heptacanthus</i> , as treated here (following Hunt 1999), is the most widely distributed in the genus and is quite variable, including many populations that have been described as separate taxa. These are mainly defined by geographical isolation and quantitative characters. <i>D. heptacanthus</i> is characterised by broadly rounded ribs that are conspicuously dissolved into relatively large, rather ascending tubercles. Ssp. <i>magnimammus</i> is characterised by relatively numerous vertical ribs and pronounced tubercles, combined with rather short, thin, terete spines. Fully grown specimens are therefore quite well identifiable within the genus. Confusion might be with ssp. <i>heptacanthus</i> , which has a notably lower number of ribs and rather broad, flattened spines; or with ssp. <i>catingicola</i> , which is pale green and has a notably lower number of ribs and much longer spines. Maybe <i>D. ferricola</i> is a further candidate for confusion, but it has spirally arranged tubercles and much longer spines. Immature specimens however, that are still lacking the cephalium, could even be confounded with some of the coarsely spined species of the genus <i>Gymnocalycium</i> . Mature <i>Discocactus</i> of the "green" taxa in general could be confounded with mature <i>Melocactus</i> , the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
<b>Bibliography:</b>	Buining, A.F.H. (1980): The genus <i>Discocactus</i> Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands. Hunt, D. (1999): CITES Cactaceae Checklist, 2 <sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK. Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.). Taylor, N. P. (1981): Reconsolidation of <i>Discocactus</i> Pfeiff. In: The Cactus and Succulent Journal of Great Britain. Vol. 43 (2/3), p. 37-40.



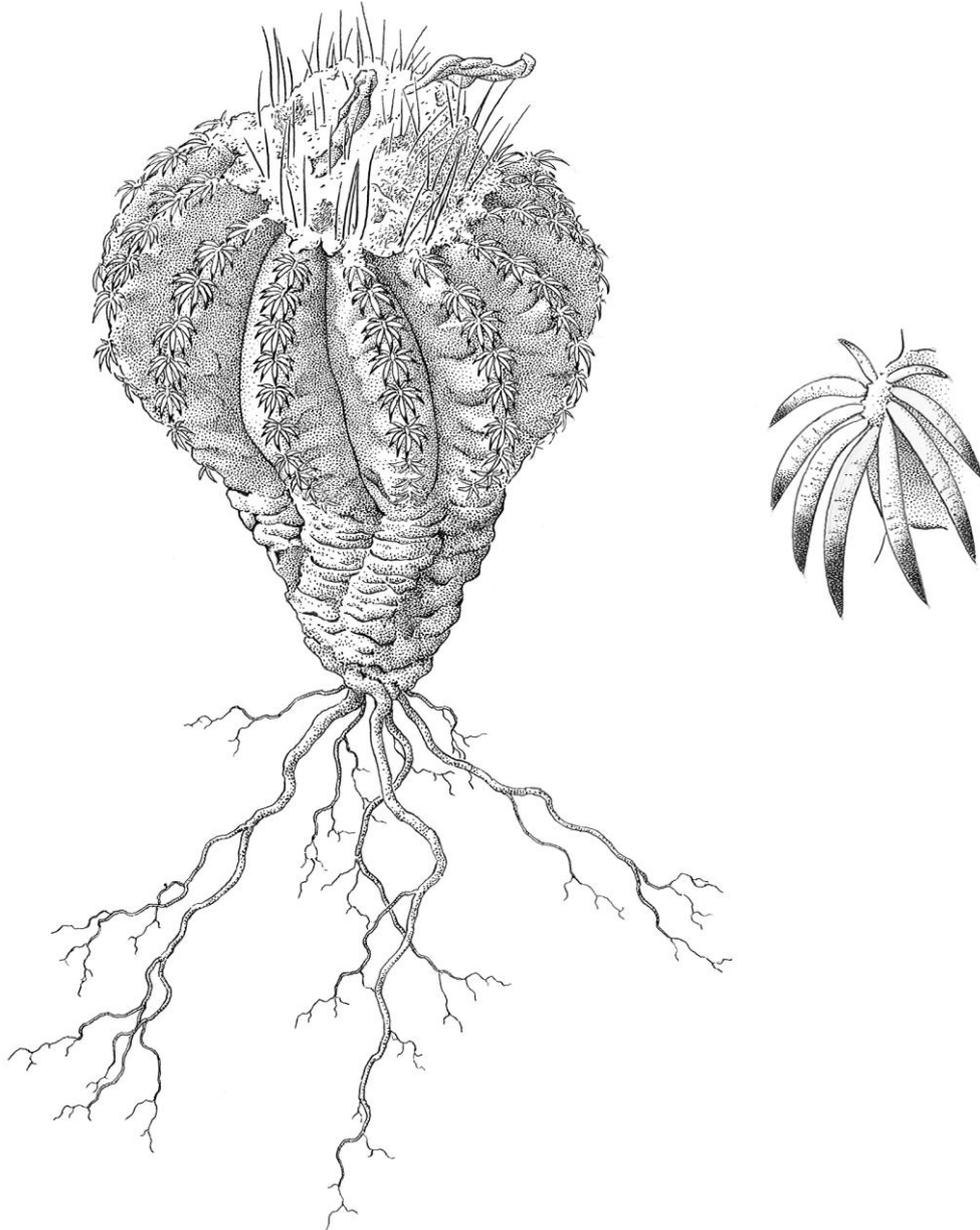
# Discocactus horstii

Buining &amp; Brederoo 1973

**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** →*Discocactus woutersianus* Brederoo & van den Broek 1980 is regarded as a natural hybrid between *D. horstii* and *D. pseudoinsignis*

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



**Characteristics:** Dwarf, cryptic, globular, finely and regularly ribbed cactus with a napiform stem base, deeply sunken in a coarse, white quartzite gravel in the habitat and barely emerging from the ground. Stem dark brownish, with short, flattened, whitish, non-pungent, appressed spines, blending with the substrate. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex. Morphologically outstanding within the genus.

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- Roots:** From the base of a rather long, napiform stem base.
- Stem:** Solitary, globular with a conspicuous napiform base, 3-4 (-7) cm Ø, up to 7 cm long, the globular stem apex up to 2-3 cm high, brown-green, distinctly and regularly ribbed.
- Cephalium:** 1.5 cm high, 2 cm Ø, with white wool and some brown, up to 2 cm long bristles and a few erect, thick, stiff spines, white with brown tips, up to 1 cm long, along the margin.
- Ribs:** 15-22, 0.6-0.8 cm high, narrow, roundish, flattened, with slightly sunken areoles.
- Areoles:** Oval, 1.5 mm long, 0.25 mm wide, first covered with white felt, soon becoming naked, 4-5 mm apart on the ribs.
- Spines:** (6-) 8-10 (-12), often with 1 descending and the remaining arranged in lateral pairs (pectinate), broadened and flattened, tapering, non-pungent, appressed and recurved, first black (but hidden in the apical wool), soon turning greyish white with "powdery" surface and dark tips, 3-3.5 mm long, 0.5 mm broad.
- Flowers:** From the centre of the cephalic zone on mature specimens, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnelform, 7.5 cm long, 6 cm Ø.
- Fruits:** Cylindric-clavate, ca. 3 cm long, up to 4 mm Ø, white, naked, with persistent floral remnant, the ripe fruit dehiscent lengthwise at one side.
- Seeds:** Helmet-shaped, 1-1.1 mm long, 0.9-1 mm wide, surface shiny black with mamillalike tubercles.

**Distribution:** State of Minas Gerais, Brazil.



**Trade:** Endemic species, for a long time known from a single population of very limited extent, in the Serra do Barao, Grão Mogol. Only recently a second population with abundant plants has been discovered (Machado 1999 in lit.). The original discovery of this dwarf *Discocactus* caused quite some sensation and demand was very high. This is certainly one of the heavily traded species of the genus. It is by far the most popular *Discocactus* in horticulture for its small size, decorative shape and fame of rarity and novelty and it is often found in collections, that otherwise have no "Brazilians". It is also the only easily identifiable species and has no synonyms. 907 plants originating from Brazil were reported in international trade prior to Appendix I-listing and 2'510 after listing. It is certain, that at least prior to Appendix I-listing, wild-collected specimens have been exported from Brazil, probably in high numbers. The originally known wild population was heavily ransacked by commercial collectors in the early 1970s (supporting statement of the App. I listing proposal, 1992). Mining of quartz crystals is another threat to the habitat. The mining activities destroyed part of the type locality (Machado 1999 in lit.). Both known localities are now protected in a local reserve with a warden living in the city of Grão Mogol (Nigel Taylor 2001 in lit.). Today, big numbers of artificially propagated specimens are in trade. They are usually grafted. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** None. The long, napiform stem base and the appressed, non-pungent spines are remarkable within the genus.

**Bibliography:** Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. In: The Cactus and Succulent Journal of Great Britain. Vol. 43 (2/3), p. 37-40.  
Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

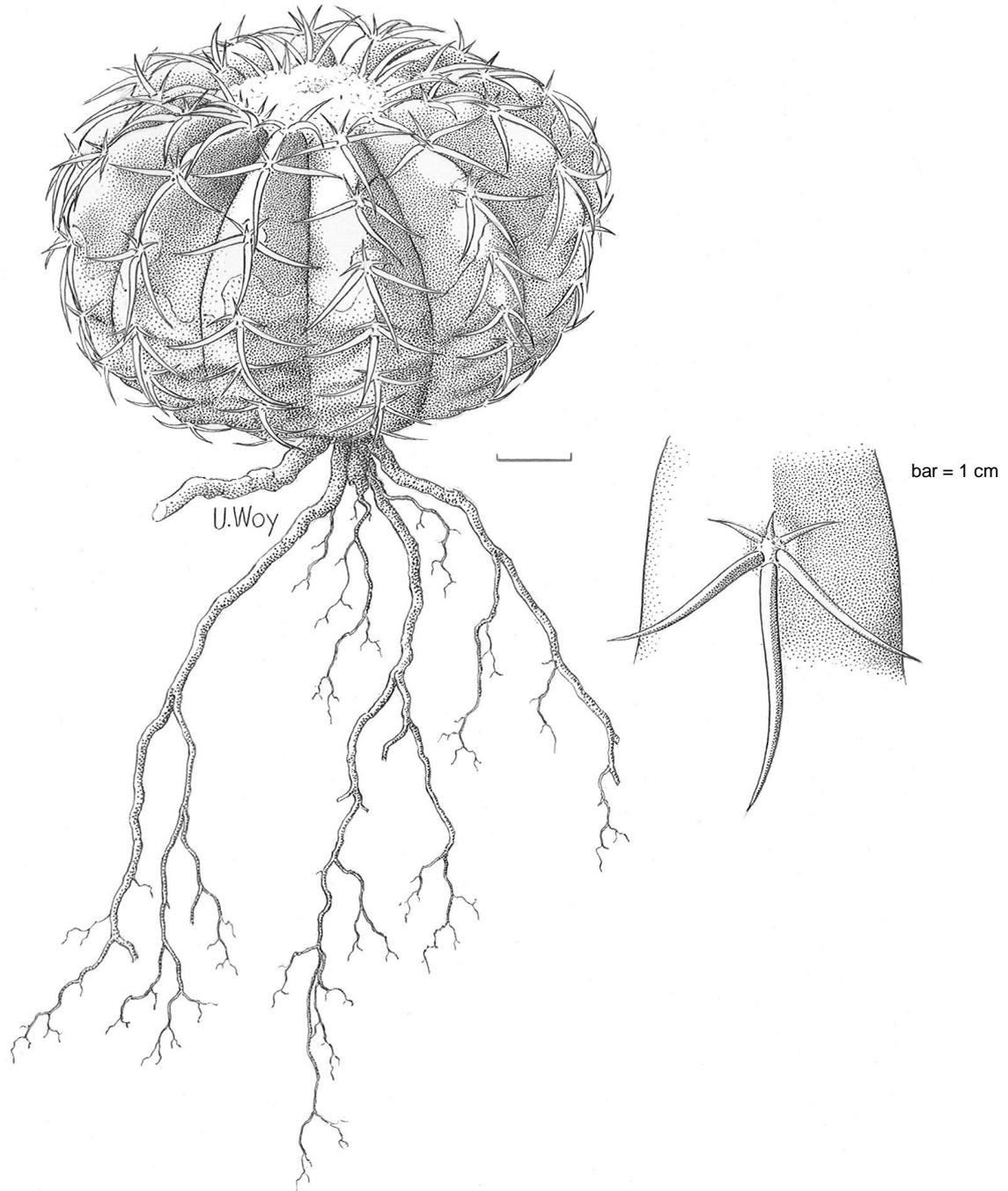
# Discocactus placentiformis „latispinus“



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** *D. latispinus* Buining & al. 1977  
→ *D. pseudolatispinus* Diers & Esteves 1987  
= *D. latispinus* ssp. *pseudolatispinus* (Diers & Esteves) Braun & Esteves 1993  
→ *D. pulvinicapitatus* Buining & Brederoo 1980  
= *D. latispinus* ssp. *pulvinicapitatus* (Buining & Brederoo) Braun & Esteves 1993

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



**Characteristics:** Flat, middle-sized, green, solitary, distinctly disc-shaped and ribbed cactus with strong, notably broad and flattened, spreading and recurved, often grooved spines. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex.

Roots:	Fibrous, long, ramified, from the centre of the stem base.
Stem:	Flat-globular, 7-8 cm high (without cephalium) and 22-25 cm Ø, light to dull to dark green.
Cephalium:	Up to 7 cm high, 7-10 cm Ø, with whitish or slightly grey wool and dark bristles (varying from dark red to dark brown), rising ca. 1.5-2.5 cm above the wool (up to 3.5 cm in <i>D. pulvinicapitatus</i> ).
Ribs:	Up to 20 (in <i>D. latispinus</i> ), usually only very slightly divided into tubercles, almost level between the areoles, to 4 cm wide and 3 cm high.
Areoles:	Up to 7 per rib (in <i>D. pulvinicapitatus</i> ), 1.2-2 (-2.5) cm apart on the ribs, ± round, 7-15 mm long x 7-12 mm wide, first with light-grey or yellowish to light-brown wool, soon naked, somewhat sunken into the rib.
Spines:	3-5 radial spines, first black (to red) to horn-coloured, later grey, partly with darker transverse bands and tip, distinctively broad and flattened, sometimes longitudinally furrowed, spreading to appressed, recurved, 1 descending, 4 mm broad and 35-45 mm long, 1 (-2) pair(s) laterally radiating, the lower pair slightly descending to horizontal, 10-30 mm long, the upper pair (if present) slightly ascending, 13-20 mm long and only 1.5 mm broad. Sometimes a porrect central spine in the upper part of the areole, 15-20 mm long and 1-3 weaker additional secondary spines, ascending, 5-17 mm long.
Flowers:	Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 4.5-7.5 cm long and 3.6-5.6 cm Ø.
Fruits:	Clavate, 3-4 cm long, 6-8 mm Ø, with persistent floral remnant, whitish to white, dehiscent lengthwise at the side.
Seeds:	Helmet-shaped, 1.2-2 mm long, 1-2 mm wide, surface shining black, with mamillalike tubercles.

**Distribution:** State of Minas Gerais, Brazil.



**Trade:** The large-stemmed, many-ribbed, thick-spined form of *D. placentiformis*, treated here as “*latispinus*”, is reported from the western slopes of the Serra do Espinhaço and from the Serra do Cabral and northwards (Taylor & Zappi 2001). Specifically *D. latispinus* is reported from the Serra do Cabral, *D. pulvinicapitatus* from near the Rio Jequitau. Machado (2000, in lit.) reports one population of *D. latispinus* to comprise no more than ca. 300 individuals; one population of *D. pulvinicapitatus* is estimated at several thousand plants, occurring over a vast area of several hundred hectares of rocky, unfarmable terrain with a high density. Between 1984 and 1985, 1'124 specimens have reportedly been exported from Brazil to Germany and the Netherlands. They have only partly been declared as artificially propagated and moreover, such declarations may have been incorrect. Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation: Germany P-DE-1001.

**Similar species:** *D. placentiformis*, as treated here (following Hunt 1999), includes various taxa. *D. latispinus* and *D. pulvinicapitatus* are described with notably bigger stems and cephalia than typical *D. placentiformis* and are therefore treated separately here. Taylor & Zappi (2001) state, that these two and *D. pseudolatispinus* are distinctive and may be worthy of recognition as one distinct subspecies. They are connected however to typical *D. placentiformis* by intermediate populations (*D. multicolorispinus*). They further point out, that the form described as *D. pugionacanthus* from Mun. Grão Mogol is also distinctive for its ± strongly tuberculate stem and could be mistaken for *D. heptacanthus* and that some plants from the region north of Diamantina superficially resemble *D. pseudoinsignis* in their spination. *D. pseudoinsignis* is in deed very similar with respect to the flattened and distinctly ribbed stem, but has narrower spines. *D. placentiformis* (in a broad sense) shows a similar general morphology and arrangement of spines like *D. heptacanthus*. It can be distinguished by quite distinctive ribs, that are usually only weakly dissolved into tubercles (exception cf. *D. multicolorispinus*, above). Further *D. bahiensis* has a ribbed stem, but usually distinctively narrower and more numerous spines. Immature specimens of *D. placentiformis*, still lacking the cephalium, could be confounded with some of the coarsely spined species of the genus *Gymnocalycium*. Mature *Discocactus* of the “green” taxa in general could be confounded with mature *Melocactus*, the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.

**Bibliography:** Buining, A.F.H. (1980): The genus DISCOCACTUS Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. In: The Cactus and Succulent Journal of Great Britain. Vol. 43 (2/3), p. 37-40.  
Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.



# Discocactus placentiformis

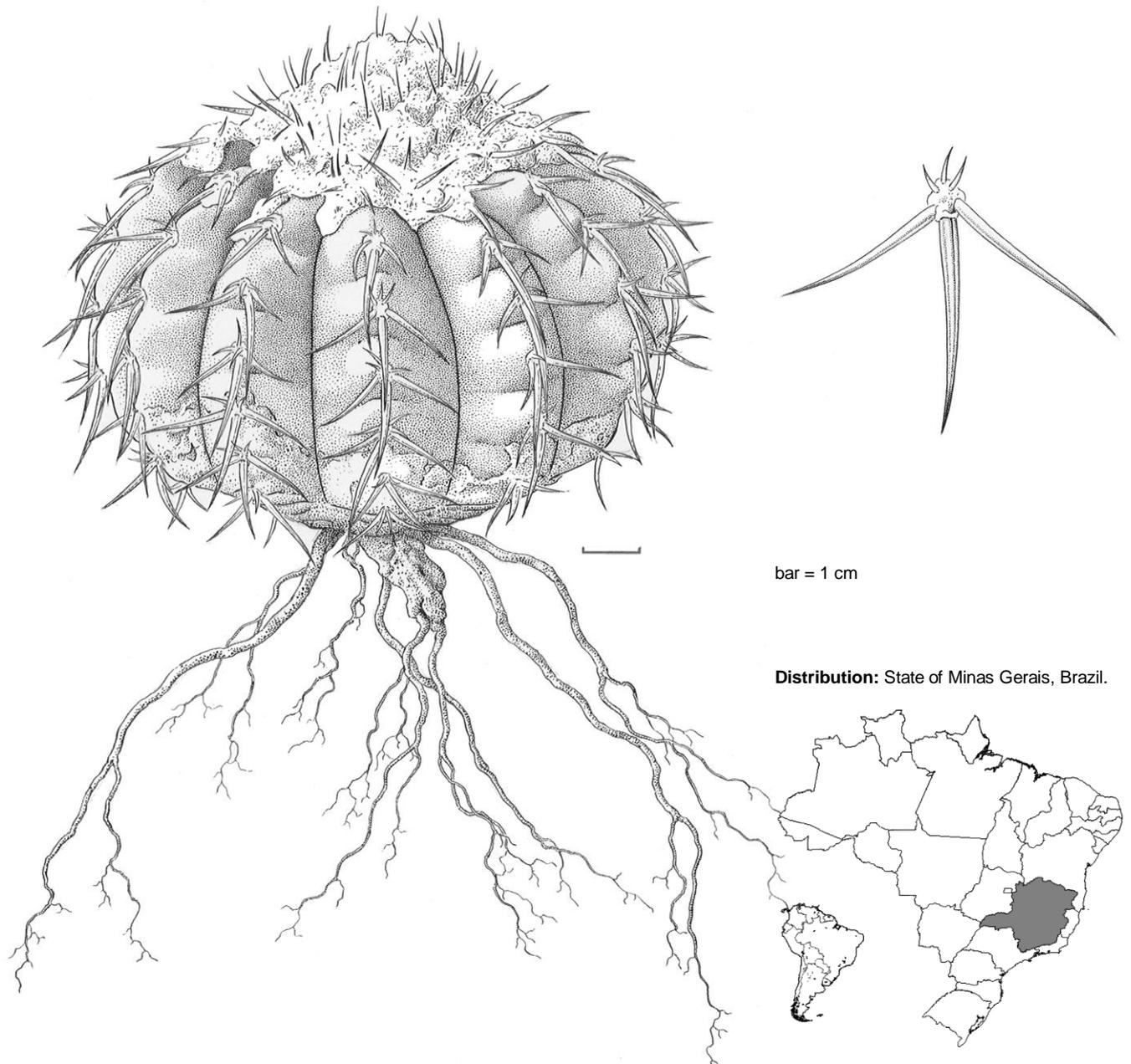
(Lehmann) K. Schumann 1894

**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:**

- *D. alteolens* Lemaire ex Dietrich 1846
- = *D. placentiformis* var. *alteolens* (Lemaire ex Dietrich) Braun & Esteves 1993
- = *D. placentiformis* ssp. *alteolens* (Lemaire ex Dietrich) Braun & Esteves 1995
- *D. crystallophilus* Diers & Esteves 1981
- *D. insignis* Pfeiffer 1837
- *D. lehmannii* Pfeiffer 1839 (nom. illeg.)
- *D. multicolorispinus* Braun & Brederoo 1981
- = *D. placentiformis* ssp. *multicolorispinus* (Braun & Brederoo) Braun & Esteves 1993
- *D. pugionacanthus* Buining & al. 1977
- = *D. placentiformis* var. *pugionacanthus* (Buining & Brederoo) Braun & Esteves 1993
- = *D. placentiformis* ssp. *pugionacanthus* (Buining & Brederoo) Braun & Esteves 1995
- *D. tricornis* Monville ex Pfeiffer 1843

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** State of Minas Gerais, Brazil.

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<b>Characteristics:</b>	Flat, middle-sized, green, solitary, distinctly disc-shaped and ribbed cactus with strong, notably broad and flattened, spreading and recurved, often grooved spines. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex.
Roots:	Fibrous, long, ramified, from the centre of the stem base.
Stem:	Flat-globular, 3-6 cm high (without cephalium), 12-17 cm Ø, light to dull to dark green.
Cephalium:	2.5-5 cm high, 4-6 cm Ø (7-10 cm Ø in <i>D. alteolens</i> sensu Buining 1980), with whitish or slightly grey wool and dark bristles (varying from dark red to dark brown), rising ca. 1.5-2.5 cm above the wool (up to 3.5 cm in <i>D. alteolens</i> sensu Buining 1980).
Ribs:	(11-) 12-15, usually only very slightly divided into tubercles, almost level between the areoles, 2.5-3.5 cm wide at the stem-base, 1.5-2.5 cm high.
Areoles:	3-5 per rib, 1.2-2 (-2.5) cm apart on the ribs, ± round, 7-15 mm long x 7-12 mm wide, first with light-grey or yellowish to light-brown wool, soon naked, somewhat sunken into the rib.
Spines:	3-5 radial spines, first black (to red) to horn-coloured, later grey, partly with darker transverse bands and tip, distinctively broad and flattened, sometimes longitudinally furrowed, spreading to appressed, recurved, 1 descending, 2-3 mm broad at the base, 15-32 mm long, 1 (-2) pair(s) laterally radiating, the lower pair slightly descending to horizontal, 10-30 mm long, the upper pair (if present) slightly ascending, 13-20 mm long and only 1.5 mm broad. Sometimes a porrect central spine in the upper part of the areole, 15-20 mm long and 1-3 weaker additional secondary spines, ascending, 5-17 mm long.
Flowers:	Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 4.5-7.5 cm long and 3.6-5.6 cm Ø.
Fruits:	Clavate, 3-4 cm long, 6-8 mm Ø, with persistent floral remnant, whitish to white, dehiscent lengthwise at the side.
Seeds:	Helmet-shaped, 1.2-2 mm long, 1-2 mm wide, surface shining black, with mamillalike tubercles.
<b>Trade:</b>	Endemic to central and northern Minas Gerais. About 15 sites have been reported up to 1992, holding between a few dozens to a few hundred plants each. Only one population of <i>D. placentiformis</i> in a strict sense is estimated at a few thousand individuals, two populations of <i>D. alteolens</i> are reported to comprise a few thousand plants each and one population of <i>D. pulvinicapitatus</i> (treated separately under "latispinus" here) is estimated at several thousand plants, occurring over a vast area of several hundred hectares of rocky, unfarmable terrain with a high density (Machado 2000 in lit.). Between 1984 and 1985, 1'124 specimens have reportedly been exported from Brazil to Germany and the Netherlands. They have only partly been declared as artificially propagated and moreover, such declarations may have been incorrect. Generally, a considerable international trade in wild-collected <i>Discocactus</i> spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of <i>D. horstii</i> ), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in "cephalic cacti" create a certain demand, which has been much stimulated by the description of "new species" in the 1970s and 1980s. <i>Discocactus</i> spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation: Germany P-DE-1001.
<b>Similar species:</b>	<i>D. placentiformis</i> , as treated here (following Hunt 1999), includes various taxa. <i>D. latispinus</i> and <i>D. pulvinicapitatus</i> are described with notably bigger stems and cephalia than typical <i>D. placentiformis</i> and are therefore treated separately here. Taylor & Zappi (2001) indicate, that they are connected however to typical <i>D. placentiformis</i> by intermediate populations ( <i>D. multicolorispinus</i> ). They further point out, that the form described as <i>D. pugionacanthus</i> from Mun. Grão Mogol is also distinctive for its ± strongly tuberculate stem and could be mistaken for <i>D. heptacanthus</i> and that some plants from the region north of Diamantina superficially resemble <i>D. pseudoinsignis</i> in their spination. <i>D. pseudoinsignis</i> is in deed very similar with respect to the flattened and distinctly ribbed stem, but has narrower spines. <i>D. placentiformis</i> (in a broad sense) shows a similar general morphology and arrangement of spines like <i>D. heptacanthus</i> . It can be distinguished by quite distinctive ribs, that are usually only weakly dissolved into tubercles (exception cf. <i>D. multicolorispinus</i> , above). Further <i>D. bahiensis</i> has a ribbed stem, but usually distinctively narrower and more numerous spines. Immature specimens of <i>D. placentiformis</i> , still lacking the cephalium, could be confounded with some of the coarsely spined species of the genus <i>Gymnocalycium</i> . Mature <i>Discocactus</i> of the "green" taxa in general could be confounded with mature <i>Melocactus</i> , the other mostly globular, cephalic cactus genus, which however has acute ribs and more numerous, but shorter cephalic bristles.
<b>Bibliography:</b>	Buining, A.F.H. (1980): The genus DISCOCACTUS Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands Hunt, D. (1999): CITES Cactaceae Checklist, 2 <sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK. Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.). Taylor, N. P. (1981): Reconsolidation of <i>Discocactus</i> Pfeiff. In: The Cactus and Succulent Journal of Great Britain. Vol. 43 (2/3), p. 37-40. Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.



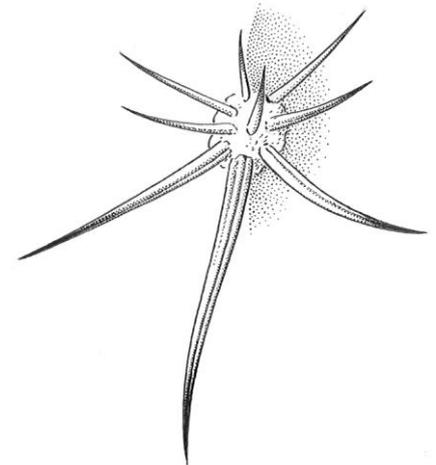
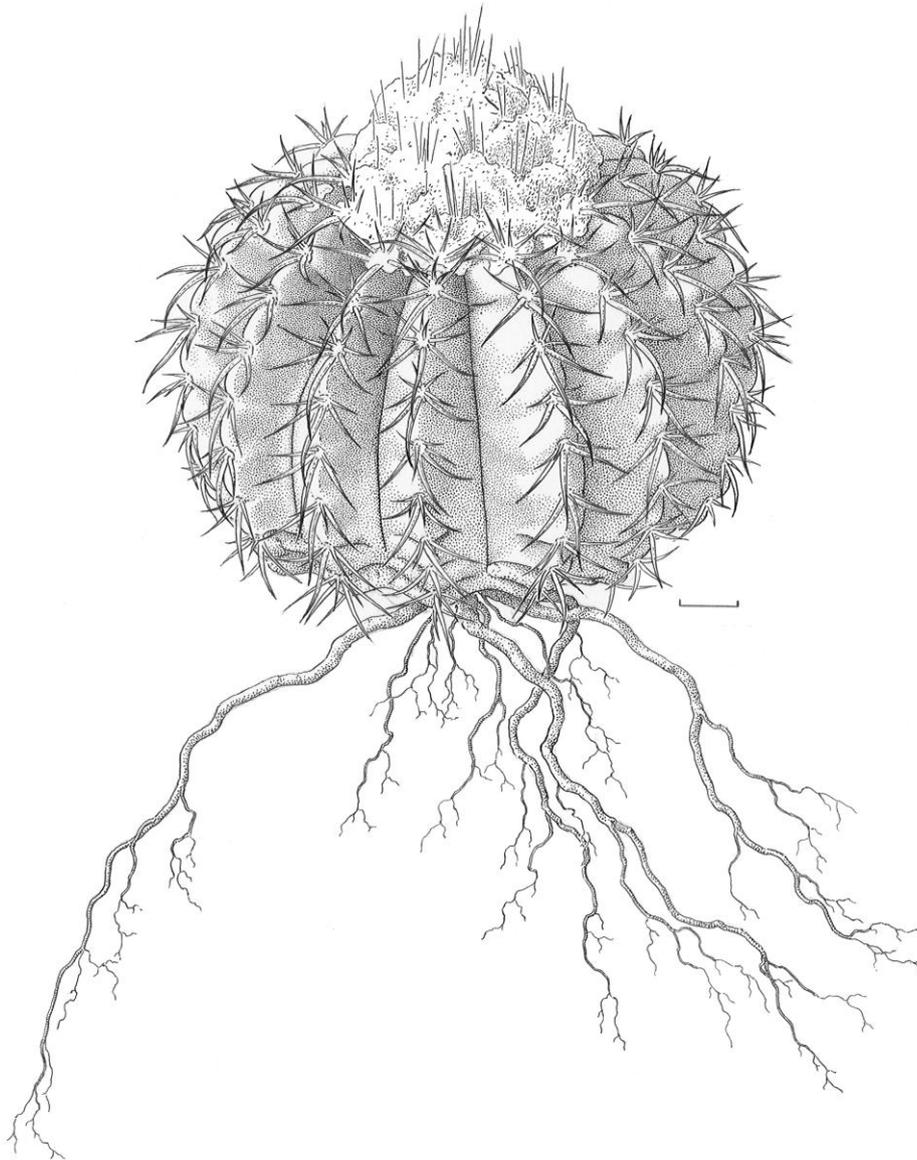
# Discocactus pseudoinsignis

N. P. Taylor &amp; D. Zappi 1991

**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** →*Discocactus insignis* Pfeiffer 1837 sensu Buining 1980

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** State of Minas Gerais, Brazil.



**Characteristics:**

Flat, middle-sized, green, solitary, distinctly disc-shaped and regularly ribbed cactus with rather weak and open spination, spines quite short, thin, acicular, slightly protruding. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex. Usually deeply buried in quartz sand in habitat and only the uppermost part of the stem emerging.

**Roots:** Fibrous, long, ramified, from the centre of the stem base (reported <1 m).

**Stem:** Solitary, flat-globular, up to 8 cm high, 21 cm Ø, light to pale green.

**Cephalium:** 5 cm high, up to 10 cm Ø, ± semi-globose, with white to light greyish wool and thin, dark brown bristles, rising above the wool up to 3.2 cm.

**Ribs:** 12-13, very regular, quite acute, in old specimens more rounded, straight and perpendicular, 4 cm wide at the base, 2.5 cm high, not dissolved into tubercles.

**Areoles:** 5-6 per rib, 10-12 mm apart, 4-5 mm Ø, first with whitish to yellowish felt, soon naked.

**Spines:** 5 radial spines, 1-1.5 mm Ø at the base, stiff, pungent, straight to somewhat curved, spread and characteristically slightly protruding, first black to dark-red, later grey with a darker tip, sometimes

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- longitudinally grooved above, 1 descending, 25-32 mm long, one pair lateral and slightly descending, 15-17 mm long, 1 pair lateral and ascending, notably shorter. 2-3 additional, secondary spines in the upper part of the areole, thin, straight, ascending, up to 10 mm long, sometimes one porrect central spine, ca. 10 mm long
- Flowers:** Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 4.5-7.5 cm long and 6 cm Ø.
- Fruits:** Clavate, 3.2-4.5 cm long, 5-9 mm Ø, with persistent floral remnant, white to slightly pinkish, dehiscent lengthwise at the side.
- Seeds:** Helmet-shaped, 1-1.4 mm long, 1 mm wide, 1.2-1.5 mm high, surface shining black, with mamillalike tubercles.
- Trade:** Local endemic of a small area near Grão Mogol, (about 20 km) with only 3-4 known populations of less than 100 individuals each. Recently reported to be probably underrecorded (Taylor & Zappi 2001); documented from six sites and the extent of occurrence estimated at 89 square kilometers. Restricted to quartzite sand. No international trade has been registered, but this may be related to problems with nomenclature. The taxon was collected in 1972 & 1974 and identified as *D. insignis* by Buining (1980). Subsequently, material came into cultivation. Taylor & Zappi (1991) disagree with Buining's identification and described a new species, *D. pseudoinsignis*. Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in "cephalic cacti" create a certain demand, which has been much stimulated by the description of "new species" in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. Nurseries registered for artificial propagation: Germany P-DE-1001.
- Similar species:** *D. pseudoinsignis* is rather distinctive, due to its pronounced ribs and short, acicular, protruding spines. In habitat, it is usually much more flattened than the cultivated specimen illustrated here and the stem base is buried in the substrate. It could first of all be confounded with *D. placentiformis* and falls within the geographical range of the latter. It however shows more pronounced, non-tuberculate ribs and distinctively more slender spines. However Taylor & Zappi (2001) point out, that some plants of the variable *D. placentiformis* from the region north of Diamantina superficially resemble *D. pseudoinsignis* in their spination. Immature specimens, still lacking the cephalium, could be confounded with some of the coarsely spined species of the genus *Gymnocalycium*. Mature *Discocactus* of the "green" taxa in general could be confounded with mature *Melocactus*, the other mostly globular, cephalic cactus genus. Especially *D. pseudoinsignis* could easily be confounded with a *Melocactus* for its pronounced ribs, it is specifically quite similar to *M. paucispinus*.
- Bibliography:** Buining, A.F.H. (1980): The genus DISCOCACTUS Pfeiffer. The Buining Fonds-Succulenta, Venlo, Netherlands  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
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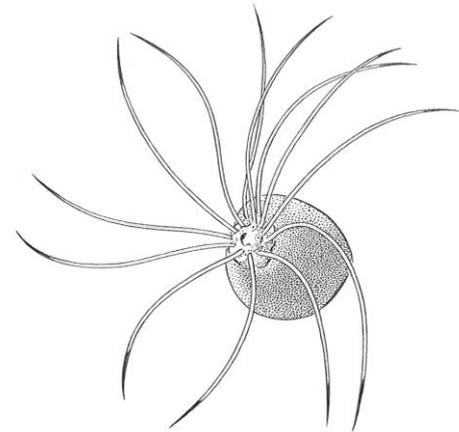
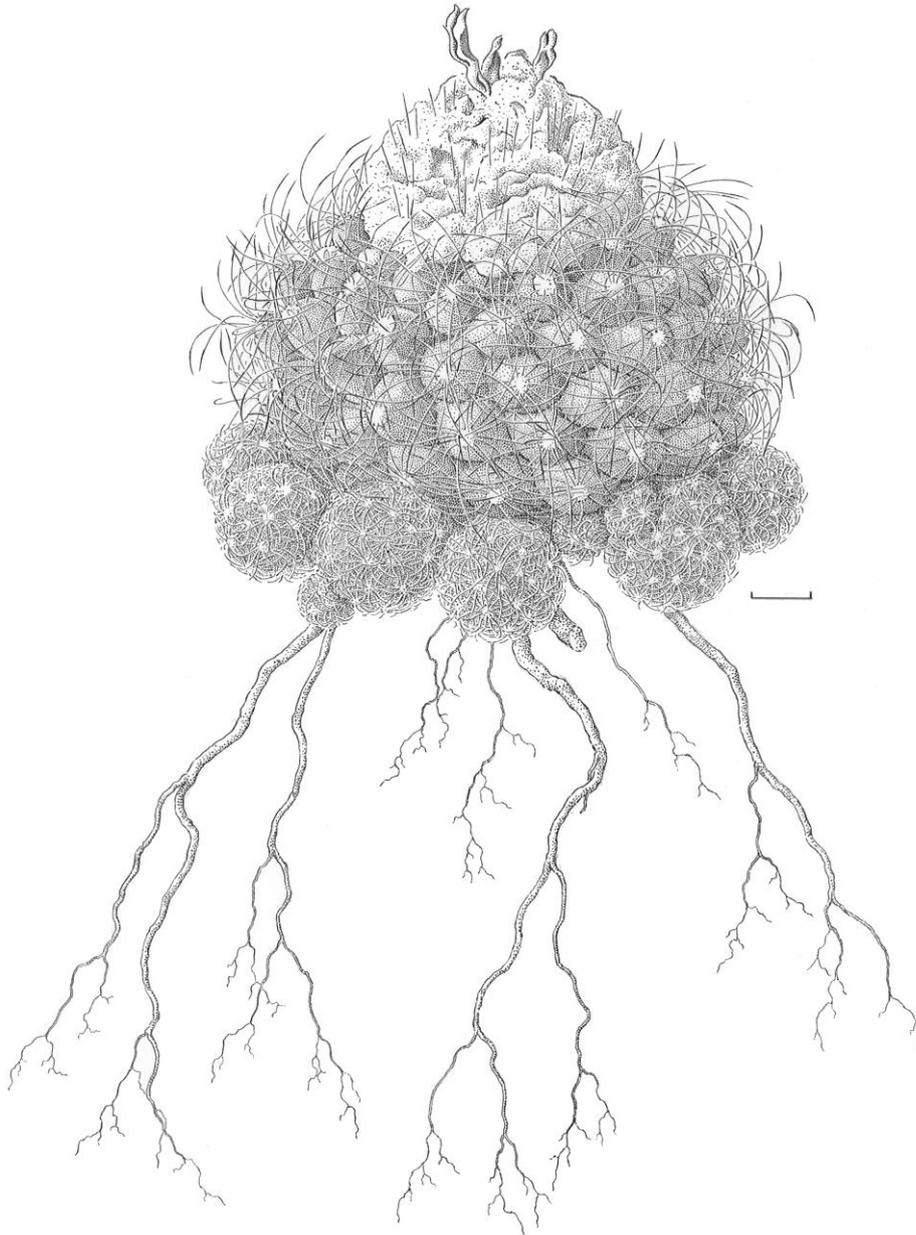
# Discocactus zehntneri ssp. boomianus „araneispinus“



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** *Discocactus araneispinus* Buining & Brederoo 1977  
= *Discocactus zehntneri* var. *araneispinus* (Buining & Brederoo) Braun 1990  
= *Discocactus zehntneri* ssp. *araneispinus* (Buining & Brederoo) Braun & Esteves 1995

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992.



bar = 1 cm

**Distribution:** State of Bahia, Brazil.



**Characteristics:** Small to medium sized, very distinctive, globular, tuberculate cactus, very densely covered with long, rather thin, strongly appressed, curved and interwoven spines. Normally proliferating around the base and forming small clusters. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex (the description given here excludes “boomianus”, “buenekeri” and “horstiorum”, which are treated separately).

**Roots:** Fibrous, long, ramified, from the centre of the stem base.

**Stem:** Flat globular, up to 6-7 cm high (without cephalium), up to 10-12 cm Ø, light to dark green, proliferating around the stem base (especially if grafted) and forming small clusters.

**Cephalium:** Up to 4.5 cm high, 3 cm Ø, with white wool and numerous long, slightly curved, erect, stiff bristles, especially around the margin, first yellowish, later greyish.

**Ribs:** Up to 21, helical, completely divided into mamillalike tubercles.

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Tubercles:	Nipple-shaped, rounded, 1-1.3 cm Ø at the base, 1.-1.1 cm long.
Areoles:	Ca. 6-7 per rib, ca. 0.7-0.8 cm apart, oval, 7 mm long, 3 mm wide, situated on or somewhat beneath the tip of the tubercle, first with conspicuous, short, cream-coloured wool, later naked.
Spines:	Obscuring the stem, rather thin, bristle-like, first yellowish, later greyish white with a darker tip. Ca. 13-16 radial spines, regularly radiating and strongly curved and interwoven, ± appressed, all ± equally ca. 2-3 cm long. Rarely 1 central spine, ascending to appressed, 3 cm long, slightly thicker than the radials.
Flowers:	Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 3.5-4 cm long and ca. 5.5 cm Ø.
Fruits:	Clavate, 3 cm long, 8-9 mm Ø, with persistent floral remnant, distinctively red with a lighter base, dehiscent lengthwise at the side.
Seeds:	Helmet-shaped, 0.8-1 mm long, 1 mm wide, surface shining black, with mamillalike tubercles.
<b>Trade:</b>	<i>D. zehntneri</i> ssp. <i>boomianus</i> (including “ <i>araneispinus</i> ”, “ <i>buenekeri</i> ” and “ <i>horstiorum</i> ”) is classified as vulnerable by Taylor & Zappi (2001), due to its fragmented habitat and being subject to collection. <i>D. araneispinus</i> is documented from a single site in the more easterly part of the Serra da Mimosa. Its commercial collection from the habitat is documented with a foto published in Buining (1980), that shows a pile of collected plants and bags, baskets and backpacks to be filled. Reported trade includes <i>D. araneispinus</i> under <i>D. boomianus</i> . It shows 3 major shipments originating from Brazil, after Appendix I-listing. 1994-1995, 600 specimens went to USA and 2'600 to the Netherlands. They were declared as artificially propagated, but reports on infractions show, that such declarations have not always been correct. No exports from Brazil have been reported prior to 1994. Generally, a considerable international trade in wild-collected <i>Discocactus</i> spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of <i>D. horstii</i> ), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. <i>Discocactus</i> spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. <i>D. zehntneri</i> ssp. <i>boomianus</i> and its allies can relatively easily be propagated by grafting a motherplant and then cutting off the numerous offsets. Nurseries registered for artificial propagation ( <i>D. araneispinus</i> ): None.
<b>Similar species:</b>	<i>Discocactus zehntneri</i> is very distinctive within the genus for its dense, white, interwoven spination and the rather small tubercles. The red fruits are an exclusive character. Probably <i>D. bahiensis</i> with its bigger ssp. <i>subviridigriseus</i> comes closest for its sometimes interwoven spination, but it shows a ribbed stem and less numerous spines (max. 9 radials, max. 3.5 cm long). <i>D. albispinus</i> is included here in <i>D. zehntneri</i> ssp. <i>zehntneri</i> , it is stated to differ by a bigger and less globose stem (Buining 1980) and has thicker tubercles, rather longer radial spines and often 1-2 very strong and long central spines. Several further taxa, namely <i>D. boomianus</i> , <i>D. araneispinus</i> , <i>D. buenekeri</i> and <i>D. zehntneri</i> var. <i>horstiorum</i> are all included here in <i>D. zehntneri</i> ssp. <i>boomianus</i> (following Hunt 1999). These taxa are all quite strongly proliferating from the base and usually forming small clusters. The stems are more depressed than globose to elongate as in ssp. <i>zehntneri</i> (Taylor & Zappi 2001). This classification however is based on rather weak characters and seems to be a bit arbitrary. <i>D. boomianus</i> is described with more ribs (16-20) and smaller tubercles (Ø 1cm) as well a shorter spines (ca. 3 cm) in comparison with ssp. <i>zehntneri</i> . <i>D. araneispinus</i> looks quite distinct, having even more ribs (to 21), small tubercles (Ø 1-1.3 cm) and more numerous (ca. 16), distinctively appressed, strongly curved, relatively thin and flexible, short spines (2-3 cm). <i>D. buenekeri</i> is a very distinctive, dwarf, clustering taxon with very short, appressed spines (4-5 mm) and a napiform root and <i>D. zehntneri</i> var. <i>horstiorum</i> is little known, it is a dwarf taxon with a napiform root and has thin, flexible and distinctively longer spines than <i>D. buenekeri</i> (12-22 mm).
<b>Bibliography:</b>	Braun, P. J. (1990): Over de taxonomie van <i>Discocactus zehntneri</i> Britton & Rose emend. Buining & Brederoo. <i>Succulenta</i> 69 (10): 215-221. Buining, A.F.H. (1980): The genus <i>Discocactus</i> Pfeiffer. The Buining Fonds - Succulenta, Venlo, the Netherlands. Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2 <sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK. Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).

Family Cactaceae

**Discocactus zehntneri**  
**ssp. boomianus „araneispinus“**

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# Discocactus zehntneri

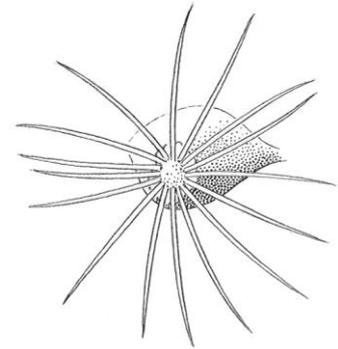
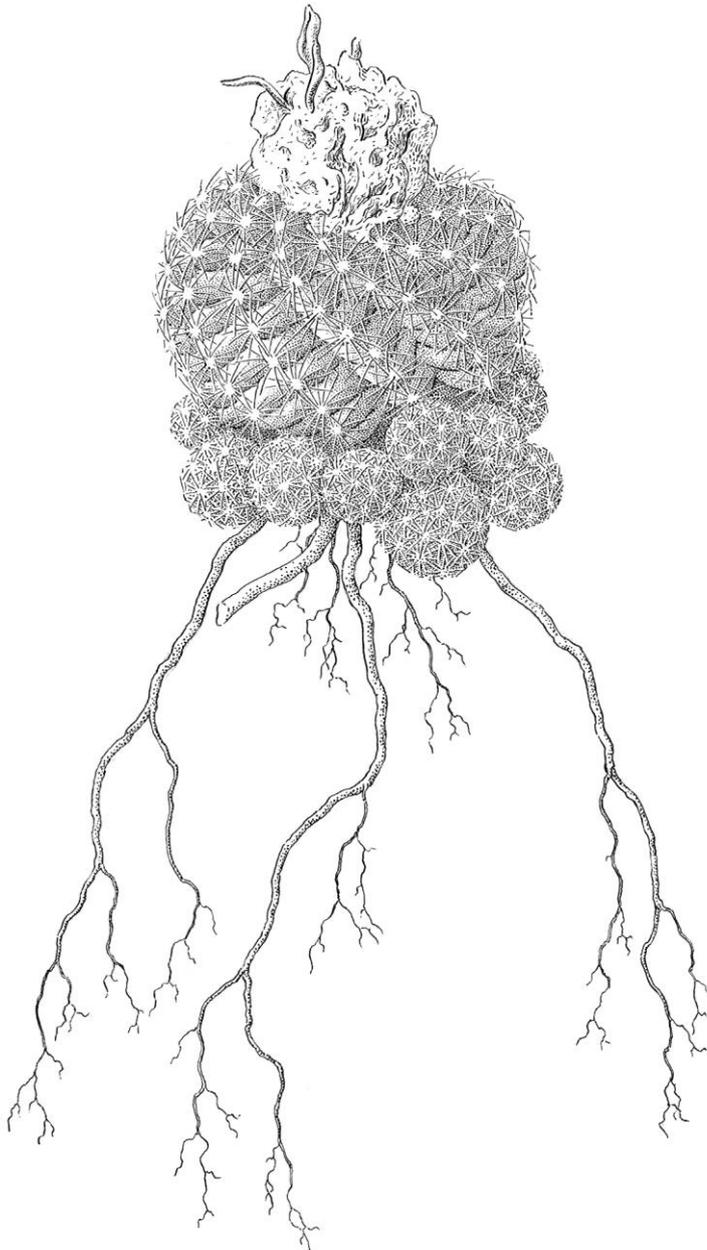
## ssp. boomianus „buenekeri“



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** *Discocactus buenekeri* Abraham 1987  
= *Discocactus zehntneri* ssp. *buenekeri* (Abraham) Braun & Esteves 1993

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992.



**Distribution:** State of Bahia, Brazil.



**Characteristics:** Dwarf, extremely cryptic, largely subterranean cactus, growing deeply embedded in quartzite sand. Stem globular with a napiform base, distinctly tuberculate, with non-pungent, short, white, regularly radiating and strongly appressed spines, normally strongly proliferating around the base and forming small to considerable clusters. Adult specimens with a whitish, woolly cephalic zone in the centre of the stem apex (the description given here excludes "*araneispinus*", "*boomianus*" and "*horstiorum*", which are treated separately)..

**Roots:** Fibrous, long, ramified, from the centre of the stem base (1 m reported).

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**Stem:** Dwarf, flat, globular, with a slightly napiform base, up to 3 cm high (without cephalium), up to 6 cm  $\varnothing$  (grafted specimens up to 8 cm  $\varnothing$ ), dull green, finely tuberculate. After reaching 2-3 cm  $\varnothing$ , the development of the cephalium as well as branching from the stem base starts. Forming clusters of up to 0.5 m  $\varnothing$ .

**Cephalium:** Up to 2 cm high, 3 cm  $\varnothing$ , with white wool and only a few, ca. 7 mm long, erect, dark brown, thin bristles around the margin, hidden beneath the wool.

**Ribs:** (14-) 16 (-19), helical, completely divided into mamillalike tubercles.

**Tubercles:** Nipple-shaped, rounded, 5 mm  $\varnothing$  at the base, 5-7 mm long.

**Areoles:** Ca. 5-6 per rib, ca. 5-8 mm apart, oval, 3 mm long, 2 mm wide, first covered with white wool, soon naked.

**Spines:** 14-18, non-pungent, thin, flexible, regularly radiating, recurved and distinctively appressed, 4-5 mm long, white, often with brown tips, soon turning greyish. Sometimes 2 additional, ascending, 2 mm long spines.

**Flowers:** Several appearing simultaneously from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 5 cm long and  $\varnothing$ .

**Fruits:** Clavate, 3 cm long, with persistent floral remnant, white to greenish or yellowish, dehiscent lengthwise at the side.

**Seeds:** Helmet-shaped, 2-2.2 mm long, 1.7-2 mm wide, surface shining black, with mamillalike tubercles. Hilum with a distinctive rim.

**Trade:** The taxon has been discovered in 1985 by the Brazilian collector Rudi Werner Büneker from Corvo, Brazil and has been named after him. Local endemic, only reported from the type locality. The only geographical information given is northern Bahia. *D. zehntneri* ssp. *boomianus* (including "*araneispinus*", "*buenekeri*" and "*horstiorum*") is classified as vulnerable by Taylor & Zappi (2001), due to its fragmented habitat and being subject to collection. The habitat is very difficult to find (Braun 2001 in lit.). The unexpected discovery of this second dwarf taxon in the genus (after *D. horstii*) caused quite some sensation and it is already relatively widespread in collections and readily available in trade today. There are no data on reported trade. It remains unknown, how much wild-collected material was involved in its successful introduction into cultivation, but vegetative propagation is quite fast and easy by grafting a motherplant and removing the numerous offsets. The state of the only known population is not reported anywhere. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** *Discocactus zehntneri* is very distinctive within the genus for its dense, white, interwoven spination and the rather small tubercles. The red fruits are an exclusive character. Probably *D. bahiensis* with its bigger ssp. *subviridigriseus* comes closest for its sometimes interwoven spination, but it shows a ribbed stem and less numerous spines (max. 9 radials, max. 3.5 cm long). *D. albispinus* is included here in *D. zehntneri* ssp. *zehntneri*, it is stated to differ by a bigger and less globose stem (Buining 1980) and has thicker tubercles, rather longer radial spines and often 1-2 very strong and long central spines. Several further taxa, namely *D. boomianus*, *D. araneispinus*, *D. buenekeri* and *D. zehntneri* var. *horstiorum* are all included here in *D. zehntneri* ssp. *boomianus* (following Hunt 1999). These taxa are all quite strongly proliferating from the base and usually forming small clusters. The stems are more depressed than globose to elongate as in ssp. *zehntneri* (Taylor & Zappi 2001). This classification however is based on rather weak characters and seems to be a bit arbitrary. *D. boomianus* is described with more ribs (16-20) and smaller tubercles ( $\varnothing$  1cm) as well a shorter spines (ca. 3 cm) in comparison with ssp. *zehntneri*. *D. araneispinus* looks quite distinct, having even more ribs (to 21), small tubercles ( $\varnothing$  1-1.3 cm) and more numerous (ca. 16), distinctively appressed, strongly curved, relatively thin and flexible, short spines (2-3 cm). *D. buenekeri* is a very distinctive, dwarf, clustering taxon with very short, appressed spines (4-5 mm) and a napiform root and *D. zehntneri* var. *horstiorum* is little known, it is a dwarf taxon with a napiform root and has thin, flexible and distinctively longer spines than *D. buenekeri* (12-22 mm).

**Bibliography:** Abraham, W. R. (1987): Ein aussergewöhnlicher neuer Discocactus: *Discocactus buenekeri* Abraham. Kakt. and. Sukk. 38 (11): 282-285

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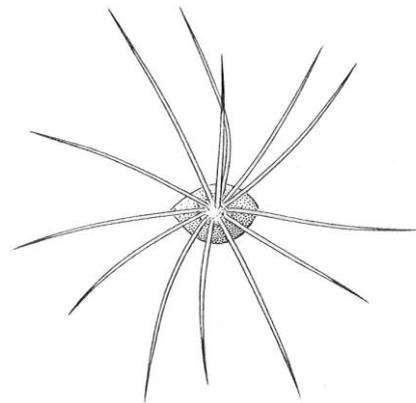
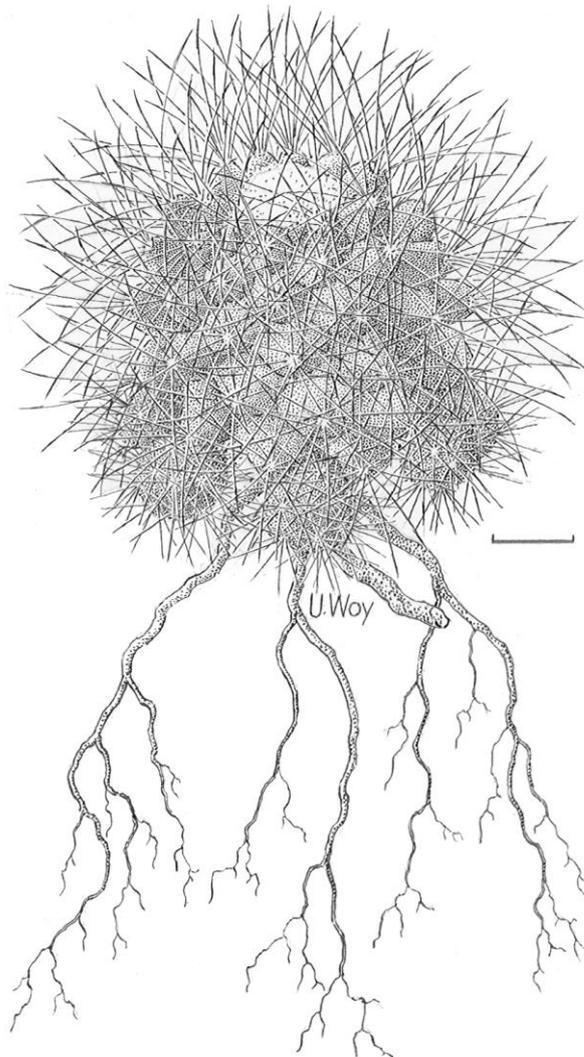
# Discocactus zehntneri ssp. boomianus „horstiorum“



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** *Discocactus zehntneri* var. *horstiorum* Braun 1990  
= *Discocactus zehntneri* ssp. *horstiorum* (Braun) Braun & Esteves 1995

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Distribution:** State of Bahia, Brazil.



- Characteristics:** Small sized, very distinctive, globular, tuberculate cactus, densely covered with long, rather thin and flexible, acicular, interwoven and partly protruding, white spines. Moderately proliferating around the base and forming small clusters. Adult specimens with a small whitish, woolly and bristly cephalic zone in the centre of the stem apex with long, yellowish-brown to red bristles (the description given here excludes "*araneispinus*", "*boomianus*" and "*buenekeri*", which are treated separately).
- Roots:** Napiform.
- Stem:** Flat, globular, 1-3 cm high (without cephalium), 3-4 cm Ø, light to dark green, proliferating around the stem base (especially if grafted) and forming small clusters.
- Cephalium:** Up to 1 cm high and 1-2 cm Ø, with brownish-white wool and numerous long, slightly curved, erect, stiff bristles, especially around the margin, yellowish-brown to dark red, later light grey, 2.5-4 (-6) cm long.
- Ribs:** 15-18, helical, completely divided into mamillalike tubercles.

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**Tubercles:** Nipple-shaped, rounded, 0.3-0.6 cm long, 0.2-0.5 cm (?)  $\varnothing$  at the base.  
**Areoles:** Oval, 1-3 mm long, situated on the tip of the tubercle, first with, short, white wool, later naked.  
**Spines:** 10-18, radiating and slightly protruding, slightly curved, all interpreted as radials, obscuring the stem, flexible, thin, 0.1-0.2 mm  $\varnothing$ , 12-22 mm long, first yellowish-brown with reddish tips, later white with black tips.  
**Flowers:** Appearing from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform.  
**Fruits:** Clavate, with persistent floral remnant, dehiscent lengthwise at the side.  
**Seeds:** Helmet-shaped to globose, surface shining black, with mamillalike tubercles.

**Trade:** *D. zehntneri* ssp. *boomianus* (including “*araneispinus*”, “*buenekeri*” and “*horstiorum*”) is classified as vulnerable by Taylor & Zappi (2001), due to its fragmented habitat and being subject to collection. *D. zehntneri* var. *horstiorum* is reported to grow on manganese ore and thus is potentially threatened through mining (Braun 1990). The habitat is very difficult to find (Braun 2001 in lit.). The taxon has been collected only a single time in 1988 by Kurt Ingo Horst under the number 667 and has been named after its discoverer. It is not well represented in collections. No trade in this specific taxon has been reported, although limited material is available in horticulture. Awareness of collectors is rather faint. In its related taxa, associated with *Discocactus zehntneri*, 3 major shipments originating from Brazil have been reported after Appendix I-listing. 1994-1995: 600 specimens went to USA and 2'600 to the Netherlands. They were declared as artificially propagated, but reports on infractions show, that such declarations have not always been correct. No exports from Brazil have been reported prior to 1994. Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. *D. zehntneri* ssp. *boomianus* and its allies can relatively easily be propagated by grafting a motherplant and then cutting off the numerous offsets. Nurseries registered for artificial propagation (*D. zehntneri* var. *horstiorum*): None.

**Similar species:** *Discocactus zehntneri* is very distinctive within the genus for its dense, white, interwoven spination and the rather small tubercles. The red fruits are an exclusive character. Probably *D. bahiensis* with its bigger ssp. *subviridigriseus* comes closest for its sometimes interwoven spination, but it shows a ribbed stem and less numerous spines (max. 9 radials, max. 3.5 cm long). *D. albispinus* is included here in *D. zehntneri* ssp. *zehntneri*, it is stated to differ by a bigger and less globose stem (Buining 1980) and has thicker tubercles, rather longer radial spines and often 1-2 very strong and long central spines. Several further taxa, namely *D. boomianus*, *D. araneispinus*, *D. buenekeri* and *D. zehntneri* var. *horstiorum* are all included here in *D. zehntneri* ssp. *boomianus* (following Hunt 1999). These taxa are all quite strongly proliferating from the base and usually forming small clusters. The stems are more depressed than globose to elongate as in ssp. *zehntneri* (Taylor & Zappi 2001). This classification however is based on rather weak characters and seems to be a bit arbitrary. *D. boomianus* is described with more ribs (16-20) and smaller tubercles ( $\varnothing$  1cm) as well a shorter spines (ca. 3 cm) in comparison with ssp. *zehntneri*. *D. araneispinus* looks quite distinct, having even more ribs (to 21), small tubercles ( $\varnothing$  1-1.3 cm) and more numerous (ca. 16), distinctively appressed, strongly curved, relatively thin and flexible, short spines (2-3 cm). *D. buenekeri* is a very distinctive, dwarf, clustering taxon with very short, appressed spines (4-5 mm) and a napiform root and *D. zehntneri* var. *horstiorum* is little known, it is a dwarf taxon with a napiform root and has thin, flexible and distinctively longer spines than *D. buenekeri* (12-22 mm).

**Bibliography:** Braun, P. J. (1990): Over de taxonomie van *Discocactus zehntneri* Britton & Rose emend. Buining & Brederoo. *Succulenta* 69 (10): 215-221.  
Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds - *Succulenta*, Venlo, the Netherlands.  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).

Family Cactaceae

**Discocactus zehntneri**  
**ssp. boomianus „horstiorum“**

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Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. In: *The Cactus and Succulent Journal of Great Britain*. Vol. 43 (2/3), p. 37-40.

Taylor, N. P. & D. Zappi (2001): *Cacti of Eastern Brazil*. Royal Botanic Gardens Kew, UK.

# Discocactus zehntneri

## ssp. boomianus

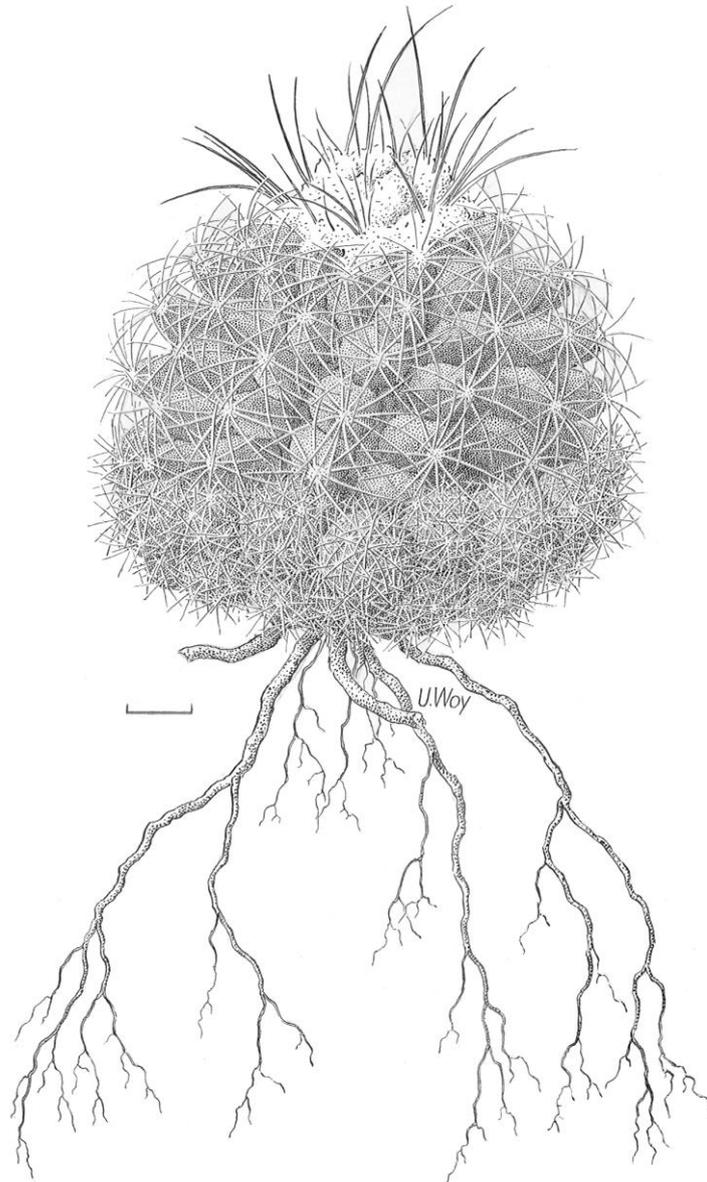
(Buin. &amp; Bred.) N. P. Taylor &amp; D. Zappi 1991



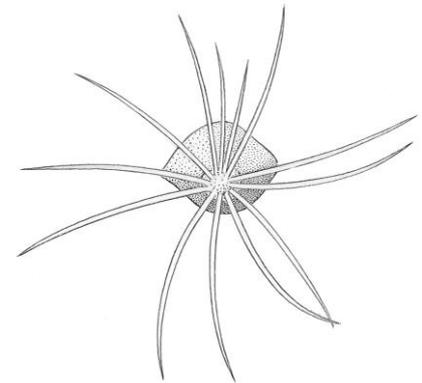
**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** = *Discocactus boomianus* Buining & Brederoo 1971  
 = *Discocactus zehntneri* var. *boomianus* (Buining & Brederoo) Braun 1990  
 further synonyms see *D. zehntneri* ssp. *boomianus* "araneispinus", "buenekeri" and "horstiorum"

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm



**Distribution:** State of Bahia, Brazil.



- Characteristics:** Small to medium sized, very distinctive, globular, tuberculate cactus, densely covered with long, rather strong, acicular, interwoven and partly protruding, white spines. Normally proliferating around the base and forming small clusters. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex (the description given here excludes "araneispinus", "buenekeri" and "horstiorum", which are treated separately).
- Roots:** Fibrous, long, ramified, from the centre of the stem base.
- Stem:** Flat, globular, up to 6 cm high (without cephalium) and 10 cm Ø, light to dark green, proliferating around the stem base (especially if grafted) and forming small clusters.
- Cephalium:** Up to 4.5 cm high and Ø, with white wool and numerous long, slightly curved, erect, stiff bristles, especially around the margin, greyish below and brown above.
- Ribs:** 16-20, helical, completely divided into mamillalike tubercles.
- Tubercles:** Nipple-shaped, rounded, 1 cm Ø at the base.
- Areoles:** Ca. 1.2-1.5 cm apart, oval, 7 mm long, 3 mm wide, situated on or somewhat beneath the tip

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- of the tubercle, first with conspicuous, short, white wool, later naked.
- Spines:** Obscuring the stem, strong, first yellowish, later white to greyish white with a greyish or light brown to brown tip. 8-12 radial spines, regularly radiating and variously curved and interwoven,  $\pm$  recurved, all  $\pm$  equally ca. 3 cm long, the lower ones rather stronger than the upper ones. Often 1 descending, 1 ascending and 3-5 lateral pairs, slightly pectinately arranged. Sometimes 1 central spine, in the upper part of the areole, porrect, slightly stronger than the radials and up to 3.5 cm long.
- Flowers:** Appearing from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, ca. 5 cm long and 4 cm  $\varnothing$ .
- Fruits:** Clavate, 3 cm long, 8-9 mm  $\varnothing$ , with persistent floral remnant, distinctively light red to red, dehiscent lengthwise at the side.
- Seeds:** Helmet-shaped to globose, up to 1 mm long and wide, surface shining black, with mamillalike tubercles.
- Trade:** *D. zehntneri* ssp. *boomianus* (including “*araneispinus*”, “*buenekeri*” and “*horstiorum*”) is classified as vulnerable by Taylor & Zappi (2001), due to its fragmented habitat and being subject to collection. *D. zehntneri* ssp. *boomianus* in a strict sense is documented from 3 sites. Machado (2000 in lit.) reports on population numbers of 2 localities near Morro de Chapéu. At the type locality, the population is estimated at 41'000 individuals, another nearby population is far bigger. Both localities are of very easy access. 3 major shipments originating from Brazil are reported after Appendix I-listing. 1994-1995, 600 specimens went to USA and 2'600 to the Netherlands. They were declared as artificially propagated, but reports on infractions show, that such declarations have not always been correct. No exports from Brazil have been reported prior to 1994. Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in “cephalic cacti” create a certain demand, which has been much stimulated by the description of “new species” in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. *D. zehntneri* ssp. *boomianus* and its allies can relatively easily be propagated by grafting a motherplant and then cutting off the numerous offsets. Nurseries registered for artificial propagation (*D. boomianus*): Germany P-DE-1001, Spain P-ES-1001.
- Similar species:** *Discocactus zehntneri* is very distinctive within the genus for its dense, white, interwoven spination and the rather small tubercles. The red fruits are an exclusive character. Probably *D. bahiensis* with its bigger ssp. *subviridigriseus* comes closest for its sometimes interwoven spination, but it shows a ribbed stem and less numerous spines (max. 9 radials, max. 3.5 cm long). *D. albispinus* is included here in *D. zehntneri* ssp. *zehntneri*, it is stated to differ by a bigger and less globose stem (Buining 1980) and has thicker tubercles, rather longer radial spines and often 1-2 very strong and long central spines. Several further taxa, namely *D. boomianus*, *D. araneispinus*, *D. buenekeri* and *D. zehntneri* var. *horstiorum* are all included here in *D. zehntneri* ssp. *boomianus* (following Hunt 1999). These taxa are all quite strongly proliferating from the base and usually forming small clusters. The stems are more depressed than globose to elongate as in ssp. *zehntneri* (Taylor & Zappi 2001). This classification however is based on rather weak characters and seems to be a bit arbitrary. *D. boomianus* is described with more ribs (16-20) and smaller tubercles ( $\varnothing$  1cm) as well a shorter spines (ca. 3 cm) in comparison with ssp. *zehntneri*. *D. araneispinus* looks quite distinct, having even more ribs (to 21), small tubercles ( $\varnothing$  1-1.3 cm) and more numerous (ca. 16), distinctively appressed, strongly curved, relatively thin and flexible, short spines (2-3 cm). *D. buenekeri* is a very distinctive, dwarf, clustering taxon with very short, appressed spines (4-5 mm) and a napiform root and *D. zehntneri* var. *horstiorum* is little known, it is a dwarf taxon with a napiform root and has thin, flexible and distinctively longer spines than *D. buenekeri* (12-22 mm).
- Bibliography:** Braun, P. J. (1990): Over de taxonomie van *Discocactus zehntneri* Britton & Rose emend. Buining & Brederoo. *Succulenta* 69 (10): 215-221.  
 Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds - *Succulenta*, Venlo, the Netherlands.  
 Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix

Family Cactaceae

**Discocactus zehntneri**  
**ssp. boomianus**

(Buin. & Bred.) N. P. Taylor & D. Zappi 1991



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I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. In: *The Cactus and Succulent Journal of Great Britain*. Vol. 43 (2/3), p. 37-40.  
Taylor, N. P. & D. Zappi (2001): *Cacti of Eastern Brazil*. Royal Botanic Gardens Kew, UK.

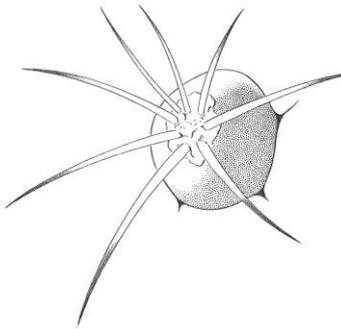
# Discocactus zehntneri ssp. zehntneri „albispinus“



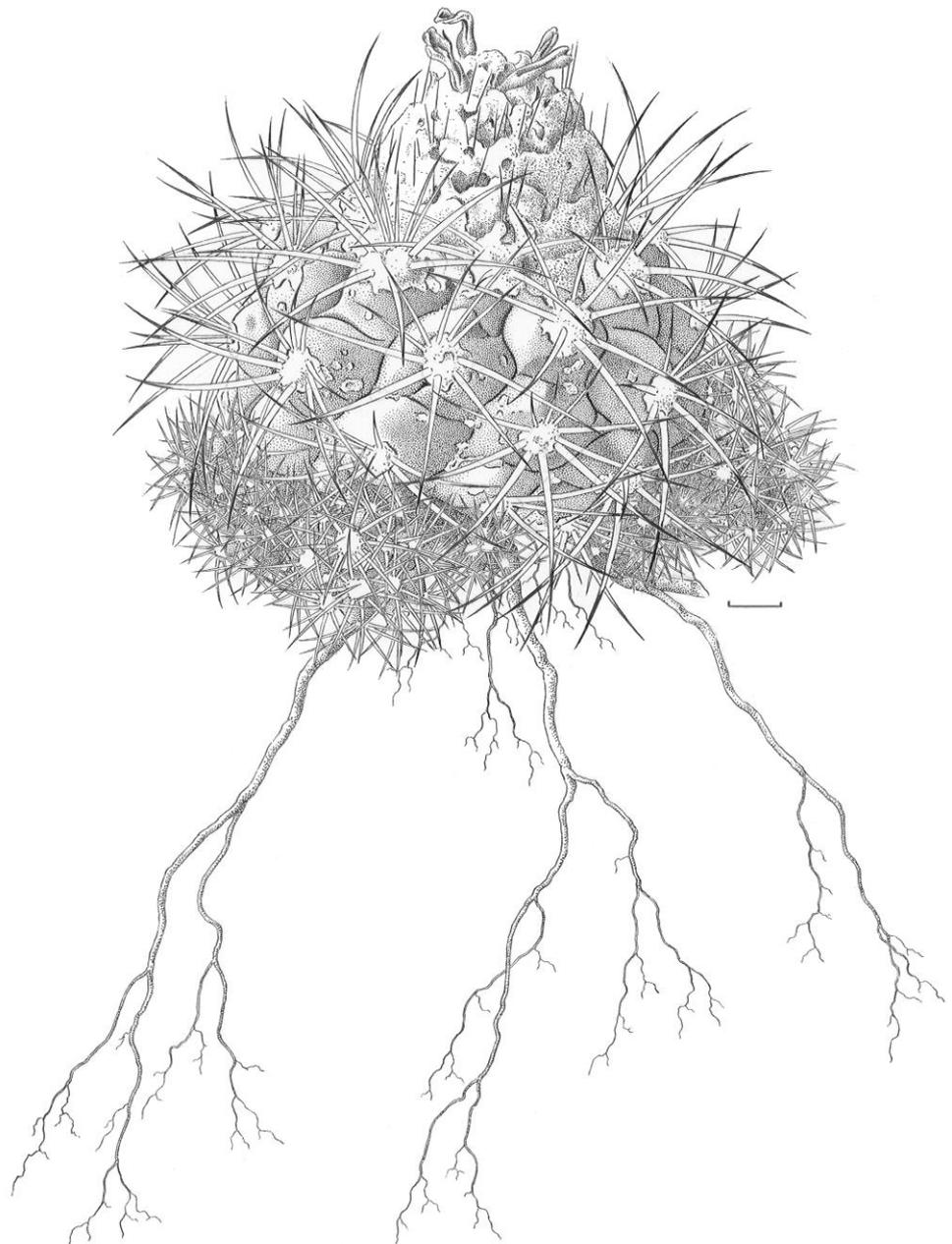
**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** *Discocactus albispinus* Buining & Brederoo 1974  
 = *Discocactus zehntneri* fa. *albispinus* (Buin. & Bred.) Riha1983  
 = *Discocactus zehntneri* var. *albispinus* (Buin. & Bred.) Braun 1990  
 = *Discocactus zehntneri* ssp. *albispinus* (Buin. & Bred.) Braun & Esteves 1995

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm



**Distribution:** State of Bahia, Brazil.



**Characteristics:** Small to medium sized, very distinctive, globular, tuberculate cactus, very densely covered with long, strong, acicular, interwoven and partly protruding, white spines. Normally solitary. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex.

**Roots:** Fibrous, long, ramified, from the centre of the stem base.

**Stem:** Usually solitary, ± globular, 5-7 cm high, 10-11 cm Ø, green to light green, tuberculate.

**Cephalium:** Rather small, 2-3 cm Ø, ca. 1 cm high, with yellowish-white wool and especially around the margin

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Ribs:	with cream-coloured bristles with a somewhat darker tip, 2.5-3 cm long. 12-13, spirally arranged, quite completely dissolved into tubercles.
Tubercles:	Nipple-shaped, rounded, 2 cm $\varnothing$ at the base, ca. 1 cm long, densely set.
Areoles:	Oval, 10 mm long, 5-6 mm wide, situated on or somewhat beneath the tip of the tubercle, first with conspicuous, short, white wool, later naked.
Spines:	Obscuring the stem, very strong, first yellowish, later white to greyish white with a light brown to brown tip. 9–11 principle radial spines, radiating and variously curved and interwoven, $\pm$ recurved, up to 1.5 mm $\varnothing$ at the base. 1 descending, up to 7 cm long, 4-5 lateral pairs, up to 6.5 cm long, the lower longer than the upper. Sometimes 1-3 much weaker, additional spines in the upper part of the areole, up to 3.5 cm long. 1-2 central spines, up to 7 cm long and up to 2 mm $\varnothing$ at the base, $\pm$ perrect, slightly curved, the lower slightly descending, the upper ascending.
Flowers:	Appearing from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnelform, 4.5 cm long and 4.2 cm $\varnothing$ .
Fruits:	Clavate, 4.6 cm long, 6 mm $\varnothing$ , with persistent floral remnant, distinctively light red to red, dehiscent lengthwise at the side.
Seeds:	Helmet-shaped, 1 mm long and wide, surface shining black, with mamillalike tubercles.

**Trade:** *D. albispinus* is known from a single locality in the Serra do Franciso, in the Region of Sento-Sé. Reported exports of *D. zehntneri* in a wide sense from Brazil start in 1980. Up to the Appendix I-listing in 1992, 56 shipments, totalling 1'145 specimens have been reported. It is possible, that more exports, only declared to genus level, took place. Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in "cephalic cacti" create a certain demand, which has been much stimulated by the description of "new species" in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. *D. zehntneri* ssp. *zehntneri* seems to be one of the more difficult *Discocacti* in cultivation and is sparsely represented. Nurseries registered for artificial propagation: Germany P-DE-1001.

**Similar species:** *Discocactus zehntneri* is very distinctive within the genus for its dense, white, interwoven spination and the rather small tubercles. The red fruits are an exclusive character. Probably *D. bahiensis* with its bigger ssp. *subviridigriseus* comes closest for its sometimes interwoven spination, but it shows a ribbed stem and less numerous spines (max. 9 radials, max. 3.5 cm long). *D. albispinus* is included here in *D. zehntneri* ssp. *zehntneri*, it is stated to differ by a bigger and less globose stem (Buining 1980) and has thicker tubercles, rather longer radial spines and often 1-2 very strong and long central spines. Several further taxa, namely *D. boomianus*, *D. araneispinus*, *D. buenekeri* and *D. zehntneri* var. *horstiorum* are all included here in *D. zehntneri* ssp. *boomianus* (following Hunt 1999). These taxa are all quite strongly proliferating from the base and forming small clusters. *D. boomianus* is described with more ribs (16-20) and smaller tubercles ( $\varnothing$  1cm) as well a shorter spines (ca. 3 cm). *D. araneispinus* looks quite distinct, having even more ribs (to 21), small tubercles ( $\varnothing$  1-1.3 cm) and more numerous (ca. 16), distinctively appressed, strongly curved, relatively thin and flexible, short spines (2-3 cm). *D. buenekeri* is a very distinctive, dwarf, clustering taxon with very short, appressed spines (4-5 mm) and a napiform root and *D. zehntneri* var. *horstiorum* is little known, it is a dwarf taxon with a napiform root and has thin, flexible and distinctively longer spines than *D. buenekeri* (12-22 mm).

**Bibliography:** Braun, P. J. (1990): Over de taxonomie van *Discocactus zehntneri* Britton & Rose emend. Buining & Brederoo. *Succulenta* 69 (10): 215-221.  
 Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds - *Succulenta*, Venlo, the Netherlands.  
 Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
 Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. In: *The Cactus and Succulent Journal of Great Britain*. Vol. 43 (2/3), p. 37-40.  
 Taylor, N. P. & D. Zappi (2001): *Cacti of Eastern Brazil*. Royal Botanic Gardens Kew, UK.

# Discocactus zehntneri

## ssp. zehntneri

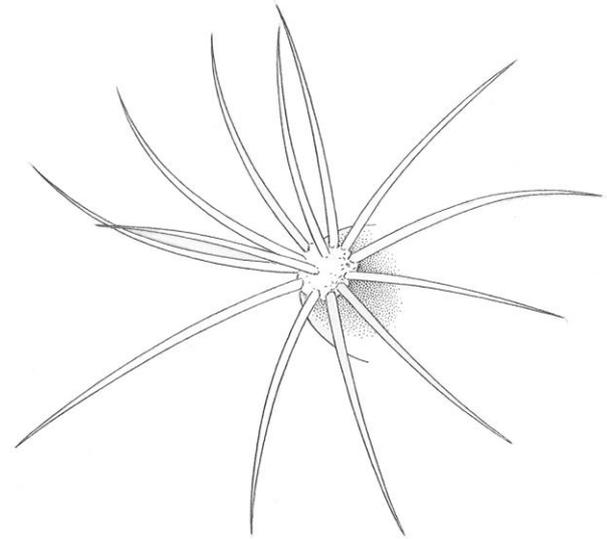
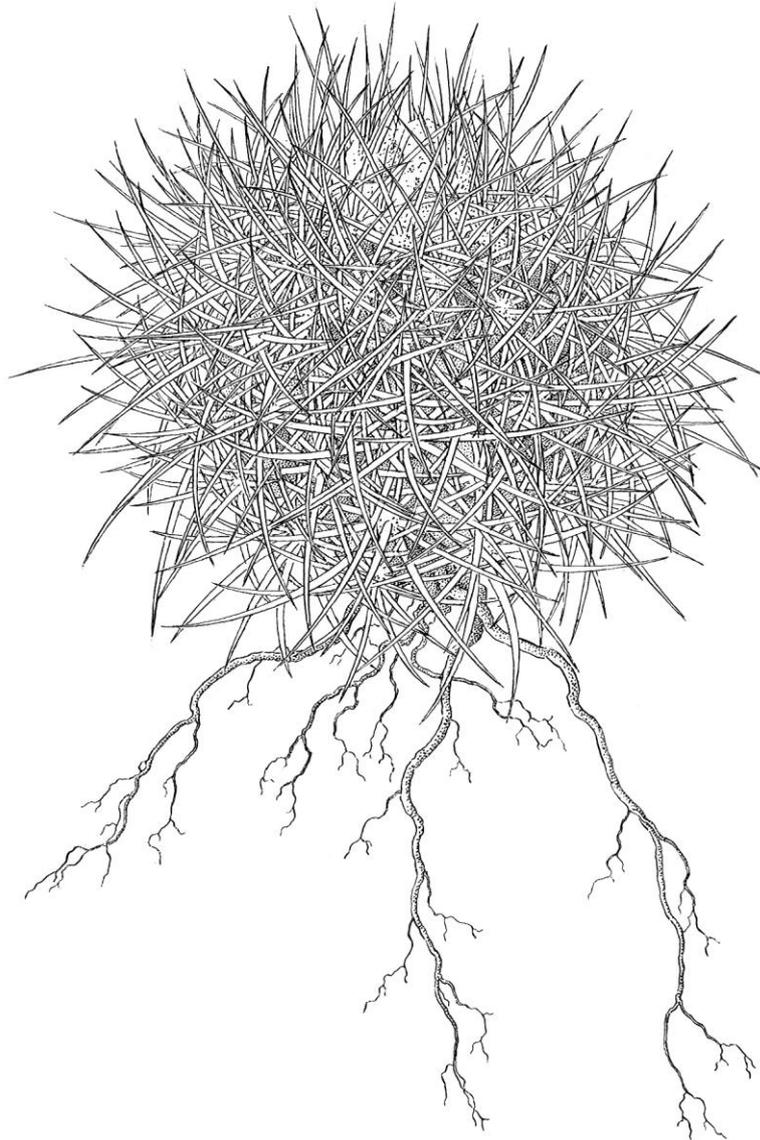
Britton &amp; Rose 1922



**Common names:** bras.: coroa do diabo, roseta do diabo, coroa de frade, cabeça de frade

**Scientific synonyms:** see *Discocactus zehntneri* ssp. *zehntneri* "albispinus"

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).

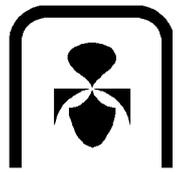


**Distribution:** State of Bahia, Brazil.



- Characteristics:** Small to medium sized, very distinctive, globular, tuberculate cactus, very densely covered with long, strong, acicular, interwoven and partly protruding, white spines. Normally solitary. Adult specimens with a whitish, woolly and bristly cephalic zone in the centre of the stem apex.
- Roots:** Fibrous, long, ramified, from the centre of the stem base.
- Stem:** Usually solitary, ± globular, up to 7 cm high and 10 cm Ø, green to light green, tuberculate.
- Cephalium:** Rather small, 3.5 cm Ø, ca. 1 cm high, with cream to white coloured wool and yellow to light brown, stiff and hard bristles, especially around the margin, which surmount the wool by 1.5-2 cm.
- Ribs:** 12-13, spirally arranged, quite completely dissolved into tubercles.
- Tubercles:** Nipple-shaped, rounded, 1.5 cm Ø at the base, ca. 1 cm long, densely set.

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- Areoles:** Ca. 5 per rib, ca. 1.5 cm apart, oval, 12-13 mm long, 10 mm wide, situated on or somewhat beneath the tip of the tubercle, first with conspicuous, short, cream-white wool, later naked.
- Spines:** Obscuring the stem, very strong, first yellowish, later white to greyish white with a greyish or light brown to brown tip. 9–11 radial spines, radiating and variously curved and interwoven, ± recurved towards the stem, up to 1.5 mm  $\varnothing$  at the base. Usually 1 descending, up to 4.2 cm long, 3-4 lateral pairs, 2.5-3.8 cm long, the lower longer than the upper. Sometimes 1-3 much weaker, ascending spines in the upper part of the areole, ca. 10 mm long and one correct ascending spine, up to 2.6 cm long, which has the appearance of a central spine.
- Flowers:** Appearing from the centre of the cephalic zone on mature specimens, nocturnal, white, with an elongated, slender tube and numerous spreading to recurved, long perianth segments, funnellform, 3.3 cm long and 3.5 cm  $\varnothing$ .
- Fruits:** Clavate, 2.5 cm long, with persistent floral remnant, distinctively red, dehiscent lengthwise at the side.
- Seeds:** Helmet-shaped, 1-1.1 mm long, 0.8-1 mm wide, surface shining black, with mamillalike tubercles.
- Trade:** Reported exports of *D. zehntneri* in a wide sense from Brazil start in 1980. Up to the Appendix I-listing in 1992, 56 shipments, totalling 1'145 specimens have been reported. It is possible, that more exports, only declared to genus level, took place. But *D. zehntneri* in the most strict sense has only been exported twice from Brazil in small numbers (Braun 2001 in lit.). It is almost absent today from living collections and only documented from two sites in nature, one referring to *D. albispinus*, the other discovered by Buining & Horst in 1974 near Sento-Sé. Taylor & Zappi (2001) classify it as endangered due to habitat loss; part of its former habitat has been submerged beneath the dam lake Represa de Sobradinho. Generally, a considerable international trade in wild-collected *Discocactus* spp. was reported in the 1970s and up to the early 1990s, mostly originating from Brazil. Main importing countries were USA, the Netherlands, the United Kingdom, Germany, Denmark and Switzerland. Many if not most of these wild-collected specimens have died since. The genus is generally not really popular with cactus collectors (with the exception of *D. horstii*), and is not well represented in cultivation, for its need of more elevated temperatures in winter. However, collectors focusing in Brazilian cacti or in "cephalic cacti" create a certain demand, which has been much stimulated by the description of "new species" in the 1970s and 1980s. *Discocactus* spp. are often grafted in cultivation, which allows for much faster growth and better survival. The scented, nocturnal flowers are quite an outstanding feature. Several hybrids have been created. *D. zehntneri* ssp. *zehntneri* seems to be one of the more difficult *Discocacti* in cultivation and is sparsely represented. Nurseries registered for artificial propagation: Germany P-DE-1001.
- Similar species:** *Discocactus zehntneri* is very distinctive within the genus for its dense, white, interwoven spination and the rather small tubercles. The red fruits are an exclusive character. Probably *D. bahiensis* with its bigger ssp. *subviridigriseus* comes closest for its sometimes interwoven spination, but it shows a ribbed stem and less numerous spines (max. 9 radials, max. 3.5 cm long). *D. albispinus* is included here in *D. zehntneri* ssp. *zehntneri*, it is stated to differ by a bigger and less globose stem (Buining 1980) and has thicker tubercles, rather longer radial spines and often 1-2 very strong and long central spines. Several further taxa, namely *D. boomianus*, *D. araneispinus*, *D. buenekerii* and *D. zehntneri* var. *horstiorum* are all included here in *D. zehntneri* ssp. *boomianus* (following Hunt 1999). These taxa are all quite strongly proliferating from the base and forming small clusters. *D. boomianus* is described with more ribs (16-20) and smaller tubercles ( $\varnothing$  1 cm) as well a shorter spines (ca. 3 cm). *D. araneispinus* looks quite distinct, having even more ribs (to 21), small tubercles ( $\varnothing$  1-1.3 cm) and more numerous (ca. 16), distinctively appressed, strongly curved, relatively thin and flexible, short spines (2-3 cm). *D. buenekerii* is a very distinctive, dwarf, clustering taxon with very short, appressed spines (4-5 mm) and a napiform root and *D. zehntneri* var. *horstiorum* is little known, it is a dwarf taxon with a napiform root and has thin, flexible and distinctively longer spines than *D. buenekerii* (12-22 mm).
- Bibliography:** Braun, P. J. (1990): Over de taxonomie van *Discocactus zehntneri* Britton & Rose emend. Buining & Brederoo. *Succulenta* 69 (10): 215-221.  
Buining, A.F.H. (1980): The genus *Discocactus* Pfeiffer. The Buining Fonds - Succulenta, Venlo, the Netherlands.  
Hunt, D. ed. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
Taylor, N. P. (1981): Reconsolidation of *Discocactus* Pfeiff. In: *The Cactus and Succulent Journal of Great Britain*. Vol. 43 (2/3), p. 37-40.  
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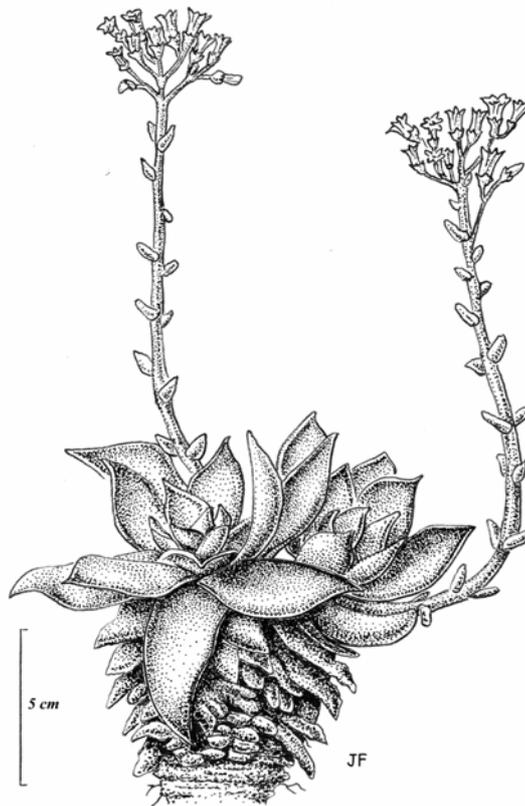


# Dudleya stolonifera

Morgan

**Common name:** engl.: Laguna Beach Dudleya.  
 esp.:  
 fr.:

**Scientific synonyms :** *Echevaria caespitosa* (Haw.) DC  
*Dudleya ovatifolia* Britt.



**Illustration:** *Dudleya stolonifera*, habit of plant with inflorescence.

## Characteristics:

- Vegetative:** Plants succulent, branched caudex, 1.5 - 3 cm thick and 10 cm or more long. Rosettes rather flat, 5-12 cm in diameter, with 15- 25 leaves. Rosette leaves oblong to obovate, short acuminate, 3-7 cm long, 1.5-3 cm broad, and 3-4 mm thick, bright green, not gleaming, often becoming maroon especially dorsally and towards apex.
- Inflorescence:** Floral stem 8-25 cm high, 2-4 cm thick, leafy to within 3-6 cm of the base. Inflorescence commonly of two simple ascending, occasionally three or more, branches. Petals bright yellow with outer tips curved outwards, 10-11 mm long, 3-3.5 mm wide, yellow anthers.
- Similar species:** *Dudleya edulis* x *stolonifera* Moran, hybrid with pale yellow flowers having orange anthers, found also in Aliso, Canyon California.
- Dudleya ovatifolia* Britt. Found in the Santa Monica Mountains, California, differs by having an unbranched caudex, smaller rosettes with fewer, more elliptical leaves.

**Distribution:**

USA, Orange County, California in Aliso and Laguna Canyons, San Joaquin Hills, 1ocally abundant on north-facing cliffs in coastal sage scrub or chaparral habitats, 10-250 meters elevation.

**Threats:**

Urban development, livestock grazing, non-native species competition, recreational activities, and potential illegal collection for private collections.

**References:**

Bartel, J.A., 1993, in *The Jepson Manual: Higher Plants of California*, Ed. J.C. Hickman, Berkeley and Los Angeles: Univ. of California Press.

Moran, Reid, 1949, *Dudleya stolonifera*, a new species from Orange County, California. *Bulletin, Southern California Academy of Sciences*, 48: 105-114.

US Fish & Wildlife Service, International Affairs Internet web site.

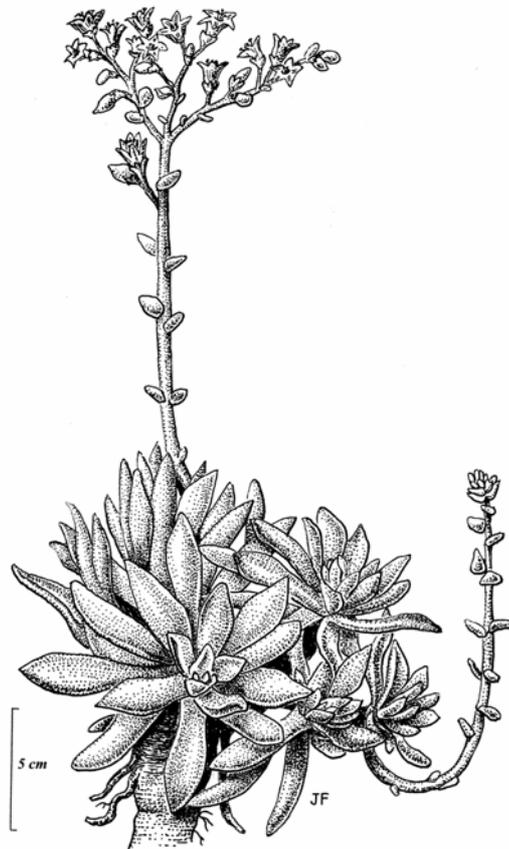


# Dudleya traskiae

Rose Morgan

**Common name:** engl.: Santa Barbara Island Dudleya.  
esp.:  
fr.:

**Scientific synonyms :** *Cotyledon lanceolata*  
*Stylophyllum traskae*  
*Cotyledon traskae*  
*Echeveria traskae*  
*Echevaria viscida*  
*Echevaria greevei*  
*Echevaria albida*



**Illustration:** *Dudleya stolonifera*, habit of plant with inflorescence.

**Characteristics:**

**Vegetative:** Plants succulent, perennial herb with short, branched caudex, forms clumps of up to 20 rosettes. Rosette leaves 25-35, strap shaped to oblanceolate, 4-15 cm long x 1-4 cm wide.

**Inflorescence:** Flower stems 2-3 cm long on stalks, flowers bright yellow, spreading petals curved downward, becoming somewhat red-veined.

**Distribution:** Santa Barbara Island (Channel Islands National Park) California, restricted to poorly developed soils on steep south-facing slopes and marine terraces above sea slopes on the east and south sides of the island.



**Threats:** Feral animal introductions and potential illegal collection for private collections.

**References:** Bartel, J.A., 1993, in The Jepson Manual: Higher Plants of California, Ed. J.C. Hickman, Berkeley and Los Angeles Univ. of California Press.

Moran, Reid, 1942, Revision of *Dudleya*, Subgenus *Stylophyllum* – II, *Desert Plant Life*, p. 9-14.

Endangered Species Information Systems, Fish & Wildlife Information Exchange, Virginia Tech Internet web site.

# Echinocereus ferreirianus ssp. lindsayi

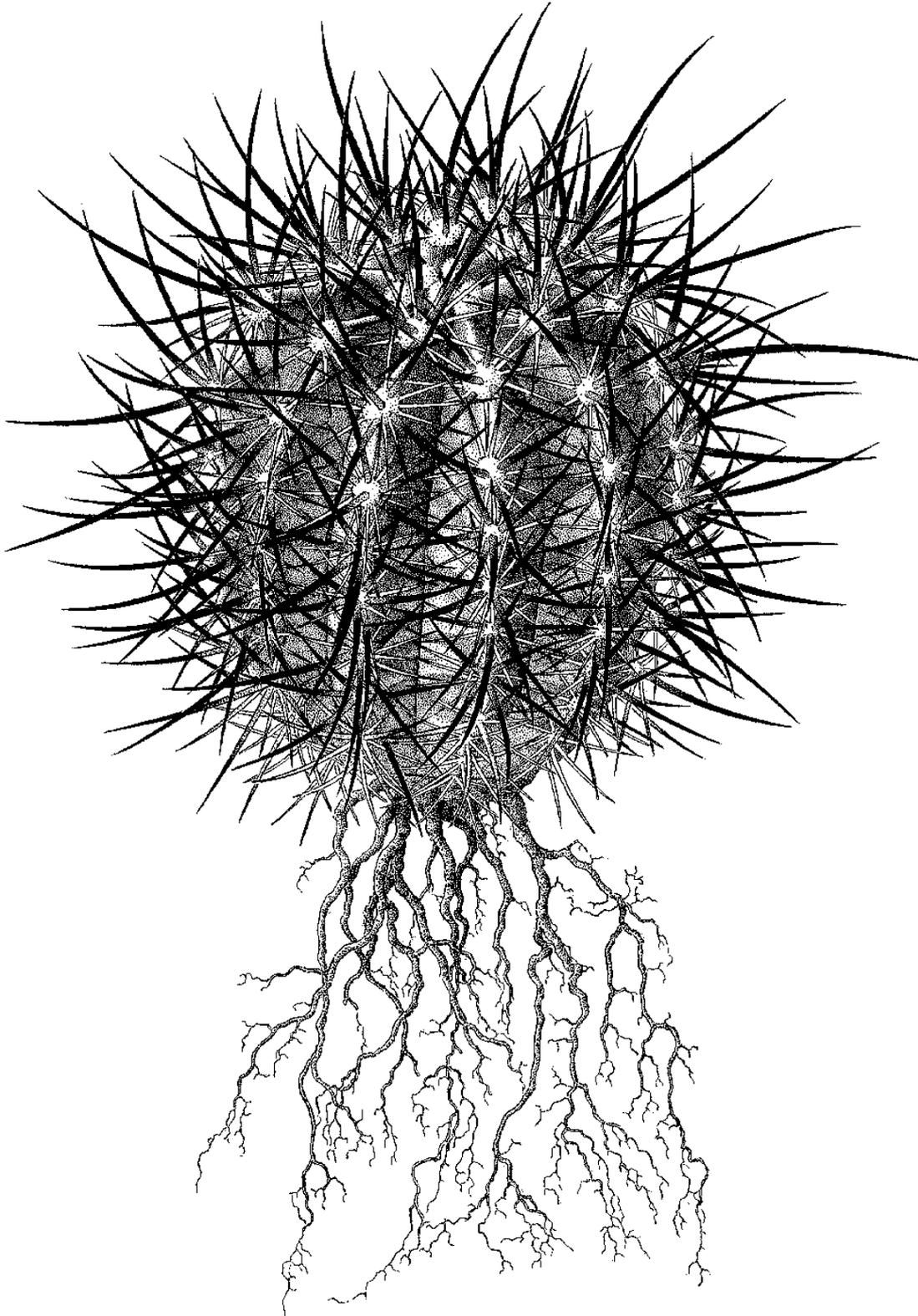
(Meyrán) N. P. Taylor 1997



**Common names:** engl.: Lindsay's cactus

**Scientific synonyms:** = *Echinocereus lindsayi* Meyrán 1975  
= *Echinocereus ferreirianus* var. *lindsayi* (Meyrán) N. P. Taylor 1985

**CITES category:** Appendix II since 01.07.1975, Appendix I since 06.06.1981 (Prop. USA).



**Characteristics:** Medium sized, barrel-shaped, ribbed cactus, distinctive for its strong, colourful (especially in new growth), extremely long and characteristically curved and twisted spines.

**Roots:** Fibrous.

**Stem:** Solitary, globose to shortly cylindrical, 8-13 cm high, 8-10 cm Ø, dark green, ribbed, densely covered by interwoven spines.

**Ribs:** 11-13 (-18), 1-2.5 cm high, only slightly tuberculate.

**Areoles:** Large, up to 12 mm long, 1.5-3 cm apart, with white wool in new growth, each bearing about 20 spines.

**Spines:**

**Radial spines:** 9-13, subulate, 1-4.5 cm long, 1-1.5 mm Ø, straight to curved, horizontal to ascending, white to horn-coloured to black tinged purple towards the tip.

**Central spines:** (4-) 5 (-7), unusually long in comparison with the stem size, 3.5-10 cm long, 1.5-2.5 mm Ø, strongly subulate, slightly striate, unusually and characteristically curved and tortuous, with bulbous base, whitish to horn-coloured to black, strikingly red at base in new growth.

**Flowers:** Funnelform, 7 cm long, 7 cm Ø, pink with contrasting, orange-red throat.

**Fruits:** 4.5 cm long, 2-2.5 cm thick, green to purplish, spiny, dehiscent, containing white pulp.

**Seeds:** Ovoid, 1.2-1.35 mm long, tuberculate, black.

**Distribution:** State of Baja California Norte, Mexico.



**Trade:** Local endemic of a small area between Cataviña and Laguna Chapala. Very sought-after by cactus collectors. Following its discovery in 1975, the plant was virtually exterminated in its only locality known by then. More recently, another, still intact population has been discovered (Glass 1998). Various nurseries in the USA and Europe successfully propagate the taxon today. In trade as seedlings, sometimes grafted. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Rather resembles a juvenile specimen of *Ferocactus gracilis* or a *Sclerocactus* spp. or even the South American *Echinopsis longispina* than any species of its own genus. The closest taxon, *Echinocereus ferreirianus* ssp. *ferreirianus* is quite distinct by its weaker, non tortuous spines and more slender, cylindrical stems, usually branching from the base. The red-throated flower is identical in both subspecies.

**Bibliography:**

Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.

Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): Las Cactáceas de México, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.

Glass, C. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.

Hunt, D., (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.

Taylor, N. P. (1985): The Genus *Echinocereus*. A Kew Magazine Monograph. The Royal Botanic Gardens, Kew, UK.

*Echinocereus*-Homepage: [www.echinocereus.de](http://www.echinocereus.de)

The *Echinocereus* Reference Collection: [www.lisowski58.freemove.co.uk](http://www.lisowski58.freemove.co.uk)



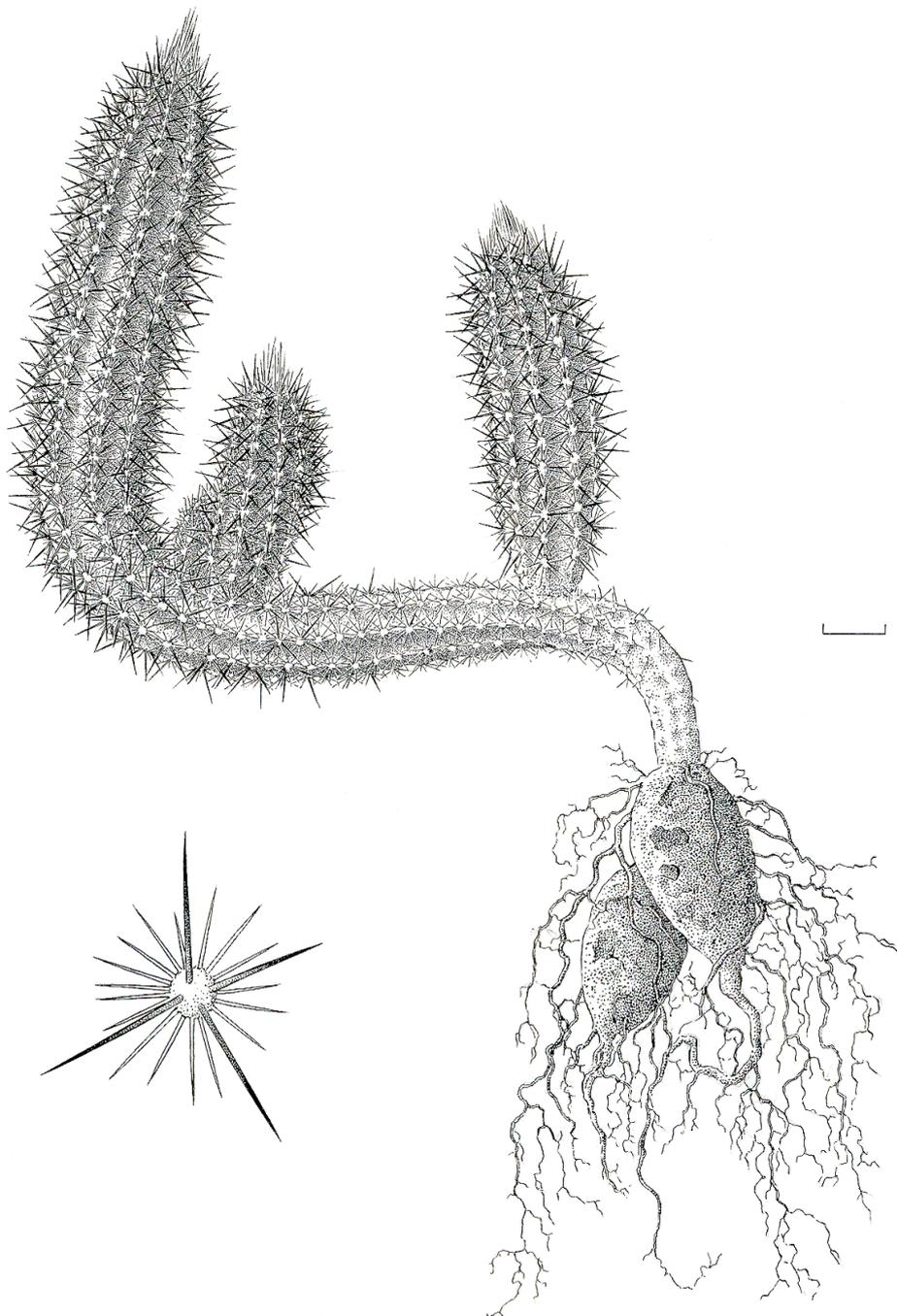
# Echinocereus schmollii

(Weingart) N. P. Taylor 1985

**Common names:** engl.: Lambs tail cactus

**Scientific synonyms:** = *Cereus schmollii* Weingart 1931  
 = *Wilcoxia schmollii* (Weingart) Backeberg 1935  
 → *Wilcoxia schmollii* var. *nigriseta* Schwarz 1937 (nom. nud.)  
 → *Wilcoxia schmollii* var. *lanata* Cartier 1980 (nom. illeg.)  
 → *Wilcoxia schmollii* var. *serpens* Hort. (nom. nud.)  
 → *Wilcoxia tuberosa* var. *pilosa* Fobe 1931  
 → *Wilcoxia tuberosa* var. *senilis* Fobe 1931  
 → *Wilcoxia nerispina* Backeberg 1960 (nom. inval.)  
 → *Wilcoxia nerispina* (Schmoll ex) Cartier 1980 (nom. inval.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



bar = 1 cm

- Characteristics:** Small, thin, columnar cactus of soft consistence, very cryptic in habitat, growing in the protection of shrubs, distinctive for its turnip-like root and (in juvenile specimens) numerous hair-like, white radial spines. The vernacular name "lamb's tail cactus" characterises well this soft-spined juvenile forms. Changing gradually to acicular spination with age.
- Roots:** Strongly succulent, napiform, turnip-like, up to 8 cm long and 3 cm Ø.
- Stem:** Solitary or slightly branched (to quite strongly branched in cultivated specimens), cylindrical, ± 7 cm long (- 25 cm in cultivated specimens), soft, first erect, later decumbent, 1-2 cm Ø, dark green, tinged purple, tapered above the root.
- Ribs:** 9-10, rounded.
- Areoles:** 0.5 mm Ø, 1.5-2 mm apart, with scant, greyish-white wool.
- Spines:**
- Radial spines:** Variably hairlike, ca. 35, at first pinkish but soon white, grey or black, giving the stem a soft woolly appearance (in juvenile specimens) to 12-18, finely acicular, glassy and pungent (in adult specimens), to 7 mm long.
  - Central spines:** 0-4 (-8), 12-21 mm long, black, becoming straw coloured with age, acicular
- Flowers:** 3.5-4 cm long, to 5 cm Ø, funnelform, mostly arising near stem apex, occasionally terminal, bright pink.
- Fruits:** Ovoid, 2-3 cm long, ca. 1.8 cm Ø, covered with spines, juicy, olive green with white pulp.
- Seeds:** Ca. 1.8 x 1.2 mm, black, tuberculate.
- Distribution:** State of Querétaro, Mexico.



- Trade:** The former genus name *Wilcoxia* is still more frequently used in horticulture. Forms with predominantly acicular spination and fewer radials (mostly adult specimens, as illustrated) are frequently labelled "*nerispina*". The species is not commonly found in international trade, although it is the most popular one of the former genus (now section) *Wilcoxia* for its small size and free flowering. It is difficult to detect in habitat, due to its cryptic nature, and may be more abundant than reported (3-4 localities, Taylor 1985). Propagation from seeds, by cuttings or grafting is easy. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1002, Switzerland P-CH-1001.
- Similar species:** Other species with tuberous roots and slender stems, but without dense, white spination are the remaining *Echinocereus* spp. of section *Wilcoxia* (CITES Appendix II) and *Peniocereus* spp. (CITES Appendix II) from Mexico and USA as well as the South American *Pterocactus* spp. (CITES Appendix II). The combination of a tuberous root with a small, soft stem, covered with rather long, white, often hairlike spines, is exclusive for *E. schmollii*. Some *Turbinicarpus* spp. (CITES Appendix I) with tuberous roots have slender stems too, but a distinctly globose, head-like stem apex.
- Bibliography:**
- Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): Las Cactáceas de México, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.
- Glass, C. (1997): Neotenia in *Wilcoxia schmollii* (Weingarth) Knuth in Backeb. & Knuth 1931. Un aspetto poco conosciuto di una pianta ben conosciuta. *Piante Grasse* 17(1): 137-140.
- Hunt, D., (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.
- Taylor, N. P. (1985): The Genus *Echinocereus*. A Kew Magazine Monograph. The Royal Botanic Gardens, Kew, UK.
- Echinocereus*-Homepage: [www.echinocereus.de](http://www.echinocereus.de)
- The *Echinocereus* Reference Collection: [www.lisowski58.freerve.co.uk](http://www.lisowski58.freerve.co.uk)



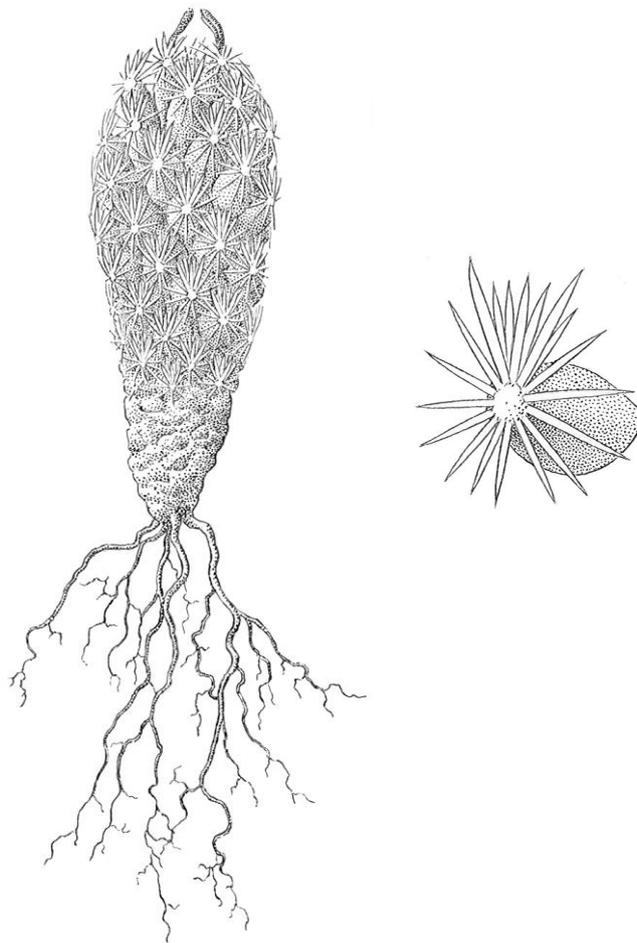
# Escobaria minima

(Baird) D. R. Hunt 1978

**Common names:** engl.: Nellie's cory cactus

**Scientific synonyms:** = *Coryphantha minima* Baird 1931  
 → *Coryphantha nellieae* Croizat 1934  
 = *Escobaria nellieae* (Croizat) Backeberg 1961

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf globose cactus, characteristic for its extremely small stem size and non pungent, flattened, mostly white spines with unique, abruptly acute spine tips. Growing on gravelly hills in Desert Grassland.

**Roots:** Fibrous.

**Stem:** Simple or infrequently sparingly branched (strongly clustering in grafted specimens), ovoid, 3-4 cm high, 1-2 cm Ø, in cultivation columnar with time.

**Tubercles:** Cylindroid, 2-3 mm long and broad, with a median longitudinal groove on the upper (adaxial) side, connecting the sterile (spine-bearing) part of the areole on the tip of the tubercle with the fertile

- 
- part (producing flowers) in the axil.
- Areoles:** Slightly woolly, 1 mm  $\varnothing$ .
- Spines:** Non pungent, dense, tending to obscure the stem, pale greyish to pure white to yellowish or sometimes pinkish, with abruptly acute spine tips, somewhat bundled in the upper part of the areole.
- Radial spines:** 18, 3-4 mm long, inserted in several series, radiating horizontally.
- Central spines:** 3-5, ascending, similar to the radials but thicker and longer, up to 8 mm long, basally bulbous, 0.5 mm broad.
- Flowers:** From the centre of the stem apex,  $\pm$  2 cm long and  $\varnothing$ , pink, perianth segments with fimbriate margins.
- Fruits:** Egg-shaped, 3-5 mm long, 1.5-3 mm broad, green at maturity, with persistent floral remnant.
- Seeds:** < 0.5 mm, black, seed coat finely pitted.
- Distribution:** State of Texas, USA.



- Trade:** Local endemic of Brewster County in western Texas. Highly in demand by cactus collectors because of its dwarf size and status of rarity. Quite well represented in collections. Relatively easy to grow from seeds and soon freely flowering, but with a reputation for not getting very old on own roots, hence often grafted. Traded as seeds or as seedlings on own roots. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1002, Switzerland P-CH-1001.
- Similar species:** Very distinctive species; no other species really looks alike. The spreading, broadened spines, abruptly narrowed at the tips, are unique.
- Bibliography:** Benson, L. (1982): *The Cacti of the United States and Canada*. Stanford University Press, Stanford, California.  
Hunt, D., (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.  
Taylor, N. P. (1983). *Die Arten der Gattung Escobaria*. *Kakt. and. Sukk.* 34 (ç): 76-79, (5): 120-123, (6): 136-140, (7): 154-158, (8): 184-188.  
Zimmerman, A. D. (1985, ined.): *Systematics of the genus Coryphantha (Cactaceae)*. Ph.D. thesis. The University of Texas at Austin.

# Escobaria sneedii

## ssp. leei

(Rose ex Bödeker) Hunt 1997

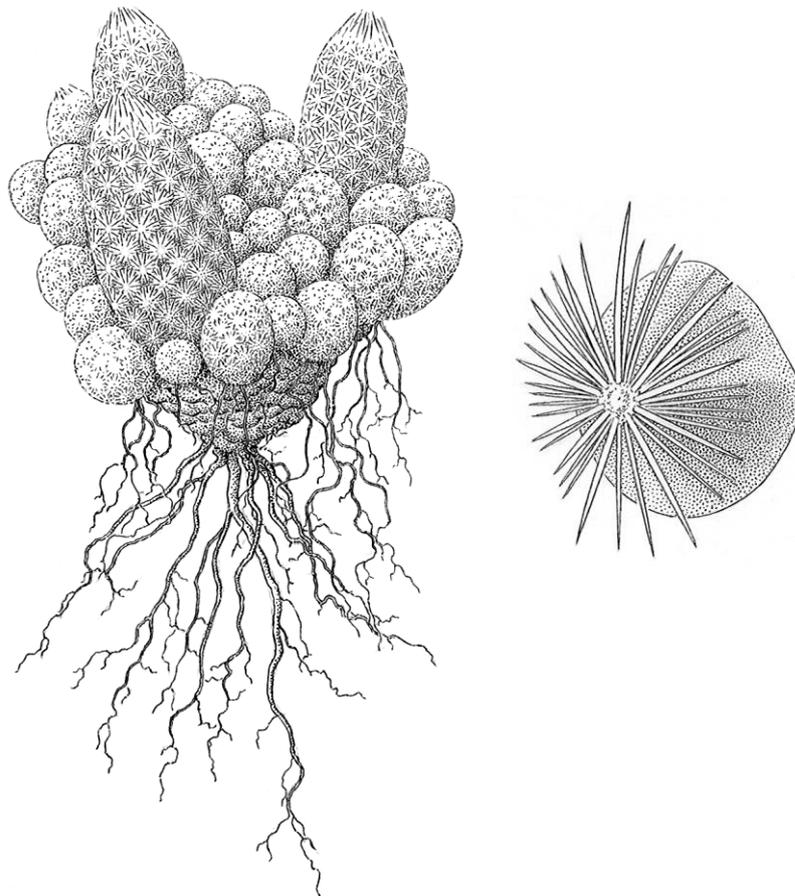


**Common names:** engl.: Lee's pincushion cactus

**Scientific synonyms:** = *Escobaria leei* Rose ex Bödeker 1933  
 = *Coryphantha sneedii* var. *leei* (Rose ex Bödeker) L. Benson 1969  
 = *Mammillaria leei* (Rose ex Bödeker) Weniger 1970 (nom. inval.)  
 = *Escobaria sneedii* var. *leei* (Rose ex Bödeker) D. R. Hunt 1978

**Excluded taxa:** *Escobaria sneedii* ssp. *albicolumnaria* (Hester) J. Lüthy 1999 (CITES App. II)  
 = *Escobaria albicolumnaria* Hester 1941  
*Escobaria sneedii* ssp. *orcuttii* (Bödeker) J. Lüthy 1999 (CITES App. II)  
*Escobaria orcuttii* Bödeker 1933  
 incl. *Escobaria orcuttii* var. *macraxina* Castetter & al. 1975  
 incl. *Escobaria orcuttii* var. *koenigii* Castetter & al. 1975  
*Escobaria sneedii* ssp. *organensis* (D. Zimmerman) J. Lüthy 1999 (CITES App. II)  
*Coryphantha organensis* D. Zimmerman 1972  
*Escobaria sneedii* ssp. *sandbergii* (Castetter & al.) J. Lüthy 1999 (CITES App. II)  
*Escobaria sandbergii* Castetter & al. 1975  
*Escobaria sneedii* ssp. *villardii* (Castetter & al.) J. Lüthy 1999 (CITES App. II)  
*Escobaria villardii* Castetter & al. 1975

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, profusely clustering, columnar cactus, densely covered with a predominantly white, strikingly dimorphic spination: Immature stems much smaller, only with short, appressed radial spines, mature stems (only a few per clump) considerably bigger with contrasting, long radial and central spines. Growing on limestone rocks.

**Roots:** Short taproot or several fleshy, adventitious roots.

**Stem:** Pale to dark grey-green, strongly branching, forming clumps with ca. 50 (rarely up to 250) dwarf

- stems, of which only a few are mature (3-4), immature branches predominating, lower branches producing own adventitious roots, stems cylindroid or clavate, 35-100 mm high, 13-30 mm Ø.
- Tubercles:** Cylindroid, truncate, 3.5-7.5 mm long, 2.5-4.0 mm Ø, with median longitudinal groove on upper (adaxial) side, connecting the sterile (spine-bearing) part of the areole on the tip of the tubercle with the fertile part (producing flowers) in the axil.
- Areoles:** 1.5 – 2.5 mm Ø, bearing a tuft of short, white wool (in the region of the stem apex).
- Spines:** 62-95, 1-10 mm long, acicular, straight, very dense, covering the stem, snowy white, very tightly appressed, sometimes nearly touching the sides of the tubercles, hence non pungent, notably pubescent on seedlings and immature branches.
- Radial spines:** (37-) 50 (-73) per areole, 3-8 mm.
- Central spines:** Inner centrals (1-) 5 (-12), (1-) 3-10 mm long, outer centrals 10-23, (1.5-) 4-10 mm, not contrasting with the radials.
- Flowers:** Apical, small, 1-2 and Ø, mostly pink, sometimes brownish or greenish white, margins of perianth segments fimbriate.
- Fruits:** Clavate, 0.5-1.2 cm long, 5 mm Ø, green turning brownish pink, with persistent floral remnant.
- Seeds:** Kidney- to egg-shaped, 1.2-1.5 mm long, reddish-brown, seed coat finely pitted.

**Distribution:** State of New Mexico, USA.



**Trade:** Local endemic of Guadalupe Mountains in Eddy County, southern New Mexico. In some demand by collectors because of the small size and status of rarity (whereas most other species of the genus *Escobaria* are not really popular). Only a few “typical”, selected clones, which don’t represent the whole morphological variability, are propagated artificially (often by cutting branches, which usually have their own roots already) and are observed in international trade. In spite of easy propagation, the plant is not very well represented in collections and artificially propagated, large clumps are seldom seen. Illegal and widespread collection is a major threat in USA. Seeds from artificial propagation are readily available in international trade. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** *Escobaria sneedii* ssp. *sneedii* is reported to intergrade with ssp. *leei*, where they occur sympatrically. It is bigger in all parts, stems 35-100 mm high, 13-30 mm Ø, less profusely branching and forming clumps with up to 30 or more (100+) stems, spines (radials and centrals) less numerous (31-68) and longer (radials –12 mm, centrals –16.5 mm), rather spreading than tightly appressed. Further, ssp. *leei* could be confused with other columnar, white spined *Escobarias*, especially in seedling stage: The remaining subspecies of *E. sneedii* listed above (CITES App. II). Furthermore *E. tuberculosa* (Engelmann) Britton & Rose (CITES App. II) could be confounded. *E. sneedii* ssp. *leei* (and ssp. *sneedii*) however are distinct from all other taxa, producing clumps of predominantly immature stems and having a rather dense, partly appressed spination. They are smaller in all aspects. *E. tuberculosa* has fewer spines, ascending tubercles, a distinctly corky stem base and very different pink, scented flowers with a narrow tube, opening in the afternoon.

**Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California.

Fletcher, R. & al., eds. (1984): A Handbook of Rare and Endemic Plants of New Mexico. The New Mexico Native Plant Protection Advisory Committee. University of New Mexico Press, Albuquerque.

Hunt, D., (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.

Taylor, N. P. (1983). Die Arten der Gattung *Escobaria*. Kakt. and. Sukk. 34 (ç): 76-79, (5): 120-123, (6): 136-140, (7): 154-158, (8): 184-188.

Zimmerman, A. D. (1985, ined.): Systematics of the genus *Coryphantha* (Cactaceae). Ph.D. thesis. The University of Texas at Austin.

# Escobaria sneedii

## ssp. sneedii

Britton &amp; Rose 1923

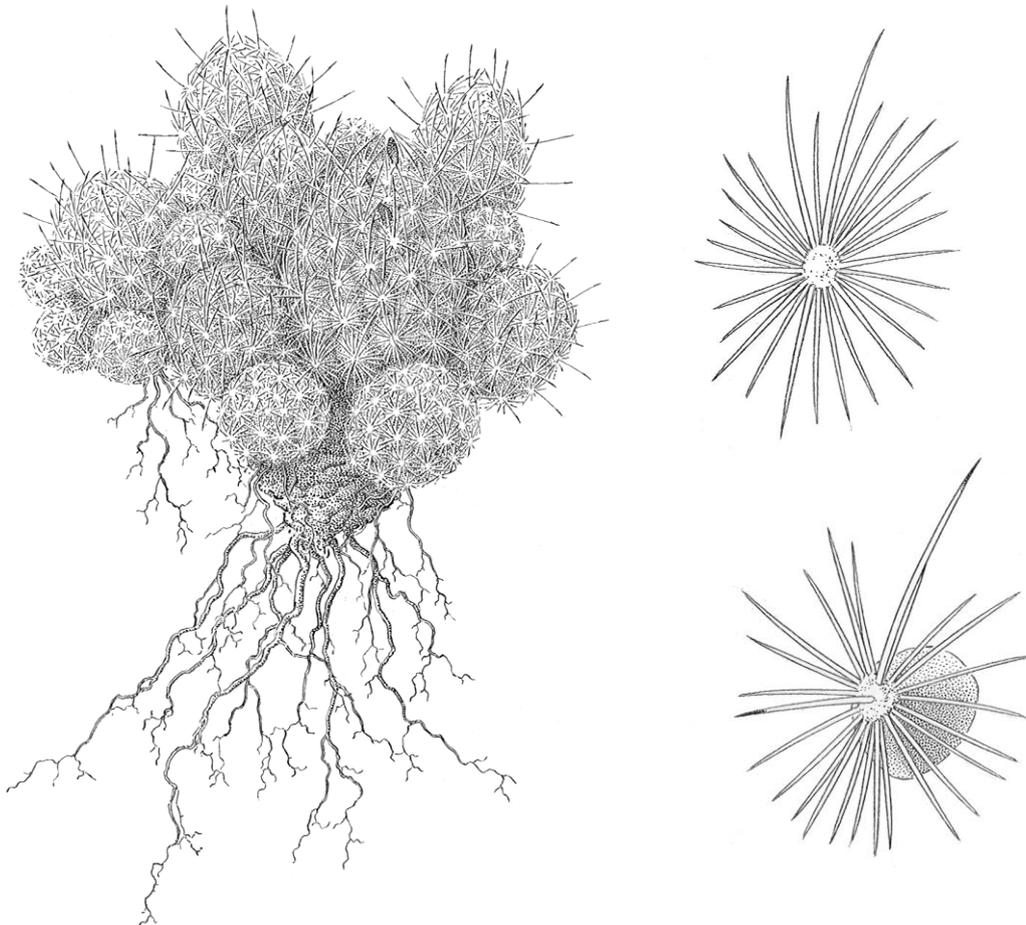


**Common names:** engl.: Sneed's pincushion cactus

**Scientific synonyms:** = *Coryphantha sneedii* (Britton & Rose) A. Berger 1929  
= *Mammillaria sneedii* (Britton & Rose) Cory 1936

**Excluded taxa:** *Escobaria sneedii* ssp. *albicolumnaria* (Hester) J. Lüthy 1999 (CITES App. II)  
= *Escobaria albicolumnaria* Hester 1941  
*Escobaria sneedii* ssp. *orcuttii* (Bödeker) J. Lüthy 1999 (CITES App. II)  
*Escobaria orcuttii* Bödeker 1933  
incl. *Escobaria orcuttii* var. *macraxina* Castetter & al. 1975  
incl. *Escobaria orcuttii* var. *koenigii* Castetter & al. 1975  
*Escobaria sneedii* ssp. *organensis* (D. Zimmerman) J. Lüthy 1999 (CITES App. II)  
*Coryphantha organensis* D. Zimmerman 1972  
*Escobaria sneedii* ssp. *sandbergii* (Castetter & al.) J. Lüthy 1999 (CITES App. II)  
*Escobaria sandbergii* Castetter & al. 1975  
*Escobaria sneedii* ssp. *villardii* (Castetter & al.) J. Lüthy 1999 (CITES App. II)  
*Escobaria villardii* Castetter & al. 1975

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, clustering, columnar cactus, densely covered with a predominantly white, strikingly dimorphic spination: Immature stems notably smaller, only with short, appressed radial spines, mature stems (only a few per clump) considerably bigger, with long radial and central spines. Growing on limestone rocks.

**Roots:** Short taproot or several fleshy roots.

**Stem:** Pale to dark grey-green, strongly branching, forming clumps with up to 30 or more (100+) stems, of which only a few are mature (average 1-5 per clump), immature branches predominating, lower branches producing own roots, stems cylindrical, 2.5-7.5 (-13.5) cm high, (1.2-) 2.5 (-4.5) cm Ø.

- Tubercles:** Cylindroid, truncate, 4-9 mm long, 2.5-4.0 mm  $\varnothing$ , with median longitudinal groove on upper (adaxial) side, connecting the sterile (spine-bearing) part of the areole on the tip of the tubercle with the fertile part (producing flowers) in the axil.
- Areoles:** 1.5 – 2.5 mm  $\varnothing$ , bearing short, white wool (in the region of the stem apex).
- Spines:** 31-68, very dense, covering the stem, spreading parallel to stem surface or even deflexed, hence little or non pungent.
- Radial spines:** 24-46 per areole (18-25 in immature stems), acicular, snowy white, radiating, spreading or deflexed, straight, 5-6 (-12) mm in upper part of the areole,  $\pm$  3 mm in lower part.
- Central spines:** Only present in mature stems, inner centrals (0-6), straight and at least the shortest ones usually porrect, (2-) 5-9 (-15.5) mm, outer centrals (5-18) in a radiating arrangement, variously protruding or appressed, (2-) 4-10 (-16.5) mm, acicular, white, tipped with pink or lavender
- Flowers:** Apical, small, 1-3 cm long and 1.2-2.5 cm  $\varnothing$ , pink with olive-brown or greenish, margins of perianth segments fimbriate.
- Fruits:** Clavate, up to 1.5 cm long, 3-6 mm  $\varnothing$ , green turning brownish pink, with persistent floral remnant.
- Seeds:** Kidney-shaped, 0.75-1 x 1.25-1.5 x  $\pm$  0.75 mm, reddish-brown, seed coat finely pitted.

**Distribution:** States of New Mexico and Texas, USA



State of Chihuahua, Mexico.



**Trade:** In some demand by collectors because of the small size and probably unjustified reputation for rarity (whereas most other species of the genus *Escobaria* are not really popular). Only a few "typical", selected clones of *Escobaria sneedii* ssp. *sneedii* and ssp. *leei*, which don't represent the whole morphological variability, are propagated artificially (often by cutting branches, which usually have their own roots already) and are observed in international trade. Illegal and widespread collection is a major threat to both subspecies in USA, e.g. the population of ssp. *sneedii* near El Paso has been depleted by local cactus collectors. Seeds from artificial propagation are readily available in international trade. Nurseries registered for artificial propagation: Germany P-DE-1001 (only ssp. *sneedii*), Switzerland P-CH-1001.

**Similar species:** *Escobaria sneedii* ssp. *sneedii* is reported to intergrade with ssp. *leei*, where they occur sympatrically. The latter is smaller in all parts, stems 13-30 mm  $\varnothing$ , 35-100 mm long, profusely branching and forming dense clumps with up to 250 stems, of which very few are mature. Spines (radials and centrals) are more numerous and shorter, 62-95, 1-10 mm long, very tightly appressed, sometimes nearly touching the sides of the tubercles. Further, ssp. *sneedii* could be confused with other columnar, white spined *Escobarias*, especially in seedling stage: The remaining subspecies of *E. sneedii*, as listed above (CITES App. II), differing mainly in quantitative aspects. Furthermore *E. tuberculosa* (Engelmann) Britton & Rose (CITES App. II) could be confounded. *E. sneedii* ssp. *sneedii* (and ssp. *leei*) are distinct from all other taxa, producing clumps of predominantly immature stems and having a rather dense, partly appressed spination. They are smaller in all aspects. *E. tuberculosa* has fewer spines, ascending tubercles, a distinctly corky stem base and very different pink, scented flowers with a narrow tube, opening in the afternoon.

**Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California.

Fletcher, R. & al., eds. (1984): A Handbook of Rare and Endemic Plants of New Mexico. The New Mexico Native Plant Protection Advisory Committee. University of New Mexico Press, Albuquerque.

Hunt, D., (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.

Taylor, N. P. (1983). Die Arten der Gattung *Escobaria*. Kakt. and. Sukk. 34 (4): 76-79, (5): 120-123, (6): 136-140, (7): 154-158, (8): 184-188.

Zimmerman, A. D. (1985, ined.): Systematics of the genus *Coryphantha* (Cactaceae). Ph.D. thesis. The University of Texas at Austin.



**Commercial names:**  
 engl.: Chilean false larch, Patagonian cypress  
 esp.: Alerce, Ciprés de la Patagonia  
 fr.: Alerce

**Common names:** Lahuan, Lahuén

**Scientific synonyms:** *Fitzroya patagonica* Hook. f.

**Subject to CITES regulations:** All parts and derivatives.

**Macroscopic characteristics of the wood:** Wood yellow ochre, non porous, growth rings distinct, but very narrow. Sapwood and heartwood differentiated; the sapwood is yellow ochre, the heartwood has a very characteristic pinkish brown or reddish colour, sometimes the wood shows a brownish violet grain. Resin absent. There is pleasant smell of cedar when the tree is freshly cut. Fibres straight.  
 Hardness: soft to moderately hard  
 Grain: fine  
 Specific weight: 0.38 – 0.58 g/cm<sup>3</sup>

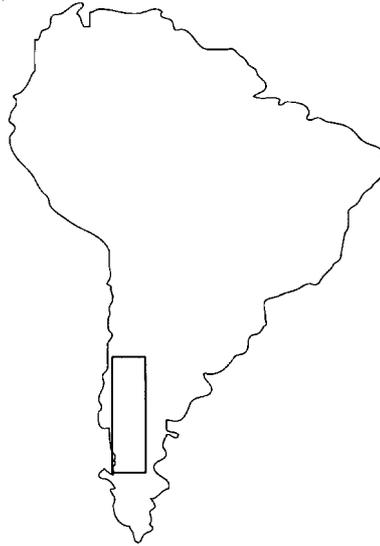
**Microscopic characteristics of the wood:** Wood non-porous. Resin canals absent. Growth rings visible. Tracheids radially distributed, (1700 –) 2400 (– 3800) µm long and 17 µm in average diameter. Late wood is very thin. Bordered pits are found on the tangential face of the tracheids, slightly smaller than those on the radial face, in a single row. Cross-fields pits cupresoid, 1 to 4 per cross-field. Axial parenchyma usually terminal, with nodular thickenings on the horizontal walls. Radial parenchyma sometimes with nodular thickenings on the terminal walls. Rays short, uniseriate, 1 to 15 cells high, sometimes with up to three radial tracheids. Both the axial and radial parenchyma contain dark deposits.

**Characteristics of the trees:** A tree up to 45 metres high, with a narrow pyramidal crown, it has a straight and cylindrical trunk 2.5 – 3.5 metres in diameter, with an average of about 30 and 1.2 metres respectively. The bark is dark brown, thick and smooth, and when split longitudinally it forms long longitudinal strips. Under the bark, there is a dark, very resinous, fibrous substance. The branches are thick, irregular and open.

This is a slow-growing species, forming very narrow annual growth rings. In some cases, it grows in diameter by approximately 1 mm every three years. It usually grows in swampy areas and in wet forests at elevations between 500 – 900 metres in altitude.

**Characteristics of trade:** The logs are usually straight, well formed and can be up to 24 metres long. There are other species in Europe, Asia and the Americas also known a larch, but these belong to the genera *Larix*, *Sequoia* and *Thuja*.

**Distribution:** Central Chile and in the province of Chubut in southern Argentina (Southern Andes)



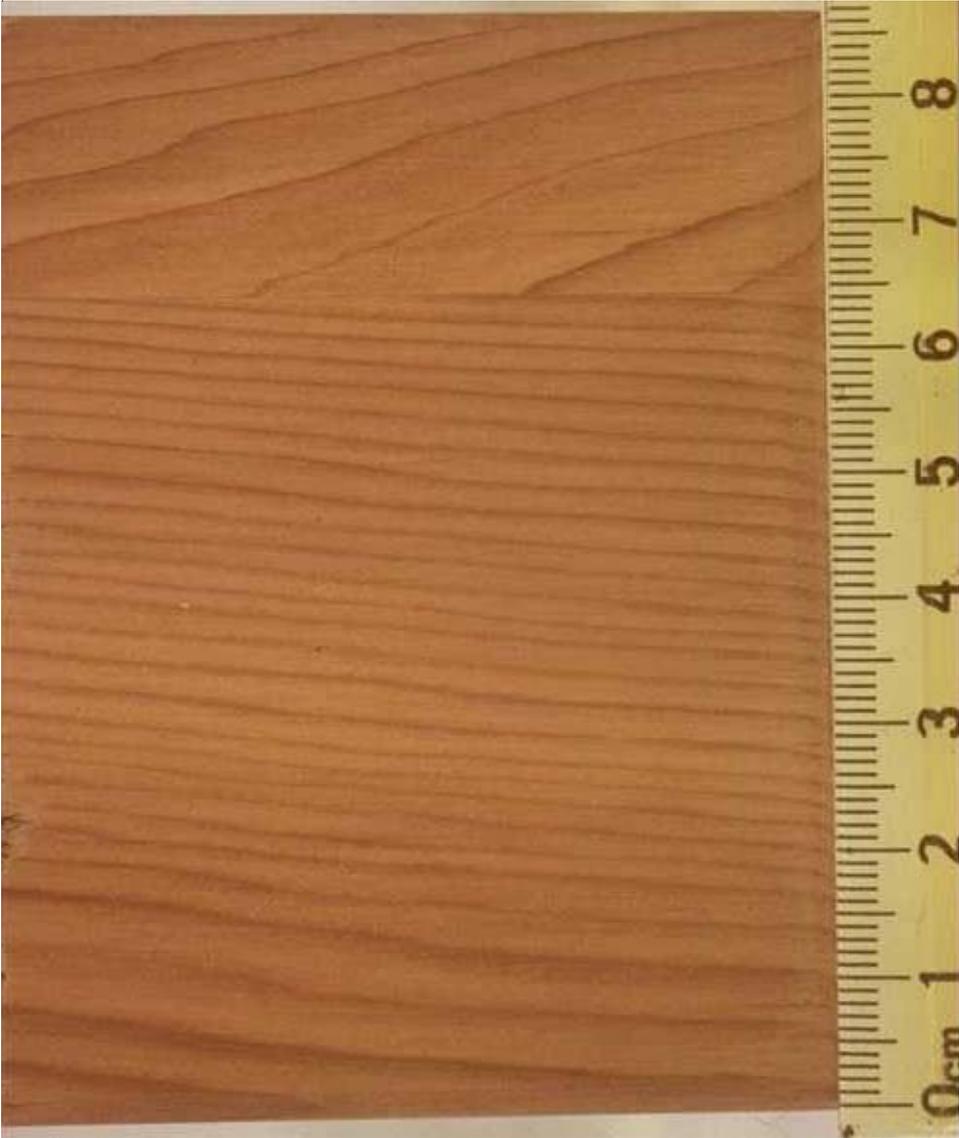
**Use:** The wood is very resistant to and can be used outside without any treatment. Used for exterior and internal flooring, mouldings, shingles, corbels, plywood, pencils, doors and windows, telephone posts, naval construction, masts, refrigeration towers, outdoor furniture, moulds for castings, barrels and musical instruments. The inside layer of bark (*estopa de alerce*) is used to calk boats. The resin is also gathered and is burned as incense or make cigar boxes.

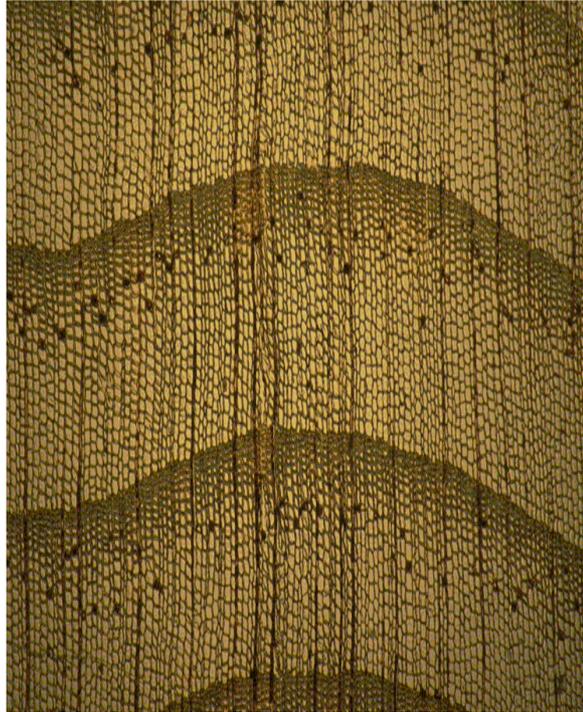
**Similar species:** There is only one species in the genus *Fitzroya*, although there are species in other genera that are similar.

Latin name	Distribution	Common name
<i>Sequoia sempervirens</i>	North America	Sequoia
<i>Thuja plicata</i>	North America	Tuya
<i>Larix decidua</i>	Europe	European larch
<i>Larix occidentalis</i>	North America	American larch
<i>Larix sibirica</i>	Northern Asia	Siberian larch

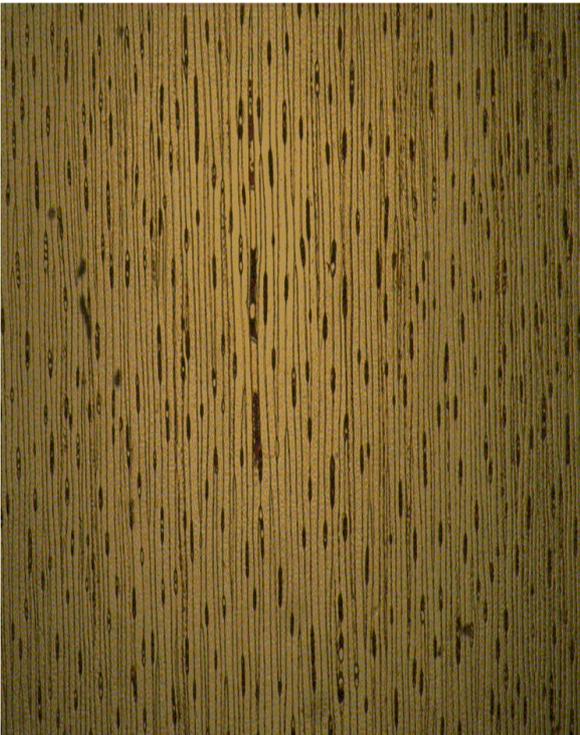
Species →				
Characteristics ↓	<i>Fitzroya cupressoides</i>	<i>Sequoia sempervirens</i>	<i>Thuja plicata</i>	<i>Larix decidua</i> <i>L. occidentalis</i> <i>L. sibirica</i>
Colour sapwood	ochre yellow	white to yellow	white	light yellow
Colour heartwood	pinkish brown	brownish red	brownish red	brownish red
Grain	fine and uniform	fine and uniform	fine and uniform	fine and uniform
Fibres	straight	straight	straight	straight
Hardness	soft	semisoft	soft	semisoft
Specific weight	0.38 - 0.58 g/cm <sup>3</sup>	0.42 g/cm <sup>3</sup>	0.37 g/cm <sup>3</sup>	0.59 g/cm <sup>3</sup>

# Fitzroya cupressoides

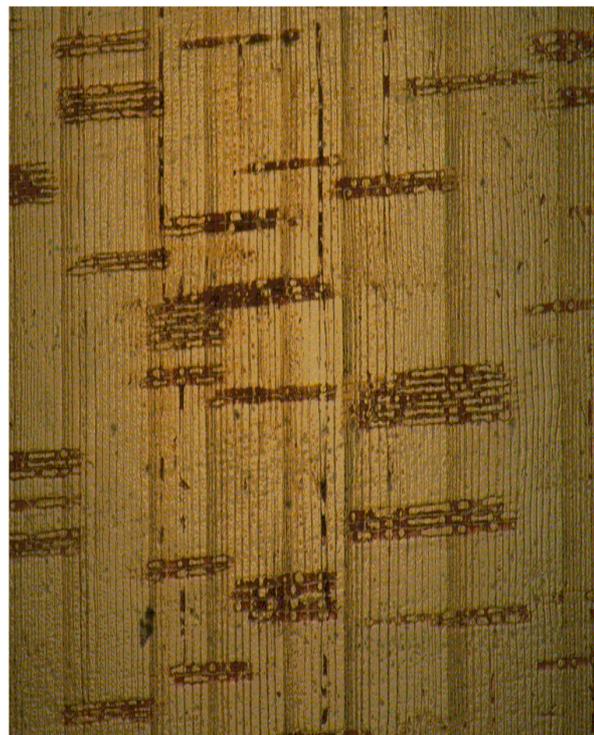




transverse section



tangential section



radial section

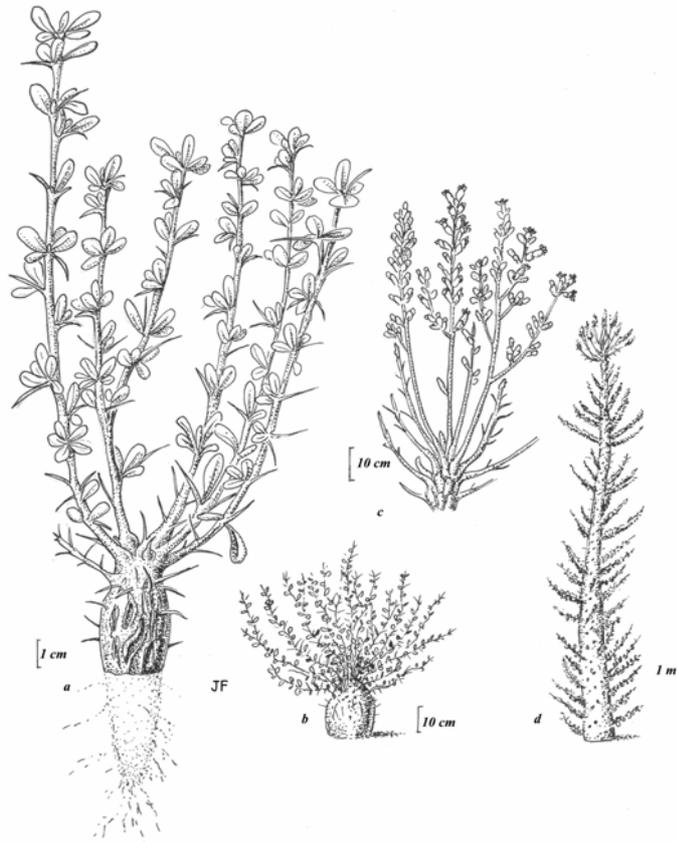


# Fouquieria columnaris

Kellogg

**Common name:** engl.: Boojum Tree.  
esp.: Cirio.  
fr.:

**Scientific synonyms:** *Idria columnaris* Kellogg  
*Fouquieria gigantea* Orcutt



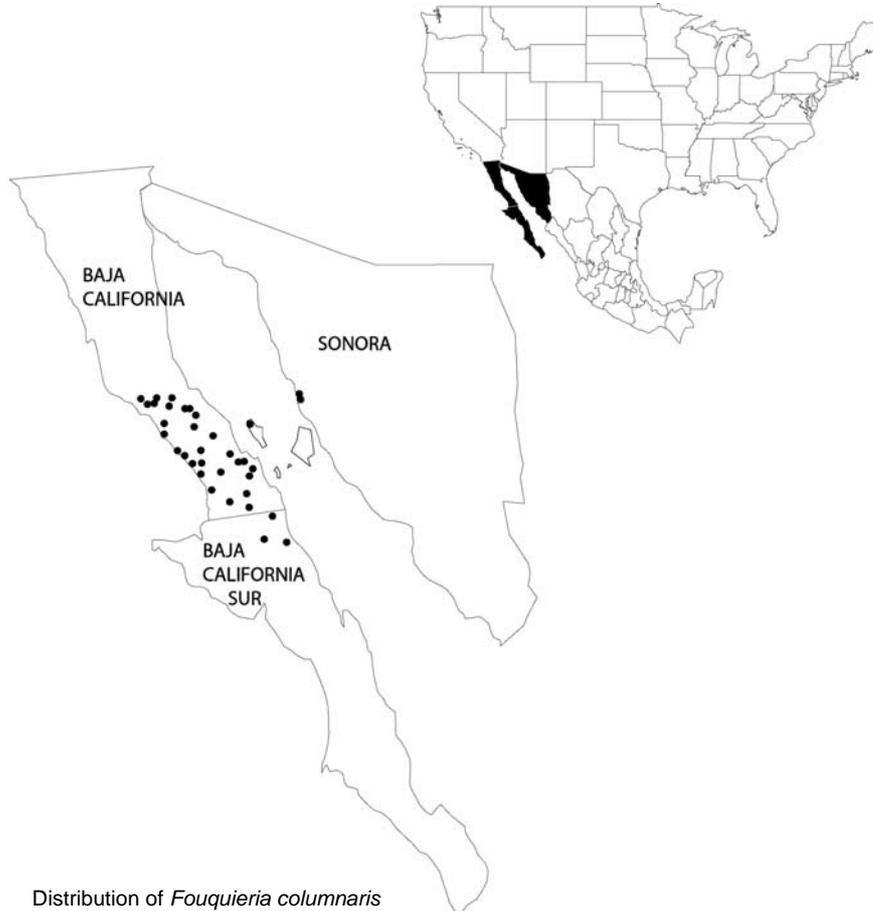
**Illustration:** a *Fouquieria columnaris* seedling.  
b. more mature plant.  
c. inflorescence.  
d. habit of mature plant.

## Characteristics:

- Vegetative:** Columniform, upwardly tapering trees, 1-16 m tall expanding from base to a maximum diameter of 20-40 cm, at 20-70 cm above base and tapering towards apex, with the central axis single or variously branched. Expanded trunk and stems smooth, solid, cylindrical to conical, dull green to light yellow or grayish with deciduous leaves, 22-40 mm long and 3-12 mm broad, arising out of trunk in lateral nodes, in a spiralled pattern on more mature plants. Leaves also arising out of young lateral branches, some branching secondarily, with petiolar spine 5-25 mm in length.
- Inflorescence:** Elongate, produced in upper stem of current year's growth, 13-40 cm long, rachis yellowish, 3-6 mm in diameter, with small bracts associated with short spines, flowers crowded in upper 1/3 to 1/4 of inflorescence, with cream yellow sepals and petals of 6-7 mm long and 3.7-4.2 mm wide, rounded and strongly incurved.
- Similar species:** *Fouquieria purpusii* and *Fouquieria fasciculata* are both initially woody and the succulent xylem develops only in the lower portion of the main stem, whereas in *Fouquieria columnaris* it is highly developed from early stages by primary thickening of the meristem.

**Distribution:**

Baja California, Mexico between El Rosario and Santa Rosalia, on Isla Angel de la Guarda in the Gulf of California, Mexico, and in a small area south of Puerto Libertad on coastal mainland Sonora, Mexico, from sea level to 1450 m elevation in Sonoran Desert.

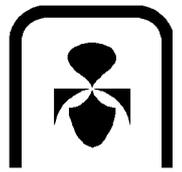
**Threats:**

Illegal collection, recreation, and harvest for wood.

**References:**

Hendrickson, J., 1972, A taxonomic revision of the Fouquieriaceae, *Aliso*, 7: 439-537.

Humphrey, R. R., 1974, *The Boojum and Its Home*, Tucson: Univ. of Arizona Press.



# Fouquieria fasciculata

Willd.ex Roem. et Schult.

**Common name:**  
 engl.:  
 esp.: Arbol de Barril.  
 fr.:

**Scientific synonyms:**  
*Cantua fasciculata* Willd. ex Roem. et Schult.  
*Fouquieria spinosa* H.B.K.  
*Bronnia spinosa* H.B.K.  
*Cantua spinosa* Willd. ex Roem. et Schult.



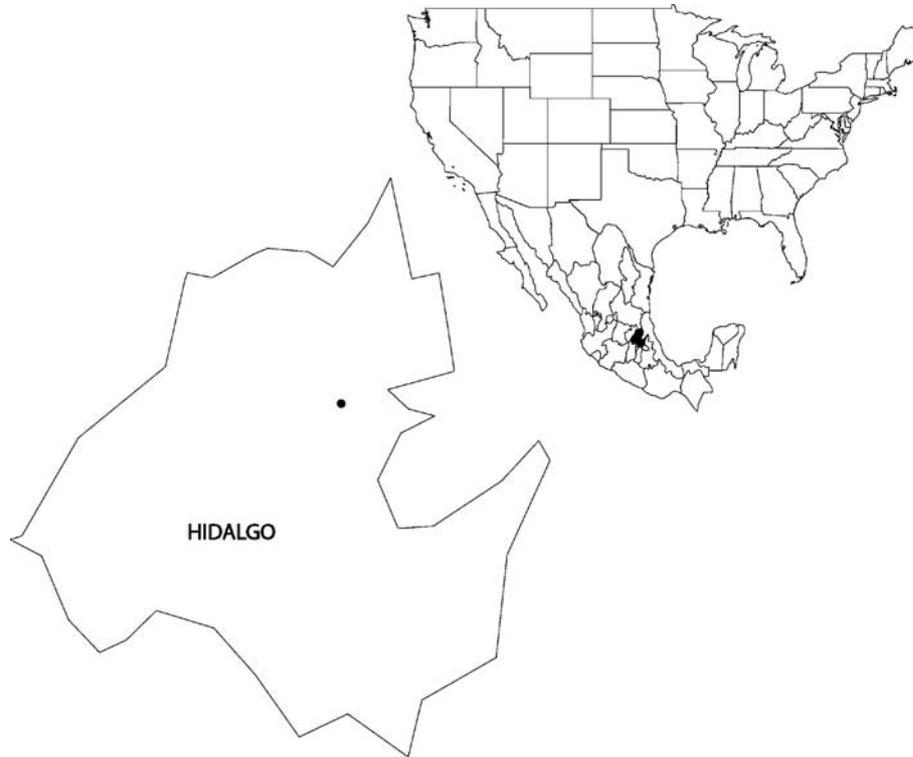
**Illustration:**  
 a. *Fouquieria fasciculata* young plant.  
 b. intermediate age.  
 c. inflorescence.

## Characteristics:

- Vegetative:** Shrubs to small trees, 2-5 m high with 1-3 greatly expanded basal trunks in mature specimens, of 25-60 cm in diameter, which narrow abruptly, continuing as one to several woody, moderately branched stems. Trunks and larger stems are shiny green, except for horizontal wedges of hard grey periderm which replace leaf bases. Young long shoots 3-4 mm diameter, decurrent ridges are dark maroon, turning grey with age. Spines on main stems 15-25 mm long, slender. Leaves 16-40 mm long and 1-15 mm wide in fascicles of 2-7, with spines up to 10 mm long.
- Inflorescence:** Round, dense, 4-9 cm long, 4-12 cm wide terminaly or sub-terminaly with green rachis bearing flowers with tubular, ivory white corolla ovary green.
- Similar species:** *Fouquieria purpusii* T. S. Brandegee - in which the expanded base extends far up the central stem to produce a tapering growth form, leaves are linear, *F. fasciculata* only has the expanded base of the central stem and the leaves are elliptical.

**Distribution:**

Known only from southern Hidalgo, Mexico in the Barrancas west of Sierra Madre Oriental north of Actopan and Atotonilco el Grande on rocky slopes at 1200-1600 meters elevation.



- Distribution of *Fouquieria fasciculata*

**References:**

Hendrickson, J., 1972, A taxonomic revision of the Fouquieriaceae, *Aliso*, 7: 439-537

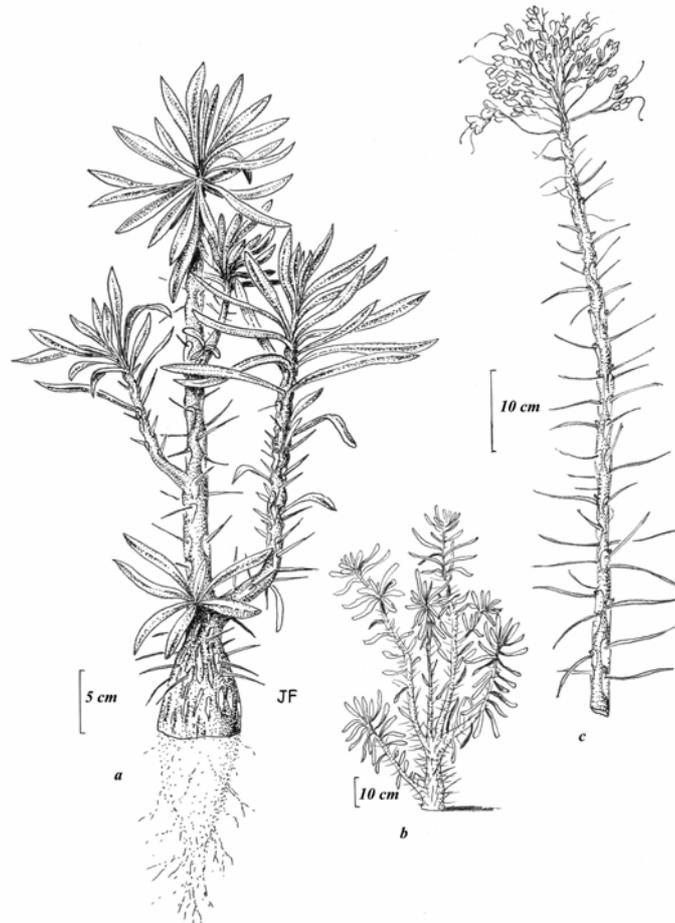
# Fouquieria purpusii

T.S. Brandegee



Common name: None

Scientific synonyms: None



**Illustration:** a. *Fouquieria purpusii* young plant.  
 b. intermediate age.  
 c. Inflorescence.

**Characteristics:**

- Vegetative:** Shrubs to small trees, 1-5 m high with 1-5 conical tapering enlarged trunks up to 20-60 cm in diameter in basal part, bearing numerous slender horizontally spinose branches. Larger stems and trunk green with smooth shiny epidermis except for horizontally elongated wedges of rigid gray epidermis which replace decurrent leaf bases. Young long shoots 3-4.5 mm diameter, decurrent ridges dark maroon turning grey with age. Spines 17-28 mm long, slender. Leaves 17-30 mm long and 2.5-6 mm wide, linear, acute at apex.
- Inflorescence:** Round, dense, 3.5-6 cm long and wide, terminal or sub-terminal with flowers having yellow white sepals, light green at base, corolla tubular, ivory white, with green ovary.
- Similar species:** *Fouquieria fasciculata* Willd. ex. Roem. et. Schult. – differs by having expanded base only at basal portion of central stem and leaves that are elliptical rather than linear.

**Distribution:**

A few localities in Southern Puebla and Northern Oaxaca, Mexico in arid tropical shrub vegetation on exposed rocky limestone outcroppings at 1000-2300 meters elevation.



- Distribution of *Fouquieria purpusii*

**References:**

Hendrickson, J., 1972, A taxonomic revision of the Fouquieriaceae, *Aliso*, 7: 439-537.



<b>Commercial names:</b>	engl.: Commoner Lignum vitae, Guayac, Lignum vitae esp.: Guayacán, Lignum vitae, Madera de gaiac, Palo Santo fr.: Gaïac, Gaïac mâle, Gaïac officinal
<b>Common names:</b>	engl.: Tree of life, Wood of life esp.: Guayacán genuino, Guayacán negro, Guayaco, Palo de hierro, Palo sano, Vera, Vera negro fr.: Bois de gaïac, Bois de vie, Bois saint port.: Guaiaco, Pau santo
<b>Subject to CITES regulations:</b>	All parts and derivatives, except seeds, spores, pollen (including pollinia), seedling or tissue cultures obtained in vitro, in solid or liquid media, transported in sterile containers and cut flowers of artificially propagated plants.
<b>Macroscopic characteristics of the wood:</b>	Wood dark brownish green, diffuse porous, growth rings distinct. The small proportion of sapwood is a pale yellow. The heartwood is light to dark olive green to brownish green with dark streaks. The sapwood is narrower in <i>G. officinale</i> than in <i>G. sanctum</i> . The resin has a slight rose-like scent. The fibres are interlocked. Hardness: exceptionally hard, resistant to nails Grain: uniform and fine. Because of its high content of an oily resin also called <i>guaiaco</i> , it has a smooth feeling similar to that of palisander. Specific weight: 1.23 g/cm <sup>3</sup> . It is one of the densest woods in trade.
<b>Microscopic characteristics of the wood:</b>	Growth rings well-defined. Diffuse porous. Vessels exclusively solitary, few, about 20 per mm <sup>2</sup> . Average tangential diameter small: (30 –) 75 (– 175) µm, perforation plates simple. Very small and bordered intervacular pitting. Deposits or gum often observed in the vessel elements. Axial parenchyma apotracheal and vasicentric paratracheal, aliform or confluent, arranged in layers. Fusiform cells frequent. Rays homocellular, exclusively uniseriate and 4 – 6 cells high, distributed in layers. Axial and radial parenchyma with crystals of calcium oxalate. Fibretracheids with thick walls, tracheids sometimes present, (440 –) 590 (– 830) µm.
<b>Characteristics of the trees:</b>	This species grows up to 10 metres in height and 0.5 metres in diameter and has a smooth bark with grey and dark green spots. The part of the trunk suitable for lumber is only 5 metres long.

**Distribution:** Caribbean, Colombia and Venezuela



**Characteristics of trade:** The genus *Guaicum* is frequently called 'lignum vitae'. The name *guayacán* is also used to designate other species such as *Tabebuia* spp. (Bignoniaceae), *Caesalpinia melanocarpa* (Fabaceae) and *Andropogon angustatus* (Poaceae).

The wood of this species is one of the hardest. Its high density, oily resin content and fine grain make it one of the most important woods for manufacturing bearings, pulleys, pivots and rollers. It is usually exported in the form of logs, planks and finished products.

**Use:** Bearings for the propeller shafts of ships and lath work: balls, cups, dishes, mallet heads, pulleys, pivots, washers, guides, rollers and wheels. It is also used to manufacture sports equipment, in the textile industry and for the preparation of medicines under the names: Guayaco gum, Guayaco resin, Guaiacum, Lignum sanctum and Lignum vitae.

**Similar species:** There are six species of trees and shrubs in the genus *Guaicum*, found in subtropical and tropical America. Lignum vitae is usually traded without use of a scientific name at the species level.

Sometimes, this species can be identified by the origin, for example: *Guaicum unijugum* is endemic to Mexico; *Guaicum coulteri* (synonym, *G. planchonii*) is found primarily in the Pacific Coast watershed, from northwestern Mexico to Central America. *Guaicum coulteri palmeri* (synonym, *G. palmeri* Vail) is found only in northwestern Mexico, from northwestern Sonora to northern Sinaloa. It can also be found under the name *Guaicum guatemalense*, which has been reported from Guatemala to Costa Rica, although it is considered to be a synonym of *G. sanctum* or a hybrid of *G. sanctum* x *G. coulteri*. In both cases, it is listed in the CITES appendices as *G. sanctum*.



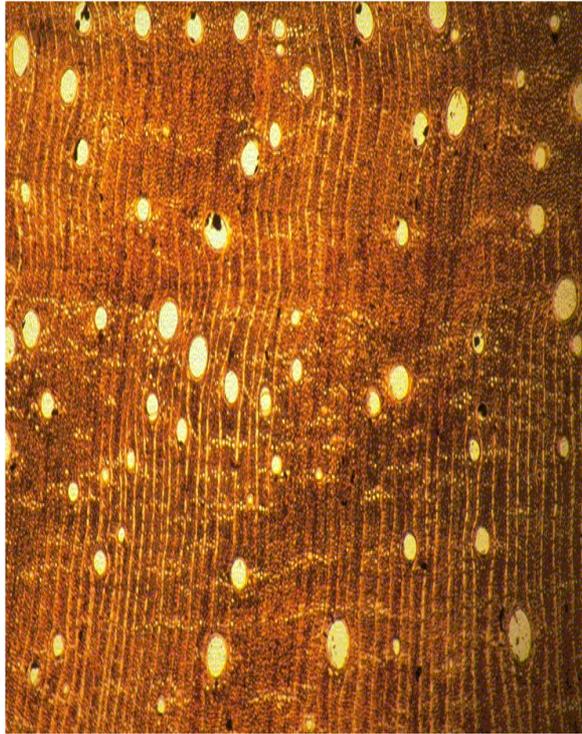
The following species are also rather similar.

Latin name	Distribution	Common name
<i>Bulnesia arborea</i>	Colombia, Venezuela	Vera, Guayacán, Guayacán resino, Palo santo
<i>Bulnesia sarmientoi</i>	Argentina, Bolivia, Paraguay	Palo santo
<i>Gymnanthes lucida</i>	Central America, Caribbean	Ébano verde, Granadillo
<i>Tabebuia</i> spp.	Southern Florida, Brazil	Madera verde

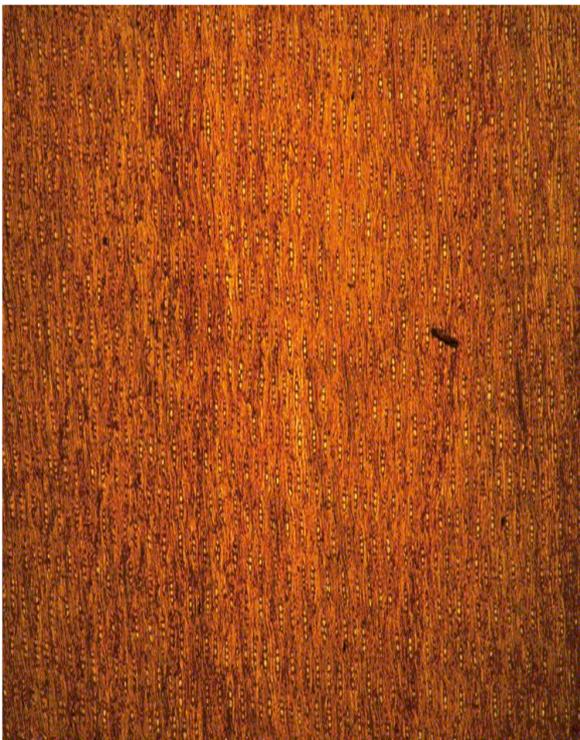
Species → Characteristics ↓	<i>Guaiacum officinale</i> <i>G. sanctum</i>	<i>Gymnanthes lucida</i>	<i>Bulnesia arborea</i> <i>B. sarmientoi</i>	<i>Tabebuia insignis</i> <i>T. longipes</i> <i>T. stenocalyx</i>
Colour sapwood	light yellow	white	whitish yellow	light yellow
Colour heartwood	olive green	olive brown	green to brownish green	dark yellow
Grain	fine and uniform	fine	fine	medium
Fibres	interlaced	straight	straight	not straight
Hardness	very hard	very hard	very hard	semihard to hard
Specific weight	1.23 g/cm <sup>3</sup>	1.1 - 1.2 g/cm <sup>3</sup>	0.9 - 1.0 g/cm <sup>3</sup>	0.64 - 0.74 g/cm <sup>3</sup>



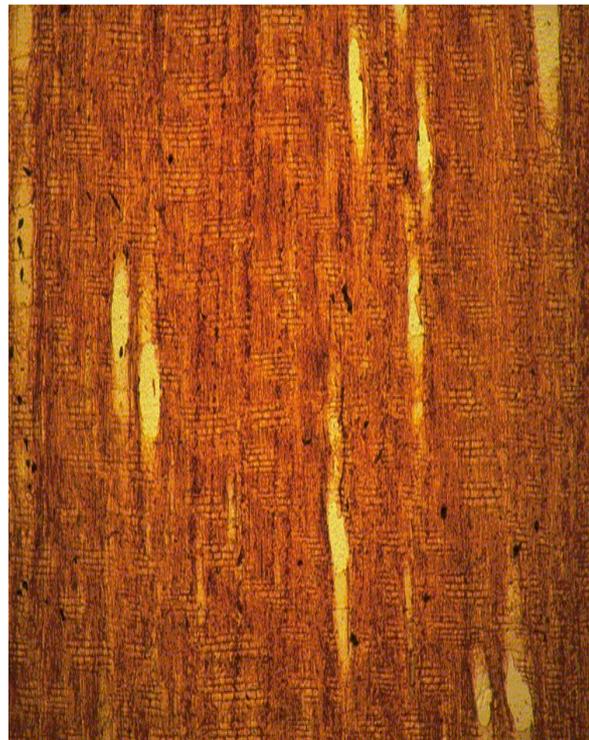




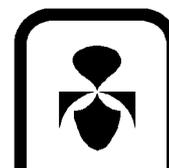
transverse section



tangential section



radial section



**Family:** Orchidaceae

**Synonyms:** –

**Vernacular names:**

english:	Gastrodia
french:	
spanish:	
german:	Gastrodie
italian:	

**Geographical range:** From the Himalayas through China to Japan and Korea and northwards to the Russian Far East (Chabarovsk, Primorje, southern parts of Sachalin and the Kurile Islands).

**Distribution by country:** Bhutan, China (including the Province of Taiwan), Democratic People's Republic of Korea, India, Japan, Nepal, Republic of Korea, Russian Federation.

**Protection:** CITES Appendix II (#7), since 01.07.1975.  
All species of the genus *Gastrodia* are included in CITES Appendix II.

**Use:** Medicinal plant used in TEAM.

## Botanical drugs in trade

**Plant parts used:** Rootstock.

**Pharmaceutical names**

latin:	Gastrodiae rhizoma, Rhizoma Gastrodiae, Rhizoma Gastrodiae elatae
english:	Gastrodia rhizome, (tall) gastrodia tuber
french:	
spanish:	
chinese:	Tian Ma (Tianma), Tien-ma
german:	Gastrodien-Wurzelstock
italian:	

**Countries of export:** China (including Hong Kong SAR), Republic of Korea.

**Source:** Artificial propagation and wild-collection.

**Commodities in trade:** Mainly dried, sliced rootstocks (cut drug); in addition also dried, whole rootstocks (crude drug).

### Characteristics:

**Crude drug:** (Fig.1) Rootstock oval to oblong, somewhat flattened, often curved, 3-15 cm long, 1.5-6 cm wide and 0.5-2 cm thick, hard, horny and not easily broken; at one end with a ±circular attachment of the stem or the remains of the stem; exterior yellowish white or pale yellow to grey-brown, strongly longitudinally wrinkled due to shrinkage and with several weak and distinctly remoted transverse rings; fractures even, horny, whitish yellow or pale brown.

Cut drug: (Fig. 2) Extremely fine, light, almost semitranslucent, only 1-2(-3) mm thick slices of the rootstocks; slices in size and shape variable, circular, oval to oblong, about 1-3 cm long; cut surface horny, pale to light brown on which vascular bundles appear as speckles or short streaks; fractures even, smooth and shiny.

Odour: Weak.

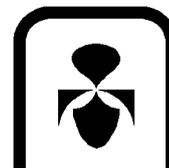
Taste: Sweet.



Figure 1. Crude drug, Gastrodiae rhizoma; species: *Gastrodia elata*, (copyright BfN).



Figure 2. Cut drug, Gastrodiae rhizoma; species: *Gastrodia elata*, (copyright BfN).



# General notes to the genera

From genera *Acanthocalycium* – *Yungasocereus*; 110<sup>1</sup> accepted genera (including 11 provisionally accepted genera - set in italic script) according to „CITES Cactaceae Checklist 2<sup>nd</sup> Ed.“ (HUNT 1999) and HUNT (2000a), KIESLING & PILTZ (2001).

Detailed information about the genera in: BACKEBERG (1958-1962), BACKEBERG (1976), BARTHLOTT & HUNT (1993), BENSON (1982), KRAINZ (1956-1975), RAUH (1979) Citation of Author names according to “CITES Cactaceae Checklist 2<sup>nd</sup> Ed.“ (Hunt 1999).

## ***Acanthocalycium* Backeberg 1936**

The genus is only provisionally accepted, possibly it belongs to *Echinopsis* (HUNT 1999).

Globular, depressed globose to short-columnar, solitary rarely clustering plants (<60 cm tall, 10-15 cm Ø); tuberculated ribs (18-20); spines (6-20 radial spines, 1-4 central spines); flowers funnellform (<5 cm Ø), white, red, pale pink-yellow; pericarpel and tube with aristate scales. 1-3 spp.; Argentina.

## ***Acanthocereus* (Engelmann ex Berger) Britton & Rose 1909**

syn. *Monvillea* p.p. Britton & Rose 1920

Erect to scandent or lateron overhanging, tree-like shrubs (<4m); stems segmented or not, 3-5 rarely flattened ribs (olive-green shoots < 9 cm Ø; big sized, white hairy areoles with many spines (5-8 red-brownish radial spines, 1-3 grey-brown-black central spines); flowers funnellform, large (12-25 cm length, 6-12 cm Ø), nocturnal, white; pericarpel and tube with spiny scales. 1-6 spp; USA, Mexico, Central America (GT, BZ, HN, NI, SV, CR, PA), Caribbean Region (CU, WI, TT, AN), Colombia, Venezuela.

## ***Acharagma* (N.P.Taylor) Glass 1997**

Solitary or clustering, globose to short columnar stems (<6 cm height, 2-7 cm Ø); distinct ± fleshy tubercles (<5 mm long) arranged in rows; areoles arranged at tubercle tips, not bipartite (without furrow / groove); usually densely spined; without nectar-secreting glands; flowers at tubercle tip, apical at stem, diurnal, white-pinkish or yellowish to reddish, short funnellform (15-20 mm length and Ø); fruits green to purplish brown; seeds black to brown, pitted. Separated from *Escobaria* by distinctive gene sequence data and lacking bipartite areoles (without furrow / groove). 2 spp.; Mexico.

## ***Ariocarpus* Scheidweiler 1838**

syn. *Neogomesia* Castañeda 1941, *Roseocactus* Berger 1925

Semi-geophytic, depressed globose, solitary or rarely branching plants (5-25 cm Ø); subterranean stembase tapering into stout rootstock; tubercles ± triangular in rosette-like orientation or spiralled; areoles usually spineless and bipartite; flowers white, yellow-green, pink or red, short funnellform; pericarpel and tube naked. 6 spp.; Mexico, SW USA (Texas). App. I: *A. agavoides*, *A. bravoanus*, *A. fissuratus*, *A. kotschoubeyanus*, *A. retusus*, *A. scaphirostris*.

## ***Armatocereus* Backeberg 1938**

syn. *Lemaireocereus* p.p. Britton & Rose 1909,

Trees or shrubs ascending or erect (3-12m); stems segmented (constricted annually), ± humped ribs 3-16 (6-15 cm Ø); flowers nocturnal, tubular-salverform (8-12 cm); pericarpel with minute scales and bristly areoles; fruit spiny. 10-13 spp., Peru, Ecuador, Colombia.

## ***Arrojadoa* Britton & Rose 1920**

syn. *Pierrebraunia* Esteves Pereira 1997

Slender, few branched, erect to semi-prostrate shrubs (<2m tall); stems (<4-10 cm Ø); 7-14 ribs; flowering zone in ring-like cephalia, alternating with vegetative growth; flowers diurnal, tubular (<3 cm long), red, orange; pericarpel and tube naked. 4 spp.; Brazil.

<sup>1</sup> Additionally A.B. Doweld proposed 9 new genera [overview of Doweld's relevant publications in D. Hunt (2000b, 2001)], which are not listed in the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999) and not recognized by the International Cactaceae Systematics Group (ICSG) (interim amendments June 2001).

Proposed new genera [*taxa of currently preferred name*]:

- Boliviacactus* Doweld 2000 [*Parodia* p.p.];
- Escobariopsis* Doweld 2000 [*Mammillaria* p.p.];
- Escobrittonia* Doweld 2000 [*Coryphantha* p.p.];
- Escocoryphantha* Doweld 1999 [*Escobaria* p.p.];
- Neonavaoja* Doweld 1999 [*Pediocactus* p.p.];
- Parrycactus* Doweld 1999 [*Ferocactus* p.p.];
- Perenocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)];
- Puebloa* Doweld 1999 [*Pediocactus* p.p.];
- Ritterocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)].

**Arthrocerus Berger 1929**

Basal branched shrubs 0,5-1m; erect trailing; slender stems (2-3 cm Ø); ribs 9-18 ± humped, flowers elongated tubular-funnelform (white - purple) (tube 6-8 cm, perianth 4 cm long); areoles of pericarpel and tube densely with minute scales (brownish 2 mm long) covered by numerous spines and hairs. 4 spp.; Brazil.

**Astrophytum Lemaire 1839**

Globular to short-columnar (5-150 cm tall, <30 cm Ø), rarely semi-geophytic; almost solitary stems; ribs 4-9; surface sparsely to densely covered with tiny tufts of minute white hairs, in exception epidermis naked ("nuda" forms); felted areoles spineless or spiny; flowers apical, funnel-salverform (2,5-8 cm Ø and length), diurnal, yellow or yellow with red throat; pericarpel and short tube woolly and densely covered with imbricate scales (scale apex ending in a black spine). 4 spp.; Mexico, SW USA. App. I: *A. asterias*.

**Austrocactus Britton & Rose 1922**

Erect or semi-prostrate, short-columnar plants (30-60 cm); stems soft fleshy; stems simple or few branched at base; stems 5-8 cm Ø; thin fibrous root system; tuberculated ribs 6-12; spines mostly ± hooked; flowers rotate-campanulate (3-6 long, 3-10 cm Ø); pericarpel and tube with imbricate triangular, aristate scales, spines or bristles and hairy; red-violet stigma. 3-5 spp.; S-Argentina, S-Chile.

**Austrocylindropuntia Backeberg 1938 p.p.**

Roots tuberous; stem cylindrical with indefinite growth (sometimes segmented); leaves terete (>4 mm long) ± persistent (lateron deciduous). 11 spp.; South America (PE, BO, AR, EC). (Further information see Opuntia.)

**Aztekium Bödeker 1929**

Plant gray-green; solitary or clustering globular stems (stems: 2-10 cm Ø, 3-10 cm tall); woolly apex sunken; ribs 8-15, transversely wrinkled; areoles almost contiguous and woolly with 1-3 short deciduous spines (3-13 mm long); flowers diurnal, tubular-funnelform (1-2 cm long, 1-3 cm Ø); pericarpel and tube naked. 2 spp.; Mexico. App. I: *A. ritteri*.

**Bergerocactus Britton & Rose 1909**

Many basal branched, low shrubs (1-1,5m), stems 3-6 cm Ø; thickened rootstock; ribs 20-25, ± humped; flowers appearing lateral at stem, size 2 x 2 cm; tube and pericarpel with many scales, felted hairs and spines; pale yellow diurnal flowers rotate-campanulate. 1 spec.; coastal ranges of Mexico (Baja California) and USA (SW California).

**Blossfeldia Werdermann 1937**

Button-like, dwarf plants; ribs, tubercles and spines absent, but with felted areoles; flowers diurnal, white to pale yellow, rotate (0,5-1,5 cm Ø); pericarpel sparsely woolly. 1 spec.; Bolivia, Argentina.

**Brachycereus Britton & Rose 1920**

Columnar erect or ascending stems (20-60 x 3-5 cm); basal branching stems forming clumps or dense colonies; low, very dense spiny ribs 16-22; fleshy stems; yellow spines darkening with age (<5 cm), flowers tubular - narrow funelform, nocturnal white (9 cm); pericarpel and tube with dense spiny areoles and minute scales. 1 spec.; Ecuador (restricted to Galapagos Islands).

**Brasilicereus Backeberg 1938**

Columnar, erect, slender, less woody, climbing shrubs (1-4m tall, <2 cm Ø); stems 8-14 ribs; felted areoles with 12-18 bristly radial spines (6-10 mm) and 1(-4) bristly central spines (<4 cm); flower nocturnal, pale yellow-green, short tubular-campanulate (6 cm long); areoles of pericarpel naked to few scales and bristles. 2 spp.; Brazil.

**Brasiliopuntia (Schumann) Berger 1926**

Segmented, treelike stems (<20m, 35 cm Ø), dimorphic shoots (cylindric stems with leave-like, flattened platyclades); unique in subfamily: pollen morphology and flowers with a ring of hairlike staminodes between the perianth and stamens. 1 spec.; South America (BR, PY, BO, PE, AR). (Further information see Opuntia.)

**Browningia Britton & Rose 1920**

syn. *Azureocereus* Akers & Johnson 1949, *Castellanosia* Cárdenas 1951, *Gymnanthocereus* Backeberg 1937, *Gymnocereus* Backeberg 1959

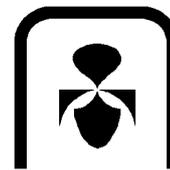
Trees or shrubs (<10m); ribs 7-34; flowers nocturnal, white, tubular-funnelform; pericarpel and tube naked. 5-11 spp.; Peru, Bolivia, Chile, Paraguay.

**Calymmanthium Ritter 1962**

Tree-like shrubs (3-8m), segmented branches (4-8 cm Ø); stems with 3-4 angled-winged ribs; ribs ± humped; concealed development of the perianth (enclosed by the pericarpel-tube); flowers nocturnal, white - pale green, tubular-campanulate (tube 8-11 cm long, 3-5 cm Ø); each areole of pericarpel with (brownish) white felt or bristly spines and one extreme minute (<1 mm long) scale. 1 spec.; Peru.

**Carnegiea Britton & Rose 1908**

Columnar or few branched, erect trees (<16m); stems many ribbed (12-30); flowers nocturnal to diurnal, white, funelform-campanulate (9-12 cm long, 5-6 cm Ø); pericarpel and tube felted, without spines or bristles. 1 spec.; USA, Mexico.

***Cephalocereus* Pfeiffer 1838**

syn. *Haseltonia* Backeberg 1949, *Neodawsonia* Backeberg 1949, *Pilocereus* Lemaire 1839

Columnar, tree-like, unbranched stems (6-15m, <50-60 cm Ø); 12-30 (-60) ribs; vegetative areoles with short 3-5 spines and 20-30 gray-white long (up to 12 cm) hairs covering the whole stem "Old Man Cactus"; flowers nocturnal, tubular-campanulate; pericarpel and tube sparsely woolly, hairy and with tiny scales. 3-5 spec.; Mexico.

***Cephalocleistocactus* Ritter 1959**

The genus is only provisionally accepted, possibly it belongs to *Cleistocactus* (HUNT 1999).

Branched shrubs (2-5m); stems (3-5 cm Ø) with 11-14 tuberculated ribs; ± dispersed lateral cephalia: floriferous areoles with flexible, hairy spines (5-6 cm long); flowers diurnal, red, tubular (4-5 x 1 cm). 1 spec.; Bolivia.

***Cereus* Miller 1754**

syn. *Mirabella* Ritter 1979, *Monvillea* pp. Britton & Rose 1920, *Piptanthocereus* (Berger) Riccobono 1909, *Subpilocereus* Backeberg 1938

Erect or ascending, usually candelaber-like branched trees or shrubs (<12m); stems distinct ribbed (3-14 ribs); spines various in number and size; flowers nocturnal, white to reddish, pink, yellow, long tubular-funnelform (13-30 cm long); pericarpel and tube with few small scales and naked. 23-35 spp.; South America (BR, AR, UY, BO, VE, PY, GY, SR), Caribbean Region (TT, AN).

***Cintia* Knize & Riha 1996**

The genus is only provisionally accepted, possibly it belongs to *Rebutia* (HUNT 1999).

Solitary semi-geophytic plants (3-5 cm Ø and height); napiform taproot (10-12 cm long); 5-8 flat tuberculated ribs with rounded podaria; spineless areoles sunken between the gibbous humps (podaria), only felted wool visible; flowers diurnal, regular salverform, yellow-orange. 1 spec.; Bolivia.

***Cipocereus* Ritter 1979**

syn. *Floribunda* Ritter 1979

Columnar shrubs; stems ribbed (4-21); stem tissue darkening when cut; areoles dense spined or spineless; flowers nocturnal (still opening to morning), pale green-yellow or white; pericarpel and tube blue-waxy, with fleshy or small scales and small areoles (with bristles or felted hairs. 5 spp.; Brazil.

***Cleistocactus* Lemaire 1861**

syn. *Akersia* Buining 1961, *Bolivicereus* Cárdenas 1951, *Borzicactella* Ritter 1981, *Borzicactus* Riccobono 1909, *Clistanthocereus* Backeberg 1937, *Hildewintera* Ritter 1966, *Loxanthocereus* Backeberg 1937, *Maritimocereus* Akers & Buining 1950, *Seticereus* Backeberg 1941, *Seticleistocactus* Backeberg 1963, *Winteria* Ritter 1962, *Winterocereus* Backeberg 1966

Ascending or erect, columnar, slender, usually basal branching shrubs (<2m tall); ribs 5-30; bristly spines few to numerous; flowers subapical - lateral, diurnal, coloured orange, yellow, red, (closed) tubular to partly ± zygomorphic (<10 cm long); pericarpel and tube dense narrow scaly and hairy. 33-50 spp.; Peru, Brazil, Paraguay, Bolivia, Argentina, Ecuador.

***Coleocephalocereus* Backeberg 1938**

syn. *Buiningia* Buxbaum 1971

Erect unbranched or decumbent branching (0,75-5m tall) shrubs; stems (4-15 cm Ø); 10-17 ribs; superficial lateral-cephalium; flowering areoles with brown-white, bristle-like hairs; flowers tubular to campanulate-funnelform (<6 cm Ø); pericarpel and tube naked. 6 spp.; Brazil.

***Consolea* Lemaire 1862**

Trees (<10m length) with dimorphic growth pattern (unsegmented, cylindrical main axis (stems) and asymmetrical, flattened, ovate lateral branches (segments = platyclades); areoles distinct, not sunken into cavities. Also distinct by seed and pollen morphology. 9 spp.; Florida to Caribbean Region. (Further information see *Opuntia*.)

***Copiapoa* Britton & Rose 1922**

syn. *Pilocopiapoa* Ritter 1961

Solitary or basal branching, clustering plants, globose to short-columnar, ascending or procumbent stems (2-20 cm Ø, 8-100 cm tall, clusters <1m Ø); rarely semi-geophytic; fibrous roots or taproots (occasionally a thin string connecting stem and taproot); plant surface often greyish by dense waxy covering; stem apex usually dense whitefelted; ribs or tuberculated ribs usually in vertically rows (rarely ribs and tubercles spirally oriented); flowers immersed at apex, diurnal, yellow (rarely pale red), short salver-funnelform (2-4 cm Ø and length); pericarpel with few mostly hairless scales. 20-25 spp.; Chile.

***Corryocactus* Britton & Rose 1920**

syn. *Erdisia* Britton & Rose 1920

Columnar erect, ascending - procumbent shrubs or trees (1-5m height); basal branching cylindrical stems (stout - slender: 3-20 cm Ø); yellow-orange coloured stem-tissue (only *Corryocactus*); napiform taproot (only *Erdisia*); spines up to 24 cm; 4-12 tuberculated ribs (areoles between the humps); flowers diurnal, rotate-campanulate; yellow, orange, purple-red; pericarpel and tube with numerous scales and bristly areoles. 12-34 spp.; Peru, Bolivia, Chile.

***Coryphantha* (Engelmann) Lemaire 1868**

syn. *Cumarinia* Buxbaum 1951, *Lepidocoryphantha* Backeberg 1938, *Neolloydia* p.p. Britton & Rose 1922

Solitary or clustering, globose to short columnar (3-20 cm Ø, 5-30 cm tall); fibrous roots or taproot; spirally tuberculated; tubercles large, elongated, terete or rhomboid and grooved above; felted furrow (with or without nectar-secreting glands) ± interconnecting areole at tip of tubercle and woolly (rarely naked) axil (with or without nectar-secreting glands); spines (7-30 radial spines, 0,4-2,2 cm; 0-4 central spines straight, curved or hooked, 2-3,5 cm); flowering areoles bipartite; flowers white, yellow, pink, funnelform - campanulate (2-7 cm Ø, 2-5 cm long); pericarpel and tube naked or scaly with hairy axils; green-yellow fruits. 41-54 spp.; Mexico, SW USA. App. I: *C. werdermannii*.

**Cumulopuntia Ritter 1980**

Segmented, strongly spined, cushion-like, caespitose shrubs; segments globose, ovoid; ephemeral tiny leaves; fleshy fruits distinctive in enclosing dry seeds (lacking pulp). 20 spp.; South America (BO, AR). (Further information see *Opuntia*.)

**Dendrocereus Britton & Rose 1920**

The genus is only provisionally accepted, possibly it belongs to *Acanthocereus* (HUNT 1999).

Tree-like (<10m, trunk <60 cm Ø); branches segmented, erect to pendent, 4-6 angled, crenated ribs; flowers nocturnal, white, funnelform (10-14 cm Ø); pericarpel and tube with spiny, deciduous scales. 1-2 spp.; Cuba, Haiti.

**Denmoza Britton & Rose 1922**

Unbranched, globose to short columnar, solitary stems (<1,5m tall, 15-30 cm Ø); 15-30 ribs; flowers in lateral cephalia, diurnal, red, tubular to slightly zygomorphic; pericarpel and tube densely hairy, bristly. 1 spec.; Argentina.

**Discocactus Pfeiffer 1837**

Stems mostly unbranched, rarely semi-geophytic, globose to depressed-globose (5-30 cm Ø, 2-10 cm tall), flattened, disc-shaped in old age; ribs (8-25) distinct or mostly tuberculated; spiny areoles (3-14 central and radial spines) at top of tubercles; depressed cephalium white woolly with brown or red bristles; flowers tubular-funnelform (7 cm long), nocturnal, white, fragrant. 6-7 spp.; Brazil, Bolivia, Paraguay. App. I: *D. bahiensis*, *D. ferricola*, *D. heptacanthus*, *D. horstii*, *D. placentifformis*, *D. pseudoinsignis*, *D. zehntneri*.

**Cylindropuntia (Engelmann) F. Knuth 1936**

Unique in the presence of papery sheaths on the spines; also distinguished in cylindrical stem segments and seeds. 33 spp.; North America (SW USA, MX, Carribean Region, 1 spec. (*C. tunicata*) introduced as medical plant in South America (CL, EC). (Further information see *Opuntia*.)

**Disocactus Lindley 1845**

syn. *Aporocactus* Lemaire 1860, *Bonifazia* Standley & Steyermark 1944, *Chiapas* Britton & Rose 1923, *Heliocereus* (Berger) Britton & Rose 1909, *Lobeira* Alexander 1944, *Nopalxochia* Britton & Rose 1923, *Pseudonopalxochia* Backeberg 1958, *Wittia* Schumann 1903, *Wittiocactus* Rauschert 1982

Climbing, pendent, epiphytic or epilithic shrubs; aerial roots; stems initially terete becoming 2-angled; margin of flattened-winged ribs crenate, lobed; spines absent or bristly; flowers diurnal, red, orange, yellow, white, pink to blueish, slender tubular, short or long funnelform. 16 spp.; Mexico, Brazil, Colombia, Venezuela, Ecuador, Peru, Central America (CR, PA, HN, NI, GT, SV). App. I: *D. macdougallii*.

**Echinocactus Link & Otto 1827**

syn. *Echinofossulocactus* Lawrence 1841, *Emorycactus* Doweld 1996, *Homalocephala* Britton & Rose 1922, *Meyerocactus* Doweld 1996

Solitary (only one species basal branching), globose to columnar plants (30-120 cm Ø, 15-300 cm tall); sharply ribbed (8-50 ribs); usually stem apex densely yellow woolly or white felted; areoles large (in one species areoles upwards groove-like elongated); spines straight to strong curved, sometimes stout, depressed or horizontal striped (red, brown, yellow, 1-4 central spines, 5-11 radial spines; 2-6 cm length); flowers diurnal, yellow or pale pink, funnelform-campanulate, (3-8 cm Ø, 2-6 cm length), apical or in subapical ring; pericarpel and short tube covered with dense wool and imbricate scales (scale apex ending in a black spine). 6 spp.; USA, Mexico.

**Echinocereus Engelmann 1848**

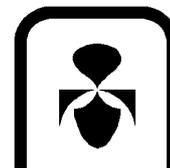
syn. *Morangaya* Rowley 1974, *Wilcoxia* Britton & Rose 1909

Basal branching (clustering) or solitary, short columnar low shrubs; soft fleshy cylindrical stems (<1m long, < 10 cm Ø); rarely semi-geophytic with subterranean stembase; usually fibrous roots or napiform taproots (*Wilcoxia*); ribbed or rarely with indistinct tuberculated ribs (5-22 ribs); pericarpel and tube with scales, spines, bristles, hairs and felted wool; flowers funnelform or campanulate, diurnal; usually green stigma; fruits densely spined, berry-like. 54-59 spp.; USA, Mexico. App. I: *E. ferreirianus* var. *lindsayi*, *E. schmollii*.

**Echinopsis Zuccarini 1837**

syn. *Acantholobivia* Backeberg 1942, *Chamaecereus* Britton & Rose 1922, *Helianthocereus* Backeberg 1949, *Hymenorebutia* Fric ex Buining 1939, *Leucostele* Backeberg 1953, *Lobivia* Britton & Rose 1922, *Neolobivia* (Backeberg) Y. Ito 1950, *Pseudolobivia* (Backeberg) Backeberg 1942, *Reicheocactus* Backeberg 1942, *Setiechinopsis* (Backeberg) De Haas 1940, *Soehrensia* Backeberg 1938, *Trichocereus* (Berger) Riccobono 1909

Solitary to basal or candelaber-like branching cluster, erect or semi-prostrate, tree-like, shrubby, globose to short columnar stems (0,15-12m tall, 1-70 cm Ø); rarely semi-geophytic with subterranean stembase extending into taproot (*Lobivia*); 4-50 sharp ribs or ± tuberculated ribs (vertically or spirally rows); tubercles often humped and slightly oblique in orientation (*Lobivia*); spiny felted areoles (2-50 radial spines, 0,5-2 cm long; 0-8 central spines, 1,2-14 cm long, sometimes hooked),



rarely pectinated spines (*E. famatinensis*); flowers subapical to lateral, nocturnal (partly still open at morning), white to pale pink, tubular-funnelform to salverform (2,5-25 cm long, 3,5-14 cm  $\varnothing$ ); flowers diurnal (*Helianthocereus*, *Lobivia*) bright coloured (yellow, red, magenta, orange, pink), pericarpel and tube with hairs, bristles and narrow (decurrent) scales. 61-129 spp.; Bolivia, Argentina, Paraguay, Peru, Chile, Uruguay, Ecuador.

***Epiphyllum* Haworth 1812**

syn. *Phyllocactus* Link 1829

Climbing, pendent, epiphytic or epilithic, branched shrubs; aerial roots; stems initially terete becoming 2-angled; margin of flattened-winged ribs crenate; spines absent or on terete stems only; flowers usually nocturnal (rarely still open at morning), white, yellow or pale pink, tubular-funnelform with elongated tube (10-30 cm long); pericarpel with decurrent scales and naked areoles. 8-19 spp.; USA, Mexico, Central America (BZ, NI, CR, HN, GT, PA), Caribbean Region (CU, KY, JM, DO, TT, PR, VI, WI), South America (EC, CO, PE, GF, GY, BR, SR, BO, AR, PY, UY).

***Epithelantha* Weber ex Britton & Rose 1922**

Dwarf globose plants (1,5-6 cm  $\varnothing$ , high); single or clustering; stem apex immersed and woolly; tubercles small (1 mm long); areoles densely spiny; spines camouflage tubercles (19-38, 1-8 mm long, cream, pale grey, yellow); the uppermost, curved and clavate-like spines are developed as glands (lateron deciduous). Flowers apical; small (6-8 mm  $\varnothing$ ), diurnal, white, pale orange- pink, campanulate; pericarpel and tube naked. Fruits red, berry-like and dry withered rest of flower deciduous. 1-2 spp.; USA (Texas) – N-Mexico.

***Eriocyce* Philippi 1872**

syn. *Chileorebutia*, *Delaetia* Backeberg 1962, *Horridocactus* Backeberg 1938, *Islaya* Backeberg 1934, *Neochilenia* Backeberg ex Doelz 1942, *Neoporteria* Britton & Rose 1922, *Pyrrhocactus* Berger 1929, *Rodentiophila* Backeberg 1959, *Thelocephala* Y.Ito 1957

Solitary or rarely branched, (depressed) globose to short columnar (1,5-40 cm  $\varnothing$ , 70 cm tall), rarely semi-geophytic; fibrous roots or taproots (with or without neck-like junction between root and stem); 7-30(-40) tuberculated ribbed (ribs  $\pm$  notched between the areoles or humped) or divided into elongated or isodiametric tubercles; tuberculated ribs in vertically rows (or slightly spiraled); spiny and woolly areoles; spines various or pectinated (*Thelocephala*); flowers lateral or apical, diurnal, orange, red, yellow, pink, whitish, campanulate; perianth curved outwards (*Eriocyce* s.str.) or tubular-funnelform; perianth curved inwards (*Neoporteria*); flowers usually one per areole (rarely more than one); pericarpel and tube with scales; tube apex with thick bristly spines (*Eriocyce* s.str.) or tube and pericarpel with thin flexible bristles. 34-35 spp.; Chile, Peru, Argentina.

***Escobaria* Britton & Rose 1923**

syn. *Cochiseia* Earle 1976, *Neobesseyia* Britton & Rose 1923, *Neolloydia* p.p. Britton & Rose, *Thelocactus* p.p. (Schumann) Britton & Rose 1922

Small (flat) globose to short columnar plants (1-7 cm  $\varnothing$ , 3-20 cm height); single stems or often clustering, rarely semi-geophytic; fibrous roots or taproots; tubercles (2 mm-2,5 cm long) in parastiches; areoles elongated from tubercle tip to its axils, groove connecting areole at tubercle-apex with axil; areoles spiny (usually radial spines, the upper spines mostly stronger, turning upwards); flowers apical, arising singular at axils (upper adaxial part of the tubercle); diurnal, yellow-green, cream, pink, purple, brown; regular, short funnelform (1-2,5 cm  $\varnothing$ ; except *Neobesseyia* 2,5-5 cm  $\varnothing$ ); short pericarpel naked; fruits pink, red (*Escobaria* s.str.) or green (*Pseudocoryphantha*); dry rest of flower left at fruit. 18-25 spp.; USA, Mexico, Canada. App. I: *E. minima*, *E. sneedii*.

***Escontria* Rose 1906**

any branched, tree-like (<7m); 7-8 ribs; flower pale yellow, tubular-campanulate (3 cm  $\varnothing$ ); pericarpel with papery triangular scales. 1 spec.; Mexico.

***Epostoa* Britton & Rose 1920**

syn. *Binghamia* Britton & Rose 1920, *Pseudoespostoa* Backeberg 1934, *Thrixanthocereus* Backeberg 1937, *Vatricania* Backeberg 1950

Columnar shrubs or trees (<7m); many ribbed stems (<20 cm  $\varnothing$ ); flowering areoles in lateral cephalium; flowers nocturnal, white to pale reddish, tubular-campanulate; pericarpel and tube scaly and hairy. 9-16 spp.; Ecuador, Bolivia, Peru.

***Espostoopsis* Buxbaum 1968**

syn. *Gerocephalus* Rttter 1968

Many basal branched shrubs (<4m); many ribbed stems (<8 cm  $\varnothing$ ); flowers in lateral cephalium; flowers nocturnal, white, short tubular-campanulate (<4 cm); pericarpel and tube naked with few tiny scales. 1 spec.; Brazil.

***Eulychnia* Philippi 1860**

syn. *Phillipicereus* Backeberg 1942

Trees or shrubs (7-25 cm  $\varnothing$ ; 9-16 ribs); broad areoles noticeable woolly or hairy and strong spiny; central spines elongated (up to 18 cm); flowers diurnal, short-campanulate, white or pale pink; pericarpel and short tube with dense scales and woolly hairs and bristles. 5-7 spp.; Chile, Peru.

***Facheiroa* Britton & Rose 1920**

syn. *Zehntnerella* Britton & Rose 1920

basal branched shrubs or trees (3-5m); dense spiny stems 5-12 cm Ø, low ribs 12-25; ± tuberculated; flowering zone undifferentiated (*Zehntnerella*) or differentiated a lateral cephalium; flowers nocturnal, white, tubular (2-4,5 cm long); pericarpel and tube white hairy and bristly with numerous imbricate scales (1-4 mm long). 3 spp.; Brazil.

***Ferocactus* Britton & Rose 1922**

syn. *Bisnaga* Orcutt 1926

Solitary or rarely clustering, (depressed) globose to cylindric plants (12-80 cm Ø, 10->300 cm tall; cluster <3-5m Ø); ribs thick and prominent (8-40); large areoles ± felted when young, and with nectar-glands; spines well developed, either straight or curved (central spines mostly coloured (red – yellow), hooked and horizontally striped, up to 15 cm length); subapical flowers diurnal, pale yellow to red, short funnelform-campanulate (2,5-7,5 cm Ø and length); pericarpel with hairless scales. 23-27 spp.; SW USA, Mexico.

***Frailea* Britton & Rose 1922**

Dwarf, globose or short columnar, single stemmed or clustering plants (2-5 cm Ø, 3-18 cm tall); rarely semi-geophytic with subterranean stembase; plant surface greyish green – brownish; (weakly) ribs (10-33) or tuberculated ribs, the tubercles sometimes oriented in spirally rows; areoles felted and short spined (central spines never hooked, radial spines sometimes depressed or curved downwards); flowers funnelform-campanulate (2-5 cm Ø), yellow and diurnal (cleistogamous or briefly opening); pericarpel and short tube with dense red-brownish bristles and cream-white wool. 11-17 spp.; Brazil, Bolivia, Paraguay, Uruguay, Argentina.

***Geohintonia* Glass & Fitz Maurice 1991**

Globular to short-columnar (10-20 cm height, 15 cm Ø), almost solitary; stem dull blue-green, covered with thick waxy secretions; strongly, distinct ribbed (ribs 18-20). Plant almost spineless, except near apex; spiny areoles 2-3 mm apart and deciduous; usually 3 spines (3-12 mm long, curved, slightly tortuous); areoles at apex woolly with long white hairs; flowers diurnal, pink, funnelform (2-4 cm Ø); pericarpel and tube naked. 1 spec.; Mexico.

***Grusonia* F. Reichenbach ex Britton & Rose 1919**

syn. *Corynopuntia* F. Knuth 1936, *Marenopuntia* Backeberg 1950, *Micropuntia* Daston 1947

Cushions or basal branched shrubs; stems usually segmented (segments cylindrical to club shaped) sometimes with tuberculated ribs; spines ± flattened, roughened or bulbous basally. 17 spp.; SW USA, northern Mexico. (Further information see *Opuntia*.)

***Gymnocalycium* Pfeiffer ex Mittler 1844**

syn. *Brachycalycium* Backeberg 1942

Solitary or rarely clustering, (depressed) globose to short columnar, green or coloured (brownish) plants (3-50 cm Ø, 2-60 cm tall); several species semi-geophytic; fibrous roots; stem apex with ± navel-like depression; ribs or tuberculated ribs (5-32), sometimes ± divided by transversely grooves into large, stout rounded or ± polyedrical tubercles; ribs and tuberculated ribs often humped between the areoles; dense felted - hairy areoles often without central spines, radial spines (5-)10-15(>30); flowers diurnal, white, pale pink or crimson red, funnelform-campanulate (2,5-7 cm Ø, 3-7 cm long), pericarpel and tube with hairless, large ovate scales. 42-69 spp., Argentina, Bolivia, Brazil, Paraguay, Uruguay.

NOTE: grafted colour-mutations of *Gymnocalycium mihanovichii* are supermarket plants and belong not to CITES restrictions.

***Haageocereus* Backeberg 1934**

syn. *Peruvocereus* Akers 1947

Erect, creeping or decumbent shrubs (< 2m tall); 10-25 ribs (5-15 cm Ø); areoles strong spiny, elongated central spines and numerous radial spines; flowers nocturnal or diurnal (white, pinkish, red), tubular-funnelform (5-10 cm long); pericarpel and tube with scales (pronounced decurrent) and felted or woolly hairy areoles. 13-21 spp.; Peru.

***Harrisia* Britton 1908**

syn. *Eriocereus* Riccobono 1909, *Roseocereus* Backeberg 1938

Trees or shrubs (<7m), erect or scandent, rarely prostrate (*H. earle*); trunks with slender, pendent stems (3-6 cm Ø) with ribs (4-12); flowers nocturnal, funnelform (10-20 cm long); pericarpel and tube with felted and bristly areoles and triangular scales. 14-20 spp.; USA, Brazil, Paraguay, Uruguay, Argentina, Bolivia, Caribbean Region (BS, HT, DO, JM, CU, KY, PR)

***Hattiora* Britton & Rose 1915**

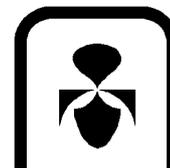
syn. *Epiphyllopsis* (Berger) Backeberg & Knuth 1936, *Pseudozygocactus* Backeberg 1938, *Rhipsalidopsis* Britton & Rose 1923

Erect to pendent, many branched, epiphytic or epilithic shrubs; stems segments (<5 cm long) flattened, angled, winged or terete; stem segments develops from apical areole-clusters; areoles usually clustered at segment apex and soft spiny or spineless; flowers rotate, campanulate, pink, cream-white, red; pericarpel naked; "Easter Cactus" (*Rhipsalidopsis*). 5 spp.; Brazil.

***Hylocereus* (Berger) Britton & Rose 1909**

syn. *Wilmattea* Britton & Rose 1920

Climbing, pendent, epiphytic or epilithic, many branched shrubs; aerial roots; stems (2-3 ribs) 3-angled or 2-winged (<5m long); margin of ribs often crenate; areoles with or without few short spines; flowers nocturnal, white, yellow or rarely red,



funnelform to tubular-funnelform (<30 cm long); pericarpel with broad triangular scales and naked areoles. 11-18 spp.; Mexico, Central America (CR, NI, PA, GT, BZ, HN, SV), Caribbean Region (CU, JM, DO, WI, VI, TT, AN), South America (Venezuela, Guyana, Surinam, Peru, Colombia).

***Isolatocereus* (Backeberg) Backeberg 1942**

Candelabra-like trees (5-15m high); stems erect, covered by grey-blueish wax (5-15 cm Ø); triangular, sharp ribs 5-8; areoles becoming confluent in age (especially flowering areoles in chain-like orientation on ribs); spines yellowish-white (1-4 central spines, <5 cm long; 6-9 radial spines, <1 cm long); flowers numerous at and beneath stem apex (apical extending lateral), nocturnal and lasting to morning, tubular to funnelform (<5 cm long, 2,5 cm Ø), greenish-white; pericarpel with few scales, but without (or very few) bristles or spines; fruit ovoid (3-4 cm long), red pulp, naked (but few scales). Separated from *Stenocereus* by distinctive gene sequence data. 1 spec.; Mexico.

***Jasminocereus* Britton & Rose 1920**

Tree-like up to 8m; branches segmented, 11-22 ribs; areoles with numerous (10-25) long (1-8 cm) spines. 1 spec.; Ecuador (restricted to Galapagos Islands).

***Lasiocereus* Ritter 1966**

Columnar, branched tree-like shrubs (1,5-4m tall); stems tuberculated ribs (10-21, 4,5-7 cm Ø); areoles usually white felted (floriferous areoles slightly differentiated with orange felted hairs); yellow to orange radial spines (8-20), 0 central spine; flowers subapical, nocturnal, white, tubular-funnelform (<5-6 cm long). 2 spp.; Peru.

***Leocereus* Britton & Rose 1920**

Few branched erect, low shrubs (2-3m); stems slender (1,5-6 cm Ø); ribs 10-20 (low, rounded); areoles of pericarpel and tube densely with minute scales (brownish 2 mm long) covered by numerous spines and hairs; nocturnal flowers white, tubular-salverform (4-7 cm). 1 spec.; Brazil.

***Lepismium* Pfeiffer 1835**

syn. *Acanthorhopsalis* (Schumann) Britton & Rose 1923, *Acanthorhopsalis* Kimnach 1983, *Lymanbensonia* Kimnach 1984, *Pfeiffera* Salm-Dyck 1845

Scandent, erect or pendent, branched, epiphytic or epilithic shrubs; stems segments flattened, angled, winged or ribbed; branching system mesotonic: young stem segments usually develops lateral from old segments, arising of areoles at the bases of old segments, never in apical clusters; areoles dispersed on whole segment surface, not clustered at segment apex; mostly spines or bristles; flowers rotate, campanulate, pink, cream-white, red; pericarpel with or without spines. 14-15 spp.; Bolivia, Argentina, Brazil.

***Leptocereus* (Berger) Britton & rose 1909**

syn. *Neoabbottia* Britton & Rose 1921

Trees or shrubs; ascending or erect (up to 5m); stems segmented and many branched; 3-8 angled humped ribs (2-6 cm Ø); flowers tubular-campanulate (2-4 cm), diurnal or nocturnal, white, pale green, yellow or pink; spiny or naked pericarpel without scales. 4-15 spp.: Caribbean Region (CU, PR, HT, DO, KY).

***Leuchtenbergia* Hooker 1848**

Solitary or rarely clustering, globular to short-columnar, glaucous plant (<50 cm; tubercle-less trunk 5-15 cm Ø); napiform rootstock; tubercles spiraled, elongated, triangular (10-12 cm); areoles apical; spines (8-14) pale yellow, papery, flexible (10-15 cm); flower from areole of young tubercle apex; funnelform, yellow (<8 cm Ø); pericarpel and tube with scales and scarcely woolly. 1 spec., Mexico.

***Lophophora* J. Coulter 1894**

Solitary or clustering, semi-geophytic, flattened-globular plants with taproots; apex sunken; soft fleshy stems (< 10 cm Ø); 5-13, flat and broad, ± transversely grooved, tuberculated ribs (flat tubercles disposed in ± vertically rows); surface blueish-green; areoles at the apex of tubercles, spineless but densely felted (cream-white wool); flowers diurnal, campanulate, white-pink; pericarpel and tube naked. 2 spp.; Mexico, SW USA

NOTE: The main trade relevance is based on *Lophophora* as a source of the hallucinogenic drug, mescaline. *Lophophora* also known under the Indian name of "peyotl".

***Maihuenia* (Philippi ex F.A.C. Weber) Schumann 1898**

Caespitose, cushion forming shrubs; succulent stems fleshy, segmented (segments terete, cylindrical, globose, <10 cm length, <2 cm Ø); leaves small, terete, deciduous or sub-persistent; areoles felted and spiny; flowers solitary, white, yellow, regular, without tube; pericarpel with broad scales. 2 spp.; S-Argentina, S-Chile.

***Mahueniopsis* Spigazzini 1925**

syn. *Puna* Kiesling 1982, *Pseudotephrocactus* Fric & Schelle 1932-1933

Densely branched cushions; roots tuberous; stem segments indistinct, ovoid (2-20 cm length); areoles sunken in hairy depressions; spines often flattened. 18 spp.; South America (PE, BO, AR, CL). (Further information see *Opuntia*.)

***Mammillaria* Haworth 1812**

Syn *Bartschella* Britton & Rose 1923, *Cactus* L. 1753, *Chilita* Orcutt 1926, *Cochemiea* (K. Brandegees) Walton 1899, *Dolichothele* (Schumann) Britton & Rose 1923, *Krainzia* Backeberg 1938, *Leptocladodia* Buxbaum 1954, *Mamillopsis* Morren

ex Britton & Rose, Neomammillaria Britton & Rose 1923, Oehmea Buxbaum 1951, Phellosperma Britton & Rose 1923, Porfiria Bödeker 1926, Pseudomammillaria Buxbaum 1951, Solisia Britton & Rose 1923

Plants flat-globose, globose, short cylindrical, semi-geophytic, elongated (e.g. *Cochemiea*: rope-like stems up to 2m long), erect or decumbent; stems solitary or clustering (ca. 1-25 cm Ø, 1-40 cm tall, clusters 1m Ø), tuberculated; usually with watery juice, some species with milk; tubercles (mammillae) terete, angled, sometimes flattened or elongated (e.g. *Dolichothele*: mammilla up to 7 cm long), never grooved on upper surface; on top of tubercles usually dense spiny areoles; all alike or sometimes with central spines, which can be very different (coloured, hooked, glandular) from the radial. Areoles bipartite (without interconnecting groove), the abaxial vegetative part at tip of mammile, and the adaxial floriferous part in axil; axils naked or felted, hairy or bristly, but without glands. Flowers arising in a subapical ring; single, diurnal, coloured (white, yellow, red, pink, brownish, greenish), small or middle-sized (1-6 cm Ø), regular or zygomorph (*Cochemiea*), (tubular)-funnelform; pericarpel and tube naked; fruits berry-like, cylindrical red; withered rest of flower persistent. Main difference between *Mammilloidya* is in the seed, which is in *Mammillaria* pitted (reticulate), not smooth as in *Mammilloidya*. 145-173 spp.; Mexico, USA, Central America (GT, HN, NI), Caribbean Region (JM, HT, VI, AN, BS, PR, WI), Colombia, Venezuela. App. I: *M. pectinifera*, *M. solisioides*.

#### ***Mammilloidya* Buxbaum 1951**

Plants flat-globose, globose to short cylindrical (ca. 15 cm Ø, 10-20 cm tall); solitary or clustering; densely spined (white, pale pink bristly spines (5-9 mm long) camouflage tubercles; 4-12 central spines, numerous (>50) radial spines); areoles bipartite (the abaxial vegetative part at tip of mammilla, and the adaxial floriferous part in axil); distinct rounded-cylindrical tubercles (mammillae) (1 cm long) without an interconnecting groove between vegetative and floriferous part of areoles; axils with pale bristly hairs. Flowers arising in a subapical ring; single, diurnal, pale green –pale pink, small funnelform (1,5 cm Ø; 2-3 cm long); pericarpel and tube naked, sometimes immersed into axil; fruits cylindrical red-pink; withered rest of flower deciduous. Main difference between *Mammillaria* is in the seed, which is in *Mammilloidya* smooth, not pitted (reticulate) as in *Mammillaria*. 1 spec.; Mexico.

#### ***Matucana* Britton & Rose 1922**

syn. Eomatucana Ritter 1965, Submatucana Backeberg 1959

Solitary or basal branching, globose to short-columnar plants (stems 5-20 cm Ø, 5-75 cm long); ascending or procumbent; by transversely grooves ± tuberculated, low ribs (7-30); areoles densely to sparsely spiny or spines absent (spines of *M. madisoniorum* easily breaking off and look-alike with *Astrophytum asterias*); flowers diurnal (red, pink, orange, yellow), usually apical and slender tubular, ± zygomorphic (bird-pollinated) (3-4 cm Ø, 6-10 cm long), or regular-funnelform in a subapical ring (4 cm Ø, 4-6 cm long); scales of pericarpel and tube with wool in the axils or naked. 15-17 spp.; Peru.

#### ***Melocactus* Link & Otto 1827**

Stems mostly unbranched, short columnar to globose (9-40 cm Ø; incl. cephalium (<1m) up to 1,5m tall); strongly ribbed and spiny; ribs (8-20); areoles often ± sunken into the ribs; areoles with strong spines (3,5 cm long, 1(-4) central spine, 4-15 radial spines); cylindrical cephalium white woolly with red or white bristles; flowers small (up to 2,5 cm long) narrow tubular, diurnal, red or pink, not fragrant; pericarpel and tube naked. 29-33 spp.; Caribbean Region, Mexico, Surinam, Guyana, Central America, Colombia, Venezuela, Ecuador, Peru, Brazil. App. I: *M. conoideus*, *M. deinacanthus*, *M. glaucescens*, *M. paucispinus*.

#### ***Micranthocereus* Backeberg 1938**

syn. Austrocephalocereus Backeberg 1938, Siccobaccatus Braun & Esteves Pereira 1990

Basal branched shrubs (<1,2m); slender stems (3-8 cm Ø); 15-20 ribs; young plants at stem bases with long (5-8 cm) white flexible, hairy spines; flowering areoles in lateral cephalia (superficial or sunken); flowers tubular (2-5 cm); pericarpel and tube naked except for minute scales. 9 spp.; Brazil.

#### ***Mila* Britton & Rose 1922**

Erect or semi-prostrate short-columnar plants with basal branches forming clumps or dense colonies; few napiform taproots; soft fleshy, cylindrical stems 5-15 cm in height, 2-3 cm Ø) ribs 10-13, bristly and spiny; diurnal yellow flowers funnelform-campanulate (1,7-3,3 cm long); pericarpel scaly and hairy. 3-4 spp.; Peru.

#### ***Miqueliopuntia* Fric ex F.Ritter 1980**

Erect branched, thicket shrubs (<1,5m high); stem segments cylindrical (7-20 cm long), glaucous when young; tubercles prominent; leaves fleshy with pointed red tips; bristly areoles strongly spined (spines <8 cm long). 1 spec.; Chile. (Further information see *Opuntia*.)

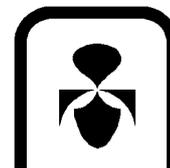
#### ***Myrtillocactus* Console 1897**

Tree-like, many branched shrubs (<4-5m); 5-9 ribs; flower diurnal, short funnelform - rotate (<2,5 cm); up to 9 flowers per areole; pericarpel and tube less woollyfruits blueberry-like. 4 spp.; Mexico, Guatemala.

#### ***Neobuxbaumia* Backeberg 1938**

syn. Rooksbya (Backeberg) Backeberg 1959

Solitary or branched, columnar trees; many ribbed; flowers nocturnal, tubular-campanulate; pericarpel and tube naked. 9 spp.; Mexico.

***Neolloydia* Britton & Rose 1922**

Solitary or basal branching, globose to short-columnar (5-7 cm Ø, 7-15 cm tall); fibrous roots; ± tuberculated ribs or ovoid tubercles spirally disposed; bipartite areoles ± elongated and grooved above; felted groove not interconnecting spiny tubercle apex and axil; flowers arising at end of groove not at axil; straight or curved spines at tubercle tip (13-20 radial spines, 6-13 mm length; 0-6 central spines, 2-3 cm length); flowers diurnal, whitish to pink; funnellform - salverform (≤6 cm Ø, 3 cm length); pericarpel and tube naked with few small scales. 1-2 spp.; SW USA, Mexico.

***Neoraimondia* Britton & Rose 1920**

syn. *Neocardenasia* Backeberg 1949

Columnar, usually basal branched shrubs or trees (<10m); 4-8 ribs (<40 cm Ø); vegetative areoles large, brown felted and usually long spiny (spines <25 cm long); flowering areoles with short brown wool, proliferous when getting older, enlarged into a cone-like short branch by continuous growth (<15 cm long); flowers 1-2 per areole, white to pale pink, short-funnelform; pericarpel and tube densely covered with scales, bristles and hairs. 2 spp.; Peru, Bolivia.

***Neowerdermannia* Fric 1930**

Solitary, depressed globose stems (4-12 cm Ø); semi-geophytic with subterranean stembase and stout rootstock; ca. 16 spirally disposed, humped tuberculated ribs, divided into triangular-conical tubercles; white felted areoles at "axil" of the upper side of tubercles; spines (radial spines 6-10, 1,5 cm long; 0-1 central spine 4 cm long); flowers diurnal, white or pale pink, funnellform (2-2,5 cm Ø and length); short pericarpel naked without scales or areoles. 2 spp.; Argentina, Chile, Bolivia, Peru.

***Obregonia* Fric 1925**

Usually solitary, sub-geophytic, depressed globose (8-20 cm Ø, <10 cm tall); taproot; plant surface grey-green; stem apex flattened, woolly; leaf-like triangular tubercles (0,5-2,5 cm broad, 1-1,5 cm long; adaxial flattened, abaxial keeled) oriented in a rosette-like arrangement; areoles at tip of tubercles with felted hairs and 2-4 ± curved spines (1-1,5 cm long), both (hairs, spines) deciduous later on; flowers apical, diurnal, white to pale pink, funnellform (2 cm Ø, 3 cm long); pericarpel and tube naked and without scales. 1 spec.; Mexico. App. I: *O. denegrii*.

***Opuntia* Miller 1754**

syn. *Austrocylindropuntia* Backeberg 1938, *Brasiliopuntia* (Schumann) Berger 1926, *Consolea* Lemaire 1862, *Corynopuntia* F. Knuth 1936, *Cumulopuntia* Ritter 1980, *Cylindropuntia* (Engelmann) F. Knuth 1936, *Grusonia* F. Reichenbach ex Britton & Rose 1919, *Maihueniopsis* Spegazzini 1925, *Marenopuntia* Backeberg 1950, *Nopalea* Salm-Dyck 1850, *Platyopuntia* p.p. (Engelmann) Ritter 1979, *Puna* Kiesling 1982, *Tephrocactus* p.p. Lemaire 1868

According to researches of the International Cactaceae Systematics Group and Anderson (2001) the genus *Opuntia* as treated in CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999) is divided into 10 genera: *Austrocylindropuntia*, *Brasiliopuntia*, *Consolea*, *Cumulopuntia*, *Cylindropuntia*, *Grusonia*, *Maihueniopsis*, *Miqueliopuntia*, *Opuntia* (sub *strictum*), *Tephrocactus*. Distinctive features: gene sequence data, flower-, pollen-, fruit- and seed morphology.

***Opuntia* Miller 1754 sub *strictum***

syn. *Nopalea* Salm-Dyck 1850, *Platyopuntia* p.p. (Engelmann) Ritter 1979

Basal branched shrubs or treelike (<10m), erect or caespitose; stems segmented, cylindrical, flattened or subglobose, not dimorphic; leaves terete to conical; felted areoles with glochids and various spines (acicular, papery, subulate); flowers rotate to funnellform or rarely ± zygomorphic, without tube, red, pink, yellow, white; pericarpel stem-like with areoles, scales, glochids. 182 spp.; North to South America, Caribbean Region and global widely introduced.

Trees, basal branched shrubs, erect or caespitose; stems usually segmented, cylindrical, flattened or subglobose, rarely ribbed or tuberculated; leaves terete; felted areoles with glochids and various spines (acicular, papery, subulate); flowers rotate to funnellform or rarely ± zygomorphic, without tube, red, pink, yellow, white; pericarpel stem-like with areoles, scales, glochids. 161-350 spp.; North to South America, Caribbean Region and global widely introduced.

***Oreocereus* (Berger) Riccobono 1909**

syn. *Arequipa* Britton & Rose 1922, *Arequipiopsis* Kreuzinger & Buining 1941, *Morawetzia* Backeberg 1936

Mostly basal branching shrubs (2-3m in height); erect, cylindrical stems; tuberculated ribs (10-25 ribs); areoles often with white long interlacing hairs; diurnal, orange - red flowers ± zygomorphic (perianth limb ± oblique), tubular-funnelform (± narrow); pericarpel and tube with numerous small scales (pronounced decurrent) and hairy. 5-9 spp.; Peru, Bolivia, Argentina, Chile.

***Oroya* Britton & Rose 1922**

Plants flattened-globose or short columnar (10-20-(25) cm Ø, 7-15(-40) cm in height), single or rarely basal branched (cushion-like) with napiform taproots. Many tuberculated ribs (7-35); areoles elongated with pectinate spines (10-30 radial spines in combelike arrangement and often sideways weaved), central spines absent or 1-2. Flowers in a subapical ring; red, pink, yellow; regular, campanulate-funnelform. Areoles of pericarpel and short tube with small decurrent scales; scale axils sparsely woolly. 1-2 spp.; Peru (3800-4200m a.s.l.).

***Ortegocactus* Alexander 1961**

Small (3-4 cm Ø) globose to short cylindrical, blueish silver-green plants with fibrous roots; usually basal branched and clustering; broad tubercles flattened (up to 12 mm Ø); areoles with short white hairs, and black or black tipped white spines (7-8 radial spines 5-10 mm; 1 central spine 4-5 mm long); fertile areoles bipartite (divided into spiny vegetative tubercle (mamillae) and single flowering, woolly axil); flowers funnellform (2-3 cm length, 1,8-2,5 cm Ø), diurnal, yellow; stigma

green-yellow; short pericarpel immersed into axil, so pericarpel naked, without areoles, scales or hairs; fruits berry-like, orange-red; dry rest of flower left at fruit. 1 spec.; Mexico (Oaxaca).

***Pachycereus* (Berger) Britton & Rose 1909**

syn. *Anisocereus* Backeberg 1938, *Backebergia* Bravo 1953, *Lemaireocereus* p.p. Britton & Rose 1909, *Lophocereus* (Berger) Britton & Rose 1909, *Marginatocereus* (Backeberg) Backeberg 1941, *Mitrocereus* p.p. (Backeberg) Backeberg, *Pseudomitrocereus* Bravo & Buxbaum 1961, *Pterocereus* MacDougall 1954

Columnar, candelaber-like trees or shrubs (3-18m); acrotonic or basal branching stems (stem 8-30 cm Ø; trunk up to 1mØ), (broad rounded or humped) ribs (3-)7->20; areoles usually broad and in some species linked by felted hairs (groove); 6-12 radial spines, 1-3 central spines (1-12 cm long), lateron deciduous; flowering areoles similar to the non-flowering areoles, or dissimilar (*Backebergia militaris*); flowers apical-lateral, mainly nocturnal, white or yellow, funnelform-campanulate (2,5-5 cm Ø, 5-10 cm long), tube and pericarpel with numerous scales, bristles and felted axils. 12 spp.; Mexico, USA, Guatemala, Honduras. App. I: *P. militaris* (syn. *Backebergia militaris*).

***Parodia* Spegazzini 1923**

syn. *Brasillicactus* Backeberg 1942, *Brasiliparodia* Ritter 1979, *Eriocactus* Backeberg 1942, *Erioccephala* Backeberg 1938, *Malacocarpus* Salm-Dyck 1849, *Notocactus* (Schumann) Fric 1928, *Wigginsia* D.M.Porter 1964

Solitary or clustering, globose to short columnar plants (5-100 cm tall, 2-25 cm Ø); stem apex ± woolly; stems ribbed and slightly tuberculated by transversely furrows (6-40 ribs); usually ribs arranged in vertically rows, spirally oriented in *Brasillicactus*; sharply ribbed in *Malacocarpus*, *Wigginsia*; usually areoles on top of tubercles, but sometimes tuberculated ribs with humps below areoles (*Malacocarpus*, *Wigginsia*); areoles felted and bristly or spiny (spines strong or short, needle-like, hooked or dagger-like; 4-60 radial spines, 0-6 central spines) or bristly; flowers apical, diurnal, tubular to shortly funnelform, yellow, pink, orange, greenish (1,5-8 cm long, 1-5,5 cm Ø); red stigma (*Malacocarpus*, *Wigginsia*, *Notocactus*); pericarpel and tube naked or dense bristly and with small scales. 60-66 spp.; Argentina, Bolivia, Brazil, Uruguay, Paraguay.

***Pediocactus* Britton & Rose 1913**

syn. *Navajoa* Croizat 1943, *Pilocanthus* B.W.Benson & Backeberg 1957, *Toumeya* Britton & Rose 1922, *Utahia* Britton & Rose 1922

Solitary or branching; mostly semi-geophytic with subterranean tapering stembase and / or taproot; stems globose to short columnar (1-15 cm Ø, 1-22 cm tall), tuberculated; young areoles at stem apex ± woolly; spines (white, creamy, brownish or black; 3-30 radial spines, 1-10 mm; 0-8 central spines, 1-7 cm); flowers apical, diurnal, white, pink or green-yellow, campanulate (1-3 cm Ø, 1-3 cm long); pericarpel naked, but tube with short fleshy, hairless scales. 6-8 spp.; W and SW USA. App. I: *P. bradyi*, *P. knowltonii*, *P. paradinei*, *P. peeblesianus*, *P. sileri*.

***Pelecophora* Ehrenberg 1843**

syn. *Encephalocarpus* Berger 1929

Semi-geophytic, solitary or rarely in old age clustering (branching basal or lateral at ground level), globose to short cylindrical (2-6 cm Ø; 1-4 cm height above ground, stem in all <10 cm long); napiform taproots; tubercles spiralled and diverse: hatchelike, lateral flattened, truncate in *P. asselliformis*, or in *P. strobiliformis* triangular, slightly keeled on lower surface, resembling a pine cone); areoles bipartite with an interconnecting groove between spiny tubercle apex and floriferous axil at tubercle base; axils woolly; spines either pectinated (<60 combelike spines, <1 mm) and persistent in *P. asselliformis*, or with radiated 7-14 flexible, whitish deciduous spines (<5 mm); flowers, diurnal, magenta, short funnelform-campanulate (1-3 cm Ø); pericarpel without scales or hairs. 2 spp.; Mexico. App. I: *P. asselliformis*, *P. strobiliformis*.

***Peniocereus* (Berger) Britton & Rose 1909**

syn. *Cullmannia* Distefano 1956, *Neoevansia* Marshall 1941, *Nyctocereus* (Berger) Britton & Rose 1909

Prostrate to ascending or scandent, branched shrubs (1-4m tall); one or numerous tuberous rootstocks (<60 cm Ø, <60kg); slender stems (1-3 cm Ø, <2m long), 3-10 ribbed or angled; areoles usually with few spines (2-9 radial spines, 1-5 central spines); flowers nocturnal (still opening to morning), tubular-salverform (1,5-15 cm long), white, greenish, pale yellow or pink; pericarpel with spiny and bristly areoles. 13-18 spp.; USA, Mexico, Central America (GT, NI, SV, CR).

***Pereskia* Miller 1754**

syn. *Rhodocactus* (Berger) F.Knuth 1936

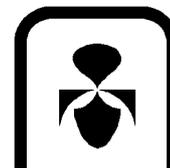
Trees, shrubs or woody scrambling plants (<8m); fibrous or tuberous roots; plants not decidedly succulent: stems slender, branching with broad foliage leaves (deciduous); flowers solitary or clustered, regular without tube (1-8 cm Ø), white, pink, orange; pericarpel naked or with few scales, bristles or hairs. 16-17 spp.; tropical America (USA (Florida), Mexico, Central America, Caribbean Region to Argentina).

***Peresklopsis* Britton & Rose 1907**

Trees-like or scrambling, few branched shrubs; stems slender with foliage ovoid or round leaves; areoles with glochids and spines; flowers regular yellow or red; pericarpel with broad leaf-like scales. 6-7 spp.; Mexico, Honduras, Guatemala.

***Pilosocereus* Byles & Rowley 1957**

syn. *Pseudopilocereus* Buxbaum 1968



Trees or shrubs (<10m); ribs (3-)4-30; areoles usually with woolly hairs (at least flowering areoles); flowers nocturnal, tubular-campanulate (4-10 cm long); pericarpel and tube naked or with few tiny scales. 34 spp.; USA, Mexico, Caribbean Region (AN, BS, CU, KY, JM, DO, PR, VI, WI, TT), Central America (GT, HN), South America (BR, VE, CO, EC, PE, PY, GY)

***Polaskia* Backeberg 1949**

syn. *Chichipia* Backeberg 1950, *Lemaireocereus* p.p. Britton & Rose 1909, *Heliabravoa* Backeberg 1956

Tree-like (4-7m); many branched, stems sharply ribbed (< 10 cm Ø) with deep vertically furrows, 7-12 ribs ± humped; areoles uniflowering; campanulate flowers (2-5 cm) cream white – pale pink (diurnal, nocturnal); small pericarpel (at least on fruit) with imbricate scales and bristly spines or hairs; stem tissue yellow; young specimens (*Polaskia* s.str.) blueish waxy. 2 spp.; Mexico.

***Praecereus* Buxbaum 1968**

syn. *Monvillea* p.p. Britton & Rose 1920

Columnar, branched trees; 8-11 humped ribs; flowers nocturnal, white, pale yellow or pink; with decurrent, broad naked scales. 2 spp.; South America.

***Pseudoacanthocereus* Ritter 1979**

Tree-like, basal branched shrubs (<2m); 2-5 angled or 5-7 ribbed, erect to pendent stems; 5-20 spines (rarely 1-3 central spines); flowers white, tubular - funnellform (<16 cm long, 6-8 cm Ø); pericarpel and tube with spiny and felted areoles. 2 spp.; Venezuela, Colombia, Brazil.

***Pseudorhipsalis* Britton & Rose 1923**

Pendent, epiphytic shrubs; stems flattened, 2-winged and leaf-like (basal and initially terete); margins of stem-wings crenate; areoles without spines; flowers short funnellform to rotate (<3 cm Ø); pericarpel with few small scales. 4-6 spp.; Mexico, Caribbean Region (JM, HT), Central America (CR, PA, GT, BZ, HN, NI, SV), South America (BR, VE, CO, EC, PE, BO).

***Pterocactus* Schumann 1897**

Small, basal branched shrubs; napiform rootstock; stem segments terete, globose or clavate; areoles with glochids and few bristles; flowers terminal, funnellform without tube (flower immersed into the stem apex); pericarpel stem-like with areoles. 9 spp.; Argentina.

***Pygmaeocereus* Johnson & Backeberg 1957**

The genus is only provisionally accepted, possibly it belongs to *Echinopsis* (HUNT 1999).

Short columnar, basal branched, low clusters (<10 cm tall); stems ribbed (12-14 ribs, ca. 2 cm Ø); flowers nocturnal, white, tubular-salverform (<6 cm long); pericarpel hairy. 2-3 spp.; Peru.

***Quiabentia* Britton & Rose 1923**

Trees or shrubs (<4m); stems terete, fleshy with foliage ovoid, ovate to spatulate leaves; areoles with glochids and numerous spines or spineless; flowers regular, crimson (<4 cm long, <8 cm Ø); pericarpel with leaves. 2 spp.; Brazil, Bolivia, Argentina, Paraguay.

***Rauhocereus* Backeberg 1957**

The genus is only provisionally accepted, possibly it belongs to *Browningia* (HUNT 1999).

Usually basal branching, columnar, erect trees (<4m); 5-6 tuberculated ribs (8-15 cm Ø), ribs divided by sharp longitudinally and transversely furrows; areoles woolly and with few spines (4 short radial spines, 2-4 central spines, <5 cm long, on young areoles red tipped); flowers apical, nocturnal, white, campanulate (8-10 cm long, <5 cm Ø); pericarpel densely covered with narrow, hairy scales. 1 spec.; Peru.

***Rebutia* Schumann 1895**

syn. *Aylosteria* Spegazzini 1923, *Digitorebutia* Buining 1940, *Mediolobivia* Backeberg 1934, *Spegazzinia* Backeberg 1933, *Sulcorebutia* Backeberg 1951, *Weingartia* Werdermann 1937

Solitary or clustering, globose to short-columnar (0,8-17 cm Ø, 0,8-20 cm tall); fibrous roots or taproots (*Weingartia* p.p., *Sulcorebutia* p.p., *Mediolobivia*); tubercles or tuberculated ribs (<30) arranged in vertically or spirally rows; areoles linear (*Sulcorebutia*), orbicular or ovoid (*Weingartia*, *Rebutia* s.str.), ± felted; white or coloured radial and not almost central spines (0,5-35 mm); linear areoles often combined with pectinated spines (*Sulcorebutia*); flowers arising apical (*Weingartia*), or usually near stem base or lateral, diurnal, pale pink, yellow, orange, red or crimson, tubular-salverform or funnellform (2,5-4,5 cm Ø, 2-4 cm long); pericarpel and tube with scales; scale axils naked (*Weingartia*) or with hairs or bristles. 24-41 spp.; Bolivia, Argentina, Peru.

***Rhipsalis* Gaertner 1788**

syn. *Erythrorhipsalis* Berger 1920

Usually pendent, epiphytic plants; stems terete, ribbed, angled, winged and usually segmented; segments usually arising in apical clusters; mostly without spines or bristles (juvenile plants of *Rhipsalis* with spines up to 1 cm); flowers small, rotate, white - pale yellow; pericarpel naked or with few bristles. 35 spp., USA, Mexico, Caribbean Region, South and Central America, Old World (trop. Africa, South Africa, Madagascar, Comores, Sri Lanka, Seychelles).

***Samaipaticereus* Cárdenas 1952**

Tree-like or shrubs (up to 3m), less branched and unsegmented, erect stems (4 cm Ø), 4-6 ribs humped (areoles between humps); flowers tubular - narrowly funnellform (5 cm long), nocturnal white, pericarpel and tube with strongly decurrent scales (1,5 cm long) and sparsely hairs and bristly spines. 1 spec.; Bolivia.

***Schlumbergera* Lemaire 1858**

syn. Epiphyllanthus Berger 1905, Epiphyllum Pfeiffer 1837, Zygocactus Schumann 1890

Erect to pendent, many branched, epiphytic or epilithic shrubs; stems segments flattened, angled or terete; areoles spiny or spineless; flowers regular to zygomorph, white, yellow, orange, red, pink; „Christmas Cactus“. 6 spp.; Brazil.

***Sclerocactus* Britton & Rose 1922**

syn. Ancistrocactus Britton & Rose 1923, Coloradoa Boissevain & Davidson 1940, Echinomastus Britton & Rose 1922, Glandulicactus Backeberg 1938, Hamatocactus Britton & Rose 1922, Toumeyia Britton & Rose 1922

Usually solitary or rarely few basal branched, (depressed) globose to short columnar (4-15 cm Ø, 3-45 cm tall); some species semi-geophytic; fibrous roots or taproot (*Ancistrocactus*, *Toumeyia*); tuberculated ribs (8-21) or tubercles; tubercles mostly 6-12 mm long vertically, 6-9 mm broad, protruding 3-6 mm; areoles circular to elliptic prolonged, sometimes (*Echinomastus*, *Ancistrocactus*) grooved above (felted / woolly furrow without nectar-secreting glands, except *Glandulicactus*); coloured spines (3-20 radial spines, 0,6-20 mm; 0-8 straight, curved, hooked or papery-flattened central spines, 1-9 cm); flowers occurring apical or in a subapical ring, diurnal, white, yellow, green, pink, red, funnellform-campanulate (2-2,5 cm Ø and length); pericarpel and tube scaly with or without hairy scale axils. 18-20 spp.; USA, Mexico. App. I: *S. brevihamatus* ssp. *tobuschii*, *S. erectocentrus*, *S. glaucus*, *S. mariposensis*, *S. mesa-verdae*, *S. papyracanthus*, *S. pubispinus*, *S. wrightiae*.

***Selenicereus* (Berger) Britton & Rose 1909**

syn. Cryptocereus Alexander 1950, Deamia Britton & Rose 1920, Marniera Backeberg 1950, Mediocactus pp. Britton & Rose 1920, Strophocactus Britton & Rose 1913

Climbing, pendent, epiphytic or epilithic shrubs; aerial roots; winged to ribbed stems (2-12 ribs, <5m long); margin of flattened-winged ribs crenate, lobed, to deeply cleft (pinnatifid, e.g. *Marniera*); areoles with or without few short bristly spines; flowers nocturnal, white, yellow or rarely red, funnellform to tubular-funnelform (<30 cm long); pericarpel with broad triangular scales and naked areoles. 18-27 spp.; USA, Mexico, Central America (BZ, NI, CR, HN, GT), Caribbean Region (CU, KY, JM, DO, PR, VI, WI), South America (EC, CO, PE, GF, GY, BR, SR, BO, AR).

***Stenocactus* (Schumann) A.W.Hill 1933**

syn. Echinofossulocactus sensu Britton & Rose 1922

Solitary or rarely clustering, (depressed) globose plants (4-20 cm Ø, 5-12 cm tall); usually thin and sinuate / undulated ribbed (25-100 ribs), except *S. coptonogonus* (10-14 tuberculated ribs); areoles white felted and widely distanced; large upwards oriented central spines (mostly flexible-papery, flattened, up to 8 cm length) and smaller radial spines; flowers diurnal, pink-striped white, pink or yellow, short funnellform (1,5-2,5 cm Ø and length); pericarpel with hairless scales. 7-10 spp.; Mexico.

***Stenocereus* (Berger) Riccobono 1909**

syn. Hertrichocereus Backeberg 1950, Lemaireocereus p.p. Britton & Rose 1909, Machaerocereus Britton & Rose 1920, Marshallocereus Backeberg 1950, Rathbunia Britton & Rose 1909, Ritterocereus Backeberg 1942

Trees or basal branching shrubs (2-15m), sometimes spread climbing (*Rathbunia*, *Hertrichocereus*) or creeping - sprawling (*Machaerocereus*); stems ribbed or with tuberculated ribs (3-17 ribs; 4-35 cm Ø); often young shoots with grey-blueish wax covering (*Ritterocereus*, *Hertrichocereus*); stems sometimes yellow fleshy (*Hertrichocereus*); areoles white or brown (yellow) felted and often dense spiny (0-20 radial spines, 1-10 central spines up to 5 cm long; 1 central spine dagger-like flattened and downwards bended (*Machaerocereus*)); flowers apical or lateral nocturnal or diurnal- white - pink, tubular-funnelform (5-7,5 cm length, 3-7 cm Ø) or campanulate (2,5-8 cm long) to narrowly tubular-salverform (10-14 cm long, 4-6 Ø, tube 4-6 mm Ø, *Machaerocereus*); or diurnal, scarlet red (hummingbird pollinated: *Rathbunia*), ± zygomorphic, narrowly tubular (7,5-12 cm long, < 4 cm Ø, *Rathbunia*); pericarpel and tube usually spiny (sometimes felted to few bristle), with minute scales (*Rathbunia*) or broad imbricate (*Ritterocereus*) or decurrent scales. 19-24 spp., Mexico, USA, Central America (GT, HN, NI, SV), Caribbean Region (CR, CU, HT, DO, JM, PR, TT, AN), Colombia, Venezuela.

***Stephanocereus* Berger 1926**

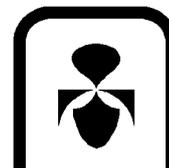
Columnar, erect, solitary (*S. luetzelburgii*) or few branched (*S. leucostele*) tree-like shrubs (1-5m tall); ribs 12-20; flowers in ring-like cephalia, apical (*S. luetzelburgii*) or alternating with vegetative growth (*S. leucostele*); flowers tubular-funnelform (5-10 cm); pericarpel and tube naked or with few tiny scales. 2 spp.; Brazil.

***Stetsonia* Britton & Rose 1920**

Columnar, candelaber-like branched trees (5-10m); 8-9 ribs; flower nocturnal, white - pale pink, tubular-funnelform (15 cm long, 9-10 cm Ø); pericarpel and tube with many broad scales. 1 spec.; Bolivia, Argentina, Paraguay.

***Strombocactus* Britton & Rose 1922**

Solitary, depressed globose to short cylindrical (<8,5 cm Ø, 3-8 cm tall); ± taproot; plant surface grey-green; rhomboid-pyramidal tubercles spirally disposed with dry apical tips; young areoles with 4-5 bristly spines (1,5 cm long) and felted hairs, both (hairs, spines) deciduous later on; flowers apical, diurnal, white-yellow, funnellform (2,5-3,2 cm Ø and length); pericarpel and tube only with rounded scales. 1 spec.; Mexico. App. I: *S. disciformis*.

**Tacinga Britton & Rose 1919**

Erect, few branching climbing or creeping shrub; stems terete or flattened (platyclades like *Opuntia*), succulent fleshy, unsegmented or segmented (0,5-10m long); leaves tiny (<5 mm long, deciduous); areoles with glochids with few or without spines; flower around stem tip nearly terminal, yellow-green, brown to violet; orange-red; pericarpel and tube stem-like with areoles. Especially species with platyclades can only be distinguished from *Opuntia* by gene sequence data 6 spp.; Brazil.

**Tephrocactus p.p. Lemaire 1868**

Small branched shrubs (branches in vertically rows); stem with distinct cylindrical or ovoid segments; areoles sunken into globose cavities with small openings; cryptic glochids. 6 spp.; Argentina. (Further information see *Opuntia*).

**Thelocactus (Schumann) Britton & Rose 1922**

syn. *Torreyocactus* Doweld 1998

Solitary or clustering, depressed globose or rarely short columnar (5-20 cm Ø, 5-20 cm tall); low or even indistinct ribs or undulated tuberculated ribs (8-13), often spiraled and divided into large, stout ± polyedrical tubercles; areoles ± elongated and grooved above; felted furrow with or without nectar-secreting glands; flowers apical appearing from the adaxial groove, diurnal yellow, red, pink, funnellform to campanulate (6-10 cm Ø, 5-7 cm long); pericarpel with imbricate scales. 10-12 spp.; Mexico, SW USA.

**Turbincarpus (Backeberg) Buxbaum & Backeberg 1937**

syn. *Bravocactus* Doweld 1998, *Gymnocactus* Backeberg 1938, *Kadenicarpus* Doweld 1998, *Lodia Mosco & Zanovello 2000*<sup>2</sup>, *Neolloydia* pp. Britton & Rose 1922, *Normanbokea Kladiwa & Buxbaum 1969*, *Rapicactus* Buxbaum & Oehme 1942, *Thelocactus* pp. (Schumann) Britton & Rose 1922

Solitary or clustering, dwarf globose to short columnar (1,5-15 cm tall, 2-10 cm Ø); often semi-geophytic; roots fibrous or napiform, sometimes tuberous root connected to the stem by a thin subterranean neck (syn. *Gymnocactus* p.p.); tubercles conical; areoles white woolly; usually white spines (acicular or tortuous, pungent or flexible; 6-28 radial spines, 0-4 central spines, rarely tipped black or entirely brown-black); juvenile plants densely covered with short whitish, ± pectinate radial spines, preserving in *Turbincarpus pseudopectinatus* (syn. *Pelecyphora pseudopectinata*), *Turbincarpus valdezianus* (syn. *Pelecyphora valdeziana*); flowers apical, diurnal, short funnellform, white, magenta or yellowish (2-4 cm long, 2 cm Ø), pericarpel and tube naked or with very few scales. 16-24 spp.; Mexico. App. I: *T. alonsoi*, (*T. bonatzii*), (*T. booleanus*), *T. beguinii*, *T. gielsdorfianus*, (*T. hoferi*), *T. horripilus*, (*T. jauernigii*), *T. knuthianus*, *T. laui*, *T. lophophoroides*, *T. mandragora*, (*T. X mombergeri*), *T. pseudomacrolele*, *T. pseudopectinatus*, (*T. rioverdensis*), *T. saueri*, *T. schmiedickeanus*, *T. subterraneus*, (*T. swoboda*), *T. valdezianus*, *T. viereckii*, *T. ysabelae*, (*T. zaragozae*)

**Uebelmannia Buining 1967**

Singled stemmed, globose or short-columnar (8-20 cm Ø, 5-120 cm) plants; plant surface rough papillate or smooth, grey-greenish, often covered with white waxy scales; young specimens with dark red-brownish epidermis; tuberculated ribs or sharp ribs (15-40); areoles spiny and felted (0,5 cm-3,5 cm); flowers yellow, diurnal, funnellform (1-3 cm Ø, 1-3,5 cm long); pericarpel and tube densely brownish woolly-bristly and with few small scales. 3 spp.; Brazil (Minas Gerais). App. I: *U. buiningii*, *U. gummifera*, *U. pectinifera*.

**Weberbauerocereus Backeberg 1941**

Tree-like (2-6m height); sharply transversely grooved, tuberculated 15-25 ribs (6-15 cm Ø); broad areoles noticeable woolly or hairy and strong spiny, elongated central spines and numerous radial spines; flowers nocturnal (white, brownish-red), regular, tubular-funnelform (5-10 cm length); pericarpel and tube with numerous imbricate scales and woolly / hairy areoles. 7-8 spp.; Peru, Chile.

**Weberocereus Britton & Rose 1909**

syn. *Eccremocactus* Britton & Rose 1913, *Werckleocereus* Britton & Rose 1909

Slender, climbing, pendent, epiphytic or epilithic shrubs; aerial roots; stems (2-5 ribs), terete, angled or flattened; margin of ribs entire, crenate to deeply cleft (pinnatifid); areoles small with or without few bristly spines; flowers nocturnal, white or pale yellow, funnellform (3-10 cm long); pericarpel with bristly areoles. 9 spp.; Mexico, Central America (NI, CR, PA, GT), Ecuador.

**Yavia Kiesling & Piltz 2001**

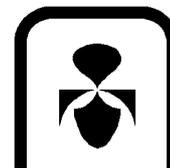
The monotypic genus is newly described by R. Kiesling and J. Piltz (2001) and therefore not yet mentioned in "CITES Cactaceae Checklist 2<sup>nd</sup> Ed" (HUNT 1999).

Dwarf, flattened globose, single-headed plant (1,3-3 cm Ø, 0,5-1,5 cm high); subterranean stem with 1 -2 large taproots (2-3 cm Ø, 2-7 cm long). Stem apex sunken with felted, woolly areoles. More or less tuberculated ribs in vertically rows (up to 40); areoles (1 mm long, 0,5 mm wide); ± pectinate, pale reddish spines (8-15); flowers pink, apical, short-funnelform to rotate (2 cm Ø, 1 cm long); pericarpel naked. 1 spp.; Argentina (restricted to the northern part close to the bolivian border).

<sup>2</sup> In supplement to the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999), Lüthy (2000) replaced the monotypic genus *Lodia Mosco & Zanovello 2000* (App. I) (*Lodia mandragora* (Fric ex A.Berger) Mosco & Zanovello) to synonymy as *Turbincarpus mandragora* (Fric ex A.Berger) A. Zimmermann 1991 ssp. *mandragora*.

***Yungasocereus* Ritter 1980**

Columnar, branched trees (4-5m tall); rounded ribs (6-10, 6-7 cm Ø), 4-12 spines (1,5-3 cm long); flowers apical, campanulate (5-6 cm long), white. 1 spec.; Bolivia.



## INTRODUCTION

Many cacti are threatened with extinction owing to the destruction of their natural habitats. These rare and slowly growing succulent plants – listed in the so-called 'Red Data Book' – have also been in demand for private collections especially in 1960-1985. Although most of them can be artificially propagated, several collectors try to add to their collections adult specimens taken in the wild. Strict measures are put in place to prevent the illegal importation of wild-collected cacti. The rapid increase in the trade in endangered cacti resulted in the inclusion of all Cactaceae in CITES Appendix II in 1975, when the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) came into force. Since 1981, 74 species from 18 genera have been gradually incorporated into CITES Appendix I. As a result of CITES regulations many cacti species are now in horticultural production. These specimens usually differ from wild-collected plants.

### Characteristics and classification of the family

The cactus family (*Cactaceae* Juss. 1789) comprises 121 accepted<sup>1</sup> genera (including 11 provisionally accepted genera) with 1307 accepted species (for a total number of 2261 taxa including subspecies, hybrids and provisionally accepted taxa) as per the CITES Cactaceae Checklist, 2nd Ed. (Hunt 1999) and the new publications (Hunt 2000a; Kiesling & Piltz 2001, Interim amendments proposed by the International Cactaceae Systematics Group Conference June 2001). The classification of the *Cactaceae* is still undergoing radical change and ongoing revision by the Working Party of the International Organization for Succulent Plant Study (IOS) (Hunt & Taylor 1990; Barthlott & Hunt 1993; Hunt 1999; for a review of the latest bibliography see Hunt 1999). This is because suprageneric division has not been completed satisfyingly and some genera are not well delimited. For example the number of accepted genera from the 1st to the 2nd edition of the CITES Cactaceae Checklist has increase from 98 to 108; while other authors mentioned ca. 100 genera of Cactaceae. New high-tech methods in development such as the study of gene sequence data expose the real relationships between the several genera and tribes; therefore the classification of the cactus family is still ongoing. The *Cactaceae* are among the most difficult families of Angiosperms to key, because the plants seem to be in a state of active evolution, lacking sharp demarcation lines to separate the genera or species. Additionally some taxa show the phenomenon of neoteny, which means that the plants pause at a youth stage without developing adult characters. Moreover the cacti are characterized by parallel evolution in vegetative morphology (globular habit evolved independently at least four times) and floral characters (same flower structure in adaption to the same pollinator) in different groups (Barthlott & Hunt 1993). These similarities and intrafamilial convergences camouflage the internal relationships of cacti. This classification problem has been aggravated by the creation of a large number of binominal synonyms based on horticultural interest and on imaginary distinctions that are not accepted. Furthermore many intrageneric hybrids occur. Finally the distinction of microscopic features in determination keys – such as pollen and seed structure or gene-sequence data – is not comprehensible to the practical user.

<sup>1</sup> Additionally A.B. Doweld proposed 9 new genera [overview of Doweld's relevant publications in D. Hunt (2000b, 2001)], which are not listed in the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999) and not recognized by the International Cactaceae Systematics Group (ICSG) (interim amendments June 2001).

Proposed new genera [*taxa of currently preferred name*]:

- Bolvicactus* Doweld 2000 [*Parodia* p.p.];
- Escobariopsis* Doweld 2000 [*Mammillaria* p.p.];
- Escobrittonia* Doweld 2000 [*Coryphantha* p.p.];
- Escocoryphantha* Doweld 1999 [*Escobaria* p.p.];
- Neonavaoja* Doweld 1999 [*Pediocactus* p.p.];
- Parrycactus* Doweld 1999 [*Ferocactus* p.p.];
- Perenocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)];
- Puebloa* Doweld 1999 [*Pediocactus* p.p.];
- Ritterocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)].

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The *Cactaceae* are part of the order *Caryophyllales* and related to *Portulacaceae*, *Aizoaceae*, *Didiereaceae* and *Caryophyllaceae*. Phytochemically they are largely characterized by betalains, which are responsible for the plant colour. Another common feature of the order members is the curved embryos centrally enclosed in the nutrient tissue (perisperm), which explains the older order name “*Centrospermae*”. Traditionally the family is divided into three subfamilies (*Pereskioideae*, *Opuntioideae*, *Cactoideae*), although macromolecular evidence (Wallace 1995) demonstrates a non-monophyletic *Pereskioideae*, with *Mahuenia* possibly representing its own subfamily *Mahuenioideae*.

### Description of the subfamilies

***Pereskioideae*** Schumann (1898): The *Pereskioideae* are considered as the most primitive subfamily combining archaic features. Their members are less succulent, often evergreen, woody caespitose cushions or scandent shrubs and deciduous trees.

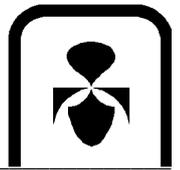
Stems terete without ribs or tubercles/mammillae. Areoles without glochids, but with foliage or terete leaves and, rarely, (strong) spines. Two genera (*Pereskia*, *Mahuenia*). *Pereskioideae* are only traded for scientific research and not for commercial purposes. The whole subfamily is listed in Appendix II.

***Opuntioideae*** Schumann (1898): Shrubby, tree-like or caespitose, occasionally scandent plants with glochids (minute barbed spines). Leaves present or absent, often (tiny) terete, deciduous after growth period; spines occasionally flattened or paper-like. Stems usually segmented (“joints”, “pads”), flattened or cylindrical (platyclades). *Opuntioideae* are in commercial trade of: fruits (e.g. *Opuntia ficus-indica*); spineless cultivars of *Opuntia* grown as fodder plants; and finally cochineal the production of the important red pigment obtained from insects feeding on *Opuntia*. The whole subfamily is listed in Appendix II.

***Cactoideae*** Schumann (1898): Tree-like, shrubby, columnar, globular, caespitose or scandent stemmed succulent plants; occasionally epiphytes, or semi-geophytes with subterranean stembase or tuberous rootstock. Stems usually unsegmented, ribbed or tuberculate. Except in flowers, foliage leaves are absent; areoles without glochids.

### GEOGRAPHICAL DISTRIBUTION AND HABITATS

Except for one species of *Rhipsalis* (*R. baccifera* (J.S.Mueler) Stearn), which extends from the neotropic region to Africa, Madagascar and Sri Lanka, the cactus family is endemic to the New World. Although typically distributed in arid and hot areas of North and South America, some frost-resistant species (*Opuntia*, *Coryphantha*, *Mahuenia*, *Tephrocactus*) can be found from British Columbia to Patagonia and even at great altitudes, up to 5,000m, in the Andes (Taylor 1997; Barthlott 1979; Rauh 1979). Has been economically important and invasive species have been introduced in subtropical and tropical regions of the Old World and Australia.

**GENERAL MORPHOLOGY AND GROWTH HABITS**

Within the flowering plants the Cactaceae belong to the Angiosperms (plant group with enclosed ovules) and are dicotyledonous (seedling germinates with two leaves = cotyledons). Cacti are all perennial, non-parasitic plants. The range of size and shapes range from terrestrial plants of giant candelabras (*Carnegia*) and leafy humid forest trees (*Pereskia*) to dwarf lithophytes (*Blossfeldia*), as well as pendent or climbing epiphytes. In habit and growth form, the cacti can be subdivided into columnar, globular, decumbent, scrawling, cushion-like clustering and scandent plants.

**Characteristic features of the Cactaceae:**

In general the cacti are morphologically characterized by thick water-storing stems with green, assimilating cortex (stem succulence), the presence of felted spiny cushion of modified short-shoots (areoles) and transformed leaves (spines), for the most part lack of foliage leaves, decrease of lateral branches, the possession of ribs, mammillae or tubercules, lack of milk (except some species of *Mammillae*, Appendix II).

Those characteristic features allow to distinguish cacti from other stem-succulent plants otherwise similar in habit and growth (convergences).

## Succulence

Together with its wide ecological and climatic spectrum, the cactus family show varied adaptations in the plant body. One of the survival responses to extreme environmental factors, such as long periods of drought and minimal amounts of available water, is the development of thickened, fleshy, or juicy water-storing tissue. Plants that have developed this feature are called succulents. Depending on the particular plant part (organ) in which the water is stored, we can distinguish between root-succulence, stem-succulence or leaf-succulence. Most frequently cacti belongs to the stem-succulents, but some of them are able to store water in their roots (*Peniocereus*, *Eriosyce*, *Pterocactus*, *Echinocereus*, etc). Often associated with but not exclusive to succulence, a number of other "xerophytic" adaptations to desert-like habitats occur: reduced plant surface (increase in volume-to-surface relationships, modification of leaves and lateral long-shoot branches into spines and areoles); thickened water-impermeable outer plant skins (cuticle, epidermis) often coated with epicuticular waxes to reduce transpiration; by waxlayers to reduce heating up from sun reflection; fewer breathing pores (stomata); and mutual shading of one plant part by another. All these features belong to the phenomenon "xerophily". Finally the cactus body builds a globular water reservoir, where the spines of the modified transpiring leaves mark the reduced lateral branches (areoles). Fig. 1 shows the phylogenetic transformation from a 'normal' leafy ancestor to a succulent cactus.

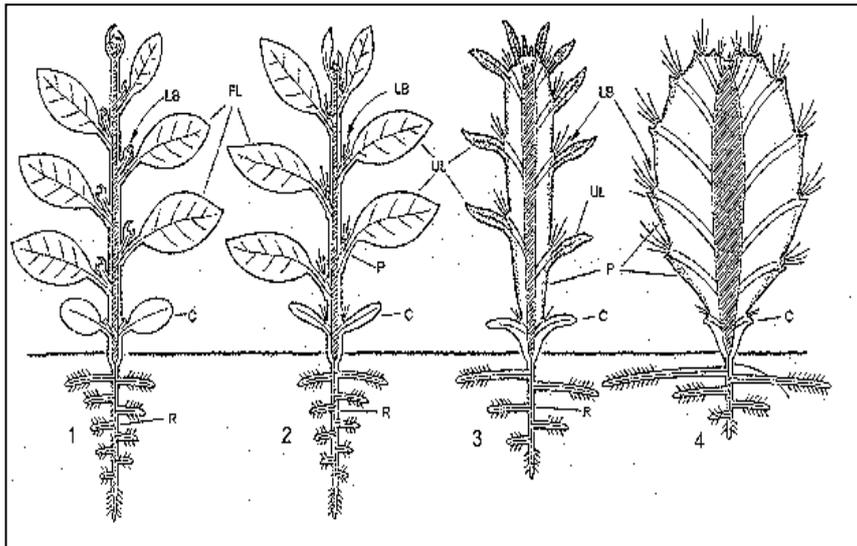


Fig. 1: Phylogenetic transformation from a "normal" leafy plant to a succulent cactus (from Rauh 1979 and Barthlott 1977).

1: "normal" leafy plant; lateral branches with well-developed foliage leaves.

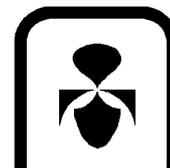
2: lateral branches (areoles) with reduced spiny leaves (Pereskioideae).

3: reduction of the upper part of leaf, and attachment of podaria to succulent stem (Opuntioideae).

4: globose succulent stem with tubercles and spiny areoles (Cactoideae).

(R = root; C = cotyledon; LB = lateral branch = areole; FL = foliage leaf; UL = upper part of leaf;

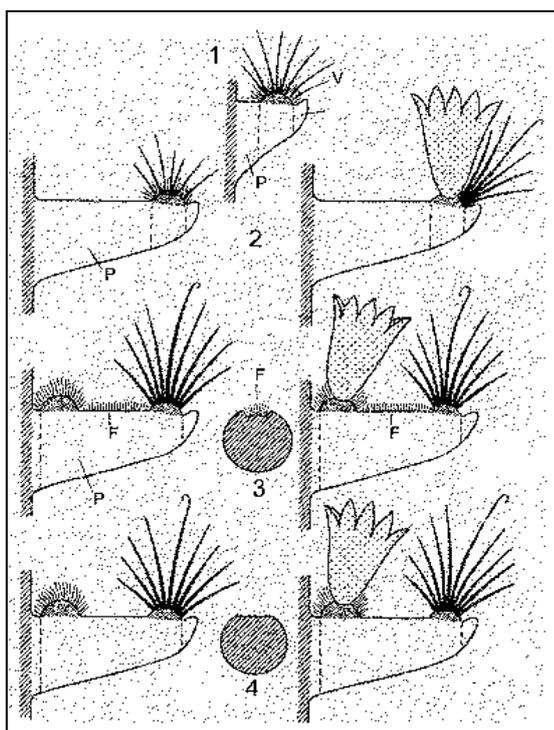
P = podaria = lower part of leaf; )



### Areoles, ribs and tubercles (mammillae)

A characteristic feature of the whole family that is an important key for determination is the presence and the structure of the areoles. As axillary buds, the areoles represent lateral shoots at the angle between the leaf (mostly a spine) and stem. They can stay as short-shoots in a dormant stage (e.g. globular cacti) or devolve into long-shoots and turn into lateral branches (e.g. well-branched candelabriform cacti). The raised or sunken areoles are covered with a felted cushion (indumentum) of

hairs (multicellular trichomes) and usually spines (foliage leaves can also be found in *Pereskia*). Areoles differ in symmetry and indumentum. Even though some areoles are apparently radial-symmetric (areoles all over and covered with identical spines) they are really bilateral. The lower (abaxial) part of the areole sustain a stronger growth, so that the vegetation-point is moved on the upper side (adaxial) of the areole. Actually the meristems of spines and flowers are separated. Spines often restricted to the lower part of areoles and reduced in the upper part, where only glochids (minutely barbed spines of the *Opuntioideae*) and hairs can be found. Also the floral meristem is limited to the adaxial, upper region of the axillary bud, with flowers arising from a groove or furrow (*Coryphantha*). The whole areole can look elongated to ovoid, with pectinate spines (arranged in comblike orientation) (*Mammillaria pectinifera*). A special case of prolonged areoles – often typical for globular cacti with tubercles – are bipartite areoles with a spatial separation of flowering and spiny parts; with the part bearing the spines located at the tubercle apex and the part producing the flowers at the base (axil) of the tubercle. Bipartite areoles can be subdivided in those with or without (short or long felted furrow between spiny tubercle apex and flowering axil) and those



without.

Fig. 2: Derivation of bipartite areoles and development of mammillae (from Rauh 1979).  
 1, 2: vegetative and fertile part of areole gathered in one point.  
 3: bipartite areole with felted groove between spiny tubercle apex and flowering axil.  
 4: bipartite areole without felted groove.  
 (F = felted furrow / groove; P = podaria)

Areoles – as lateral buds – develop only in the axil of a leaf (see Fig. 1). In cacti this leaf is reduced to the lower part of a leaf stalk (podaria). Podarias and parts of the stem form together ribs or tubercles (Fig. 2). Ribs can be transversely grooved between the areoles (as in tuberculated ribs). Humped or gibbous ribs are those where the areoles are sunken between the podarias. If these tuberculated ribs are deeply cut by transversal grooves, they are described as tubercles in vertical rows. Additionally

globular cacti show tubercles in spiral rows. Prolonged tubercles with bipartite areoles are known as mammillae.

### Thorns and “spines”

The different types of areoles produce more or less long and vigorous hairs (trichomes), bristles or “spines”. These are all modified leaves from axillary buds, and therefore their correct botanical denomination is “thorns”. However following the popular linguistic usage, we will also use the term “spines” for the cacti. Spines can be different in length, strength, shape and orientation, even within one single areole. They can be arranged in tufts without any orientation; or they may appear in comblike arrangement (pectinate spines) or in two series (outer radial spines and inner central spines). Their length varies from “hardly visible” to 30cm (*Cereus*). Individual spines can be needle-like, straight, curved or hooked (*Ferocactus*, *Hamatocactus*), flattened and paper-like (*Tephrocactus*, *Opuntia*), thin and hair-like (*Cephalocereus senilis*) or plumose (*Mammillaria plumosa*) and bristle-like. Sometimes spines are enclosed in a yellow or white paper-like sheath (e.g. *Opuntia tunicata*). The minutely barbed, fine and brittle spines (glochids) are typical of the subfamily *Opuntioideae*. Another special spine type are nectar spines (e.g. *Hamatocactus*, *Ferocactus*). From white to yellow, red, brown or black, all transitions in colour are possible. Many spines, especially large ones, are annulated or ribbed. Depending on age and environmental conditions the colour, shape, strength, length and number of spines can differ within a single species, or even on the same plant. Different types of spines and areoles are also known at immature stages of development. Young plants are often scarcely prickly or spineless and sometimes show different areole types or spines. Occasionally juvenile forms develop spines (*Rhipsalis*) that all disappear on the adult plant. Wild-collected plants usually produce stronger or longer spines, bristles or hairs than artificially-propagated specimens. Additionally some mutations (“wild forms”) without spines occur; e.g. *Pachycereus schottii* (*Lophocereus schottii* var. *monstrosus* forma *mickleanus*, *Astrophytum myriostigma* forma *nuda*).

### Flowers, fruits and seeds

Flowers can be yellow, orange, red or pink in day-flowering (diurnal) species, or white in most night-flowering (nocturnal) species. In size they vary from tiny (< 1cm in *Rhipsalis* spp.) to very large (40cm in *Selenicereus* spp.). The ovary is inferior and forms a more or less tubular receptacle (hypanthium). As a modified shoot of limited growth, the cactus flower often bears scalelike leaves, areoles or spines on the outer side of the hypanthium and pericarpel. Without exception the Cactaceae are fertilized by insects, birds or bats. In adaptation to the animal pollinator the flower shape varies from funnel-shaped or campanulate in bat- or bee-pollinated species, salver-shaped with a long tubular hypanthium in most butterfly- and hawkmoths-pollinated flowers, to zygomorphic hummingbird-pollinated flowers, the latter usually bright red or pink.

Apart from *Pereskia* which has true inflorescences, the flowers usually develop by themselves on lateral areoles. Only in a few taxa (e.g. *Wilcoxia*) do flowers occur on terminal areoles at the shoot apex. The flowers are often restricted to a special flowering zone, called cephalium, where areoles are characterized by coloured, thinner spines and/or woolly hairs. Depending on the area of the flowering zone, the cephalia are apical, lateral or ring-like.

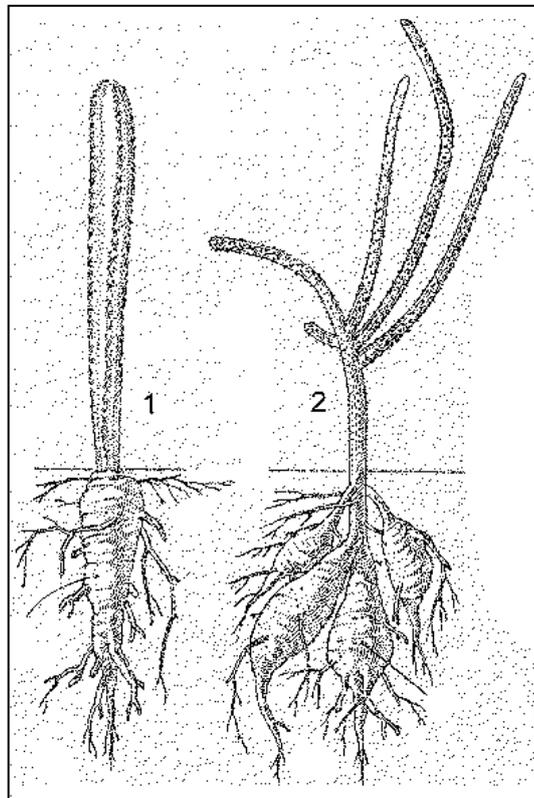
The naked, spiny, woolly or scaly fruits vary in size (from a few millimetres to 10cm) and colour (black, blue, red, yellow, white). Usually the mature fruit is a berry that does not split open (indehiscent) and it contains fleshy pulp with pale brown - to black-coloured seeds. The special morphology of seed coat and seed as well as flower and fruit features are of enormous systematic significance and the basic principles of traditional determination keys.



### Root system

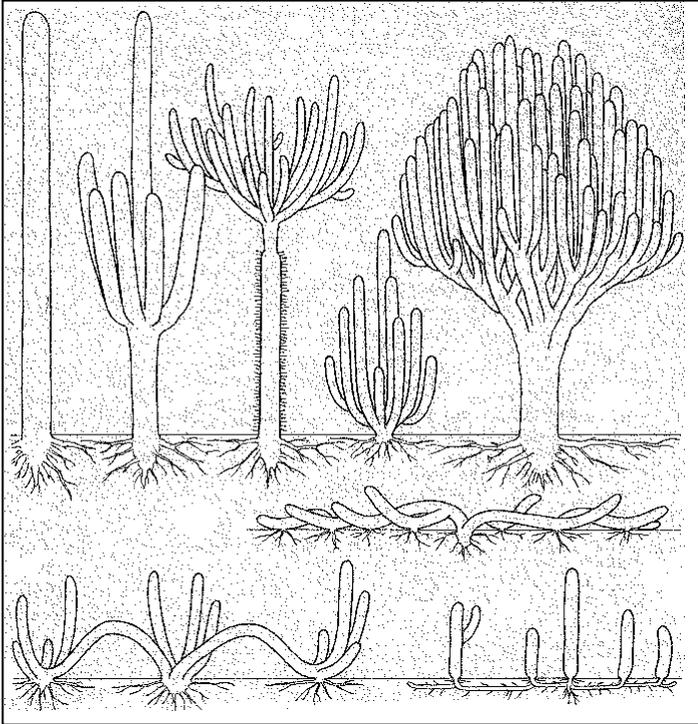
Most Cactaceae are characterized by an extensive lateral (horizontal), thin and fibrous root system adapted to absorbing water from light rain quickly. Some columnar cacti show strong roots which reach out to deeper soils. Cacti from more arid regions –especially the small globular specimens or flat-growing cacti– have water-storing tap roots or napiform rootstocks (e.g. *Pterocactus*, *Ariocarpus*, *Echinocereus*; Fig. 3).

Fig. 3: Waterstoring roots;  
1: taproot (*Peniocereus*).  
2: napiform rootstocks (*Echinocereus*)  
(from Rauh 1979).



Some semi-geophytic species show a subterranean stem base tapering into a stout rootstock (sometimes the tuberous root is connected to the stembase by a thin subterranean neck) or a compact system of short thin horizontal roots. Aerial roots can be observed on epiphytic species (e.g. *Hylocereus*, *Selenicereus*) or creeping taxa (e.g. *Stenocereus* p.p.).

## Habit and growth forms



Depending on their branching system, cacti show different growth forms (Fig. 4a, 4b). Columnar, erect, tree-like plants are mostly characterized by an acrotonical branching system, where only the stem apex grows and the lateral buds are suppressed (ceroid growth form). Within the columnar cacti, solitary, candelabra-like forms, more or less basal branched shrubs and prostrate specimens are also known.

Fig. 4a: Habit and growth forms: columnar cacti (solitary, apical to basal branched trees, candelier, prostrate, creeping).

Almost all columnar cacti are usually woody and belong to Appendix II (except *Pachycereus militaris*, Appendix I).

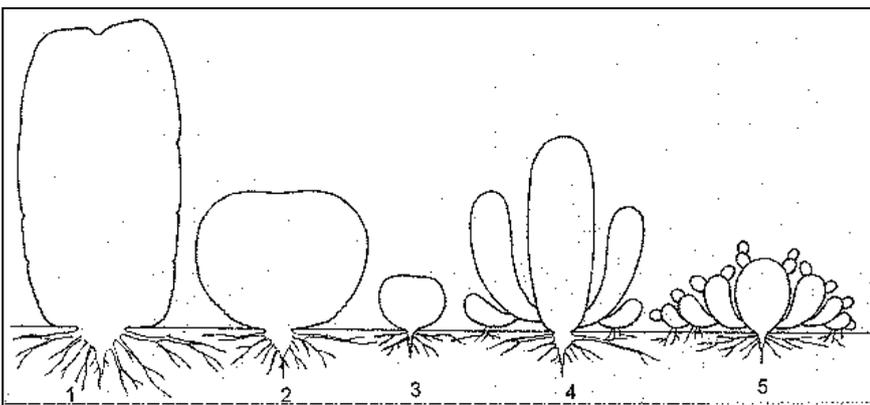


Fig. 4b: Habit and growth forms: globular cacti (solitary short-columnar to

basal branched clusters).  
(from Rauh 1979).

# General notes about the family Cactaceae

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Globular cacti (cactoid growth form) are typical of more arid regions. Solitary, short, columnar, depressed to semi-geophytic specimens also belong to the cactoid as well as to the cushion-like cluster growth forms. Epiphytes from semi-arid habitats are mostly pendent or climbing and show leaf-like stems.

### **Supermarket plants**

A number of Cactus hybrids have been exempted from the provisions of CITES. These will be dealt with in a separate chapter (still to be published).

# General notes about the family Cactaceae

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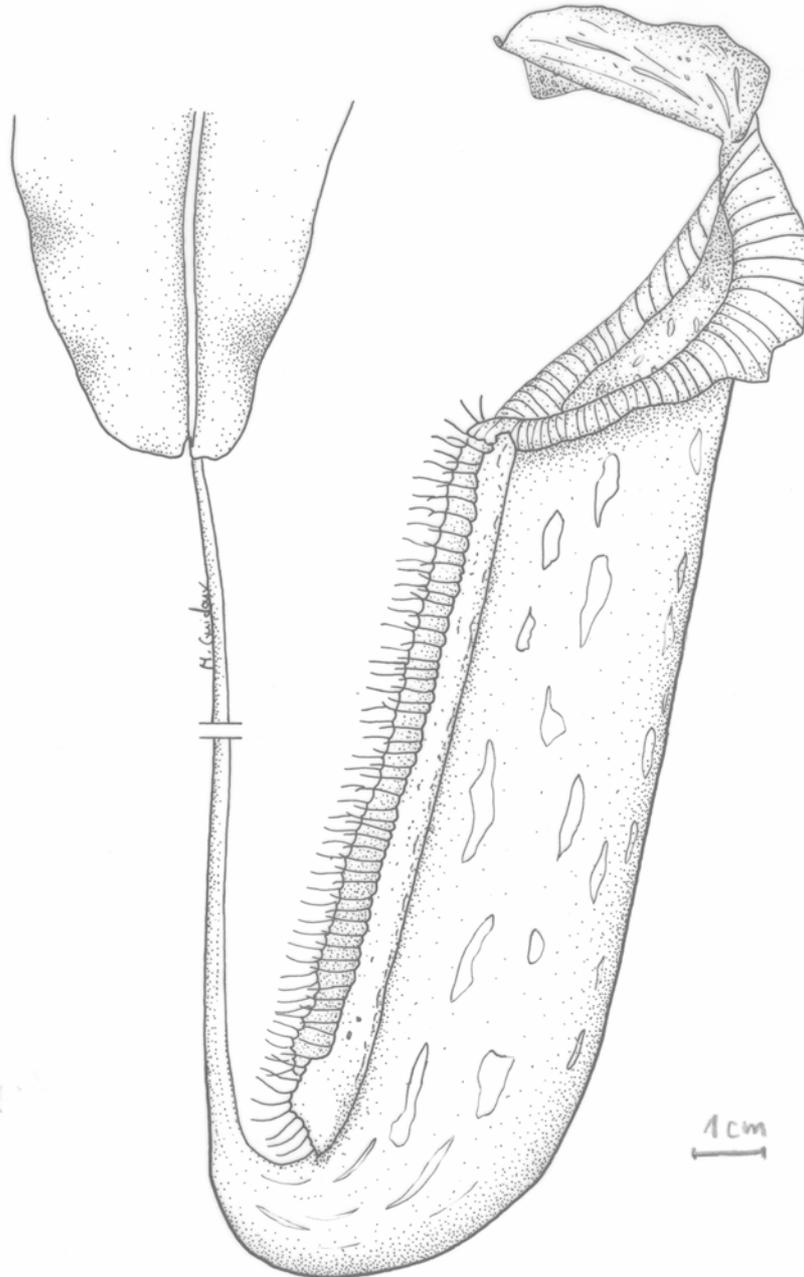
# genus *Nepenthes*

L.



**Common names:**      engl.: Hanging Pitcher Plants  
                              esp.: Cántaros  
                              fr.: Nepenthes

**Scientific synonyms:**      None



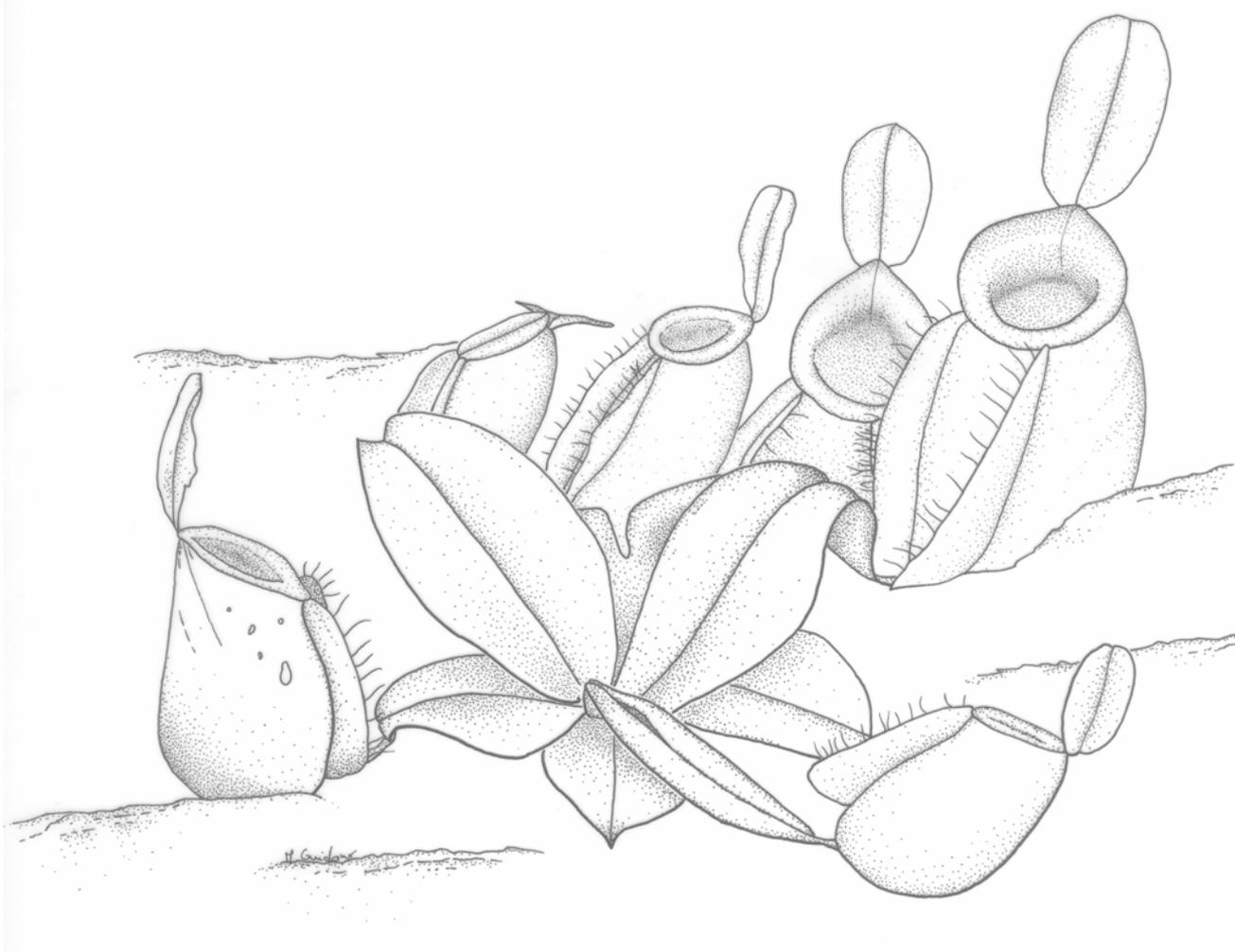
*Nepenthes maxima*

**Characteristics:**

Plants:	Herbaceous or semi-ligneous, often in the form of vines, sometimes shrubs.
Size:	A few dozens of centimetres in height to several metres.
Type of trap:	Passive, pitcher-shaped.
Traps:	In the shape of a pitcher - ascidium - attached at the end of the leaf by a tendril, which is an extension of the central vein. The pitchers are covered by an operculum (fixed cover). Contrary to popular belief, these do not close on the prey.
Leaves:	Green and tough.
Inflorescence:	The flowers, grouped in inflorescences, are small, greenish and insignificant. All flowers on a single plant are either male or female. They are, therefore, dioecious plants.
Prey:	Rather heterogenous, but usually small insects. In the case of the species with larger pitchers ( <i>N. burbidgeae</i> , <i>N. rajah</i> ), it is not uncommon to find small frogs or even birds and small mammals.
Digestion:	Bacteria and enzymes.



general aspect of the hanging traps of *Nepenthes gracilis*



general aspect of the traps on the soil of *Nepenthes hookeriana*

**Distribution:** Primarily in South-East Asia (Borneo, Java, Malaysia, the Philippines) also New Caledonia, western Madagascar and the Comores Islands.



**Habitat:** Humid tropical climate, in swamps and humid forests, on rocks close to brackish water. Some species are found at sea level, others live at altitudes of up to 3500 meters. They can be either terrestrial or epiphytic.

**Propagation:** Possible from cuttings of branches in the spring and from seeds.

**Useful part:** Whole plants as ornamentals.

**Trade:** Mainly cuttings are traded. They are wrapped in sphagnum or plastic. Potted juvenile plants sometimes resemble orchids.

**Number of species:** More than 70 depending on the taxonomy. Also a large number of horticultural hybrids.  
Egalement une grande quantité d'hybrides horticoles.

**Intraspecific variation:** See the sheets on *Nepenthes rajah* and *N. kashiana*.

**Comments:** The main difficulty in growing this type of plant is its narrow range of growing conditions. A distinction should be made between lowland species and bigland species. Temperature and especially variation in temperature and humidity are important requirements for the proper development of the pitchers.

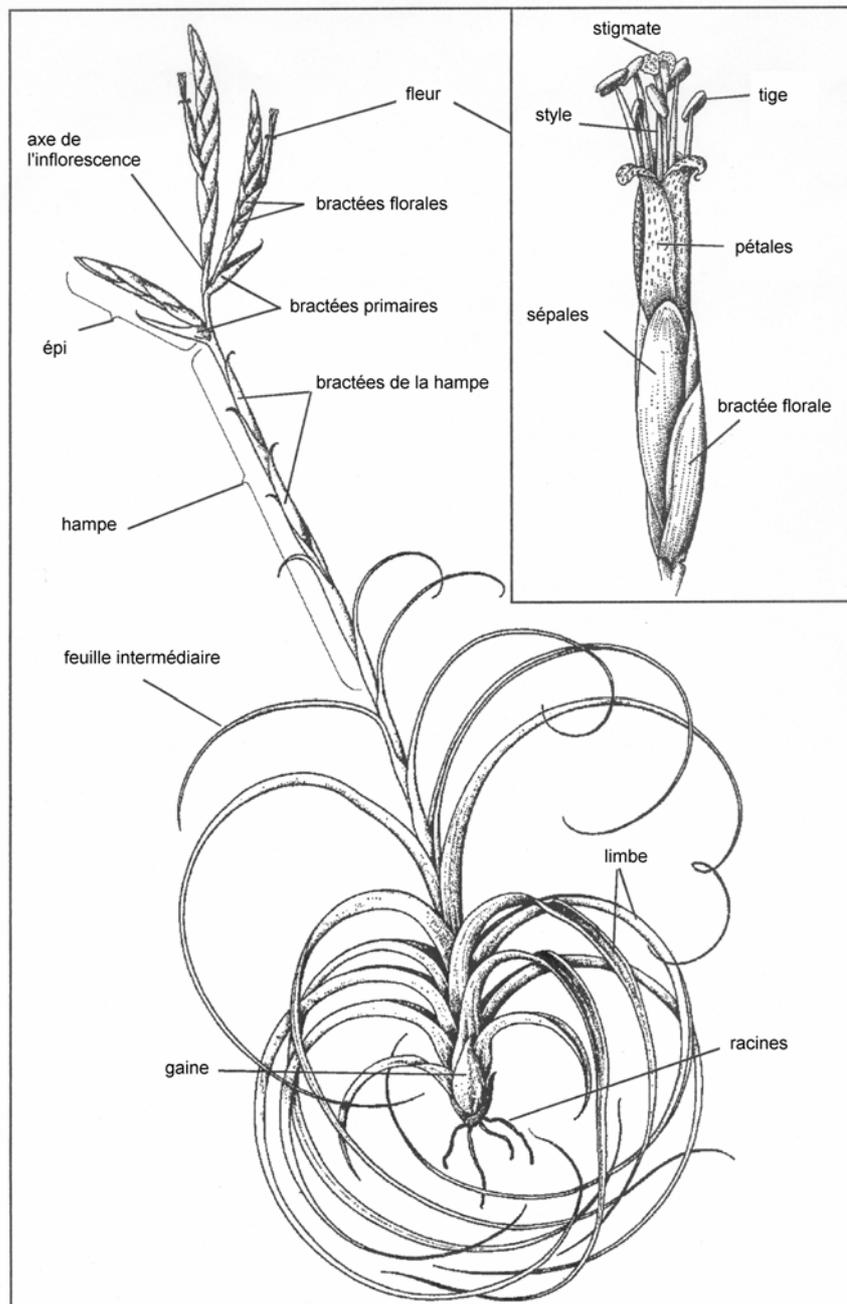


# General notes to genus *Tillandsia*

The genus *Tillandsia* was described by Linn, in 1753, commemorating Elias Tillands (1640-1693). It has by far the greatest number of species of any genus in the family, comprising over 500 species, with new ones being regularly described.

*Tillandsias* are characterized by a superior ovary, developing to a dry, dehiscent capsule. The numerous seeds are plumose (with hair-like appendages), the hairs being not folded. Leaves in the genus are often narrowly triangular, linear, thread-like or strap-shaped; leaf margins are never armed. The petals are not appendaged (as in the genus *Vriesea*).

Diagram of a Grey *Tillandsia* with the terms used in the text (from Gross 1933, modified; with the permission of E. Gross)



The atmospheric tillandsias are densely covered with scales, giving the plants - when dry - a greyish or whitish appearance. The tillandsias from more moist habitats usually do not have such a dense cover of scales, the leaves displaying different shades of green. All the species of *Tillandsia* listed in Appendix II to CITES belong to the group of the atmospheric tillandsias.

Smith & Downs (1977: p. 668-670) recognize 7 subgenera within the genus *Tillandsia*, principally characterized by the shape of the sepals (symmetric/asymmetric) and the length of the stamens and style relative to the length of the petals.

Subgenus *Allardtia*: Sepals more or less symmetric; stamens included, about equaling the petals or slightly shorter; filaments straight; style slender, much longer than the ovary.

Subgenus *Anoplophytum*: Sepals more or less symmetric; stamens included, about equaling the stalk of the petal; filaments strongly folded in many species; style slender, longer than the ovary.

Subgenus *Phytarrhiza*: Sepals more or less symmetric; petals with broad and conspicuous blades; stamens shorter than the stalk of the petal; style short and stout.

Subgenus *Diaphoranthema*: Sepals more or less symmetric; petals with narrow, inconspicuous blades; stamens shorter than the stalk of the petal; style short and stout.

Subgenus *Tillandsia*: Sepals more or less symmetric; petals usually rather narrow; stamens and style exerted.

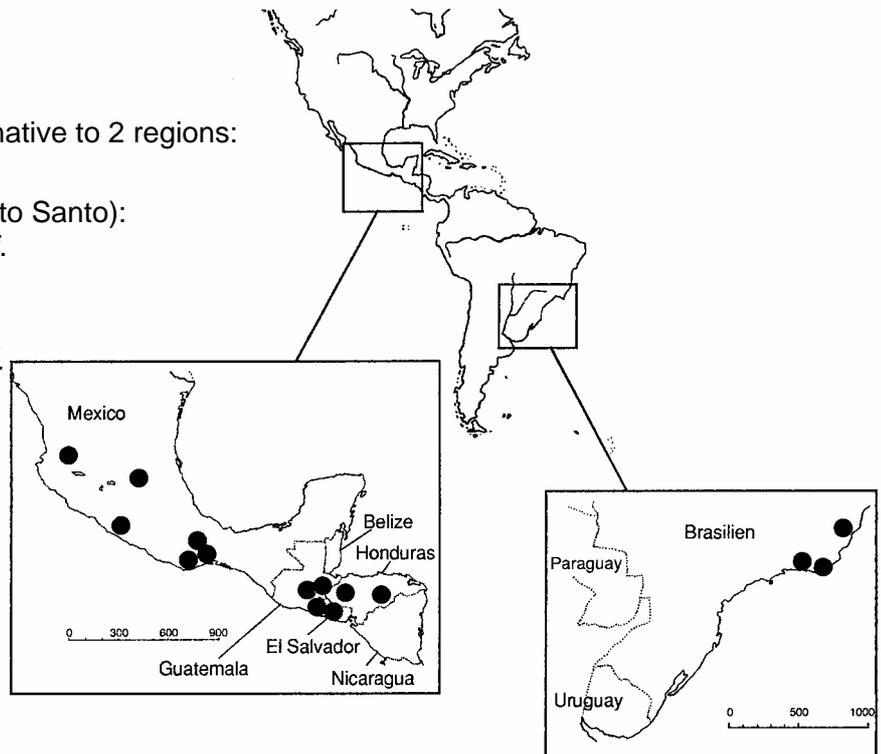
Subgenus *Pseudalcantarea*: Sepals more or less symmetric; petals flaccid (flabby) and drooping at anthesis, with narrow blades; stamens and style exceeding the petals.

Subgenus *Pseudo-Catopsis*: Sepals asymmetric apically, small (not over 12 mm long); stamens included (this subgenus has recently also been regarded as a separate genus, *Racinaea*).

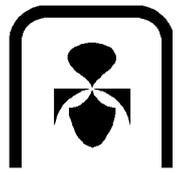
Geographical distribution of the *Tillandsia*-species listed in Appendix II to CITES  
(Drawing: D. Gribat)

The 7 *Tillandsia*-species of Appendix II are native to 2 regions:

1. Southern Brazil (Rio de Janeiro, Espirito Santo):  
*T. kautskyi*, *T. sprengeliana*, *T. Tsucrei*.
2. Central America, Mexico, Guatemala, Honduras, El Salvador: *T. harrisii* (Guatemala), *T. kammii* (Honduras), *T. mauryana* (Mexico), *T. xerographica* (Mexico, Guatemala, El Salvador).



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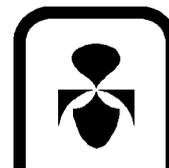
# General notes to genus *Tillandsia*

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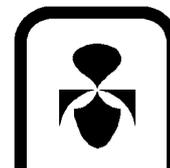
The following Journals are of special interest:

Die Bromelie.- Journal of the "Deutsche Bromeliengesellschaft e.V."  
Journal of the Bromeliad Society.



±	More or less. Nearly.
>	Bigger, higher, larger, etc. than.
<	Smaller, thinner, lower, etc. than; up to.
∅	Diameter of plant body.
Abaxial	Away from or facing away from the axis (dorsal). The lower surface of a leaf is abaxial.
Acicular	Needle-like.
Adaxial	Toward or facing the axis (ventral). The upper surface of a leaf is adaxial.
Areoles	Spiny cushions; sunken or raised axillary buds, from which arise spiny leaves and flowers. Areoles are important for determination key, because of their different expressions and characters in size, shape, symmetry, orientation, hair and spines.
Aristate	Tapered to a very narrow, much-elongated apex.
a.s.l.	above sea level.
Assimilation	Building of endogenous products by photosynthesis (anabolic metabolism).
Bilateral	Having two planes of symmetry, which divide an organ in two similar mirror images.
Caespitose	Growing in tufts or dense little clumps, forming mats and cushions.
Calyx	The outer whorl of floral envelopes, composed of usually green, foliaceous, separate or united sepals.
Cephalium	Special flowering zone on cacti stems. A modified shoot-region with dense woolly areoles, in which the flowers are borne.
Cerise	Cherrie-red colour.
Cladode	Greek: klados = shoot, branch.
Cladophyll	A flattened branch having the function and the form of a leaf, arising in the axil of a reduced, minute and functionless true leaf.
Convergence	External similarity of unrelated plants due to adaptation to same environmental conditions.
Corolla	The inner circle or second whorl of floral envelopes composed of usually coloured, separate or united petals.
Cotyledon	Seed leaf; the primary leaves of the embryo emerging at germination. (1 seedling leaf = Monocotyledon; 2 seedling leaves = Dicotyledon).
Cuneiform	Wedge-shaped.
Cuticle	(Latin cuticula = thin skin) The outermost surface layer of plant epidermis, consisting of fatty acids, cutin, wax, cellulose. The typical cuticle of succulent plants is usually more massive than in other plants or covered by wax crystalloids.

Deciduous	Not persistent, falling off at the end of a functional period, e.g. a tree that sheds all or near all its foliage each year.
Decurrent	Extending down along and adnate to the stem.
Dehiscence e.g.	Ripe fruit opens to release the seeds (e.g. capsule). See also "indehiscence".
Diurnal	Opening only during the day (of flowers).
Dorsal	Relating to, or attached to the back or outer surface of a part or organ, facing away from the axis (abaxial).
Epidermis	The outermost cell tissue-layer of the plant surface, bearing the cuticle.
Epiphyte	Plant growing on other plants (usually on branches or trunks of host trees), without being parasitic.
Gibbous	Swollen.
Globose	Globular, sphaerical or rounded.
Glochid	(Greek: glochis, glochinos = arrow-head, tip, hooked) A minutely barbed spine, often occurring in tufts on the areoles. Distinctive mark for the Cactus subfamily Opuntioideae contrary to subfamilies Pereskioideae and Cactoideae. Glochids make it very difficult to work with Opuntias and their related genera, because they will break off easily at the slightest touch, hurting and piercing the skin.
Hump	Chin-like protrusion below the areole.
Imbricate	Overlapping, as shingles on a roof.
Indehiscence	Ripe fruit does not open to release the seed (e.g. grain).
Indumentum	A covering or attire of the plant body, especially of hairs.
Geophyte	Plant that grows mostly underground.
Groove	Furrow.
Hypanthium	A ringlike, cuplike, or tubular structure of flowers, where sepals, petal, and stamens arise.
Lithophyte	Plant growing on rocks (epilithic).
Mammilla	(Plural: mammillae) A tubercle. The podarium and lateral branch (areole) forming an elongated, nipple-like, gibbous or triangular structure.
Meristem	Undifferentiated tissue that is capable of developing into various organs or tissues.
Napiform	Stout, beet-like (of roots) (fig. 3).
Nocturnal	Opening only during the night (of flowers).
Node	The place on a stem where, one or more leaves (spines) or lateral branches are attached.
Orthostiche	Areoles / tubercles arranged in vertically rows.



Ovary	The basal part of the flower that enclose the ovules.
Parastiche	Areoles / tubercles arranged in spirally rows.
Pectinate	Comb-like or arranged like the teeth of a comb, or pinnatifid with very close narrow divisions.
Perennial	Lasting several years. Of three or more vegetation-period duration.
Pericarpel	The wall of the lowermost part of cacti flower, surrounding the inferior ovary.
Perisperm	Starchy or other nutritive tissue in the seed.
Petal	A unit of the inner floral envelope (corolla), usually coloured and $\pm$ showy.
Petiole	Stalk of a leaf.
Pinnate	Constructed like a feather, with the parts (e.g. veins, lobes, branches) arranged along both sides of an axis.
Pinnatifid	Cleft or parted in a pinnate manner.
Platyclade	Flattened and green long branch that functions as a leaf.
Podaria	Sessile part of leaf-bases, which builds the abaxial part of tubercle.
Polyfloral	Consisting of many flowers arising from one areole.
P.p.	Pro parte, partly.
Prostrate	Growing flat on the ground.
Receptacle	The $\pm$ enlarged or elongated end of the stem or flower axis on which some or all of the flower parts are borne.
Reticulate	Net-like, netted.
Scandent	Climbing.
Semi-geophytic	Plants for the most part subterranean in habit, with only the stem apex protruding slightly from the substrate. Usually with subterranean stem base merge into a napiform taproot. Small cacti almost flat on the ground. Artificially propagated semi-geophytic species often elongated in cultivation.
Semi-prostrate	Growing on the ground for the back part of plant stem, whereas ascending for the front part.
Sepal	One of the separate units of a calyx, usually green and foliaceous.
Sinuate	Forming wave-like curves.
Spec. / spp.	Species (singular / plural).
Stamen	The pollen-bearing organ of a seed plant; a subunit of the male part of a flower.
Sterile	Non-flowering or non-fruiting.

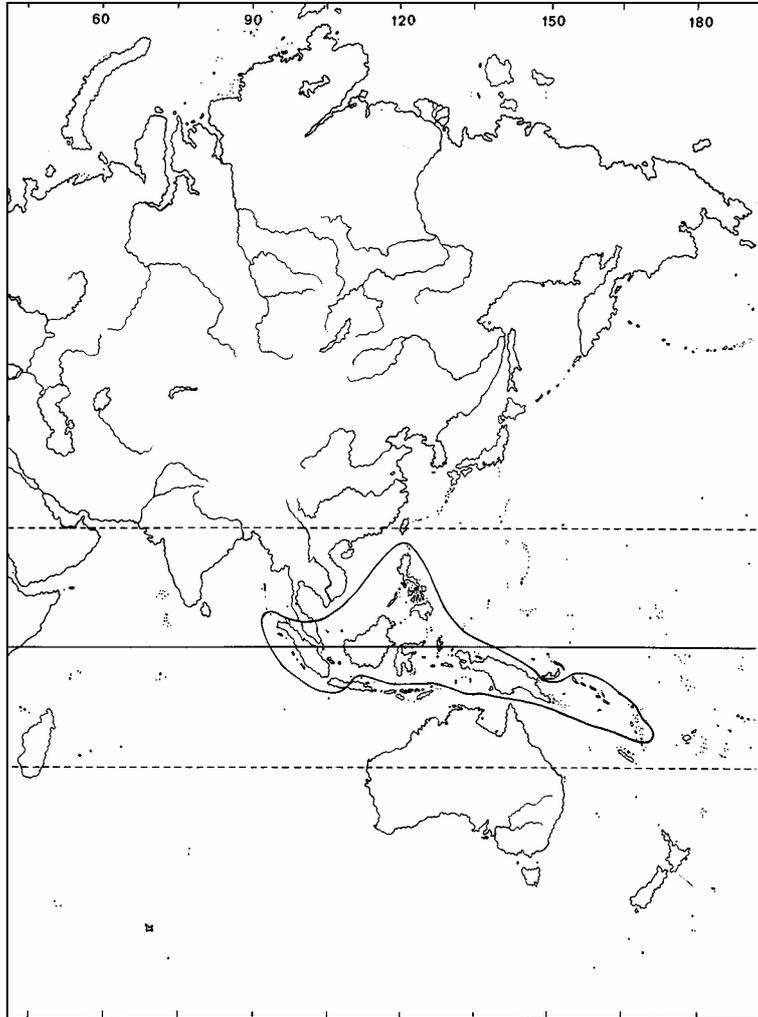
Supra	Over, above.
Syn.	Synonym.
Taxon	(plural: taxa) A general term used for a taxonomic group of any ranking (e.g. name of families, genera or species).
Terete	Circular in cross section.
Trichome	(Greek: trichos) A hair.
Vegetation-point	The one region of the plant body, where new growth take place due to specialized regeneration tissue (meristem).
Ventral	Relating to, or attached to the front or inner surface of a part or organ, facing toward the axis (adaxial).
Xeromorph	Plant showing special alteration or features adapted to water retention.
Zygomorphic	Bilaterally symmetrical, capable of being divided into two equal halves in one plane only.



<b>Commercial species:</b>	<i>G. affinis</i> Radlk., <i>G. banacanus</i> (Miq.) Kurz, <i>G. forbesii</i> Gilg, <i>G. macrophyllus</i> (Miq) Airy Shaw, <i>G. maingayi</i> Hook f., <i>G. velutinus</i> Airy Shaw (for full species list see below).
<b>Commercial names:</b>	engl.: ramin esp.: ramin fr.: ramin indon.: gahara buaya (Sumatra, Kalimantan), medang keladi (Kalimantan) malay.: gaharu buaya (Sarawak), melawis philip.: lanutang-bagyo, anauan
<b>Common names:</b>	Ramin
<b>Scientific synonyms:</b>	--
<b>Subject to CITES control:</b>	Included in Appendix III.
<b>Macroscopic characteristics of the wood:</b>	Wood creamy to yellowish white, diffuse porous, growth rings absent or indistinct. Sapwood and heartwood not differentiated. Grain straight to shallowly interlocked. Texture moderately fine and even. With unpleasant odour when freshly sawn, but odour absent after drying. Hardness: moderately soft to moderately hard Specific weight: 0.60-0.72 (0.46-0.84) g/cm <sup>3</sup> (at 12% rh)
<b>Microscopic characteristics of the wood:</b>	Wood diffuse porous. Growth rings indistinct. Vessels solitary and in radial multiples of 2-3 (--4), 3-9/sq.mm, tangential diameter 90-190 microns, perforation plates simple. Intervascular pits minute (3-4 microns), alternate, and vested. Yellowish contents often present in the perforation plate area. Parenchyma paratracheal, winged-aliform to confluent, wings usually thin and long. Rays homogeneous (very rarely weakly heterogeneous with one row of square marginal cells), almost exclusively uniseriate, sometimes with biseriate portions (biseriate fairly common in <i>G. macrophyllus</i> ), with a frequency of 9 to 10/mm. Fibres thin-walled to medium thick-walled, nonseptate, 1.1-1.9 mm long, with small but distinctly bordered pits. Crystals prismatic, diamond-shaped, or slightly elongate (short styloids) in axial and ray parenchyma. Crystals sporadic or absent in some specimens.
<b>Characteristics of the trees:</b>	The timber producing species are small to medium-sized, evergreen trees up to 42 m tall, and 60 (120) cm in bole diameter. The trees can be locally very common in lowland peat swamp forests. The trunks are cylindrical, usually without buttresses, sometimes fluted at the base. The bark is smooth to cracked, shallowly fissured or scaly.
<b>Characteristics of the trade:</b>	Ramin is one of the major export timbers of South-East Asia, with Sarawak and Penninsular Malaysia as the most important exporters. Indonesia also used to be a major exporter. Ramin accounted for a very high proportion of the sawn timber export, because of the dominance of Ramin in the lowland peat swamp forests.

**Distribution:**

Throughout Malaysian region with the exception of Central and East Java and the Lesser Sunda Islands. N. Borneo (especially Sarawak ) is a centre of species diversity. Eastwards the distribution area extends towards the Solomon Islands, Nicobar and Fidji.

**Use:**

The whitish and light to medium-density wood is a typical multipurpose timber, and is much used for furniture, wall panelling, light flooring, toys, turnery, venetian blind slats, dowels, picture frames, barrels, boxes and drawing boards. It is also used in light construction such as doors, window frames, and stairs, and as light veneer. The timber is highly susceptible to various fungal and insect attacks, and is therefore always used indoors. Like the genus *Aquilaria* (Gaharu), species of *Gonystylus* are capable of producing the highly priced incense "gaharu" in its pathological heartwood.

**Similar species:**

There are about 30 species of *Gonystylus*, of which the timbers cannot be confidently separated from each other. Among tropical hardwoods, the combination of whitish heartwood colour, uniseriate rays, vested pits, and prismatic crystals also occurs in some species of *Terminalia* (Limba, Framiré, of African provenance). These woods can be distinguished microscopically by their larger intervessel pits (4-- 9-11 /um, and less conspicuously bordered fibre pits. *Aquilaria*, the main producer of the incense "gaharu" in its pathological heartwood, differs from *Gonystylus*



in having included phloem strands scattered throughout the wood, and hardly produces big enough trees for marketable timber: most *Aquilaria* species are shrubs or small trees.

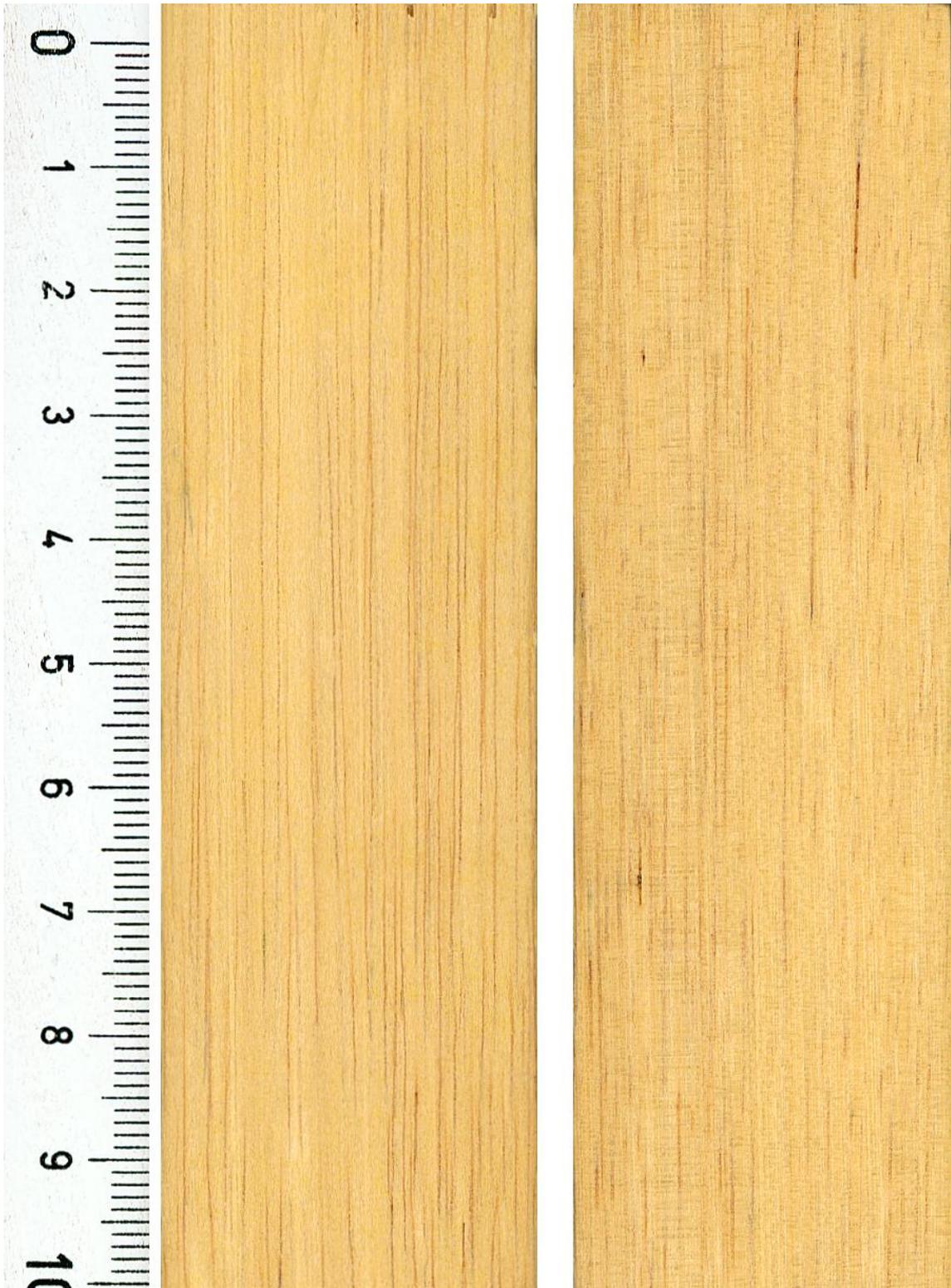
	Distribution	Common name
<i>Terminalia ivorensis</i>	Tropical Africa	Black afara, Framiré
<i>Terminalia superba</i>	Tropical Africa	Limba

#### List of *Gonystylus* species:

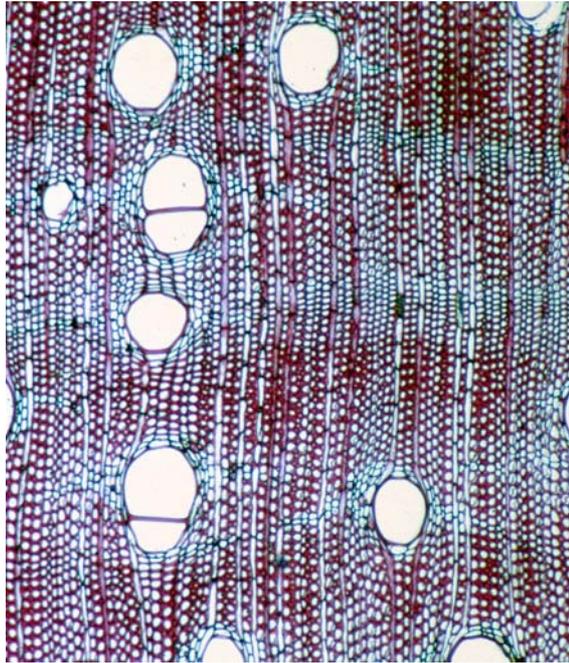
	Distribution
<i>G. acuminatus</i> Airy Shaw	Borneo*), Sumatra, Malay Peninsula
<i>G. affinis</i> Radlk.	Malay Peninsula, Borneo
<i>G. areolatus</i> Domke ex Airy Shaw	Borneo
<i>G. augescens</i> Ridl.	Borneo
<i>G. bancanus</i> (Miq.) Kurz	Malaysia and Indonesia
<i>G. borneënsis</i> (Tiegh.) Gilg	Borneo
<i>G. brunnescens</i> Airy Shaw	Malaysia
<i>G. calophylloides</i> Airy Shaw	Borneo
<i>G. calophyllus</i> Gilg	Borneo
<i>G. confusus</i> Airy Shaw	Malay Peninsula, Sumatra
<i>G. consanguineus</i> Airy Shaw	Borneo
<i>G. costalis</i> Airy Shaw	Borneo
<i>G. decipiens</i> Airy Shaw	Borneo
<i>G. eximius</i> Airy Shaw	Borneo
<i>G. forbesii</i> Gilg	Sumatra, Borneo
<i>G. glaucescens</i> Airy Shaw	Borneo
<i>G. keithii</i> Airy Shaw	Borneo
<i>G. lucidulus</i> Airy Shaw	Borneo
<i>G. macrophyllus</i> (Miq.) Airy Shaw	Throughout Malaysian region
<i>G. nervosus</i> Airy Shaw	Borneo
<i>G. macrocarpus</i> C.T. White	Solomon islands
<i>G. micranthus</i> Airy Shaw	Borneo
<i>G. maingayi</i> Hook f.	Malay Peninsula, Sumatra
<i>G. pendulus</i> Airy Shaw	Borneo
<i>G. punctatus</i> A.C. Smith	Fiji
<i>G. reticulatus</i> (Elm.) Merr.	Philippines
<i>G. spectabilis</i> Airy Shaw	Borneo
<i>G. stenosepalus</i> Airy Shaw	Borneo, Sarawak
<i>G. velutinus</i> Airy Shaw	Indonesia
<i>G. xylocarpus</i> Airy Shaw	Borneo

\*) Borneo = Sabah, Sarawak (Malaysia), Brunei and Kalimantan (Indonesia)





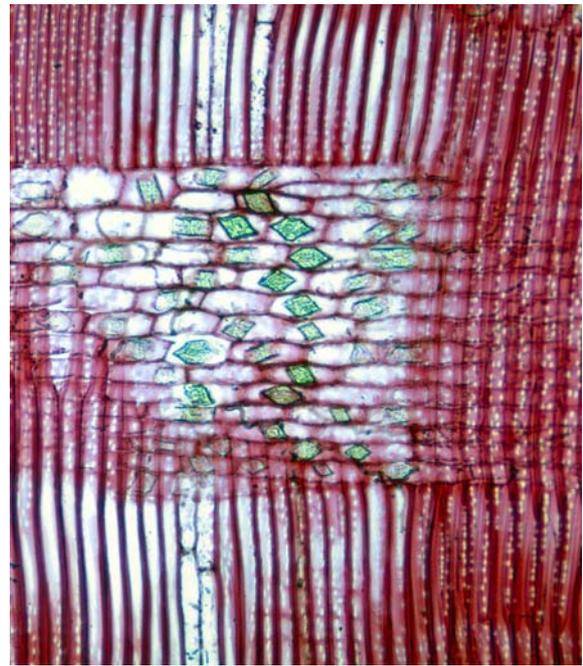
*Gonystylus bancanus*



*Gonystylus bancanus*, transverse section



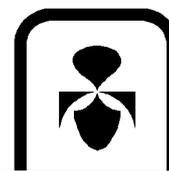
*Gonystylus bancanus*, tangential section



*Gonystylus bancanus*, radial section

# Guaiacum officinale, G. sanctum

L.



**Family:** Zygophyllaceae

**Synonyms:** *G. officinale* None  
*G. sanctum* *Guaiacum guatemalense* Planch. ex Hemsl.  
*Guaiacum verticale* Ortega

**Vernacular names:**  
 english: Guaiacum, guaiac tree, holy wood, pockwood tree, tree of life  
 french: Gaïac, gayac  
 spanish: Guayacán, guayaco, palo santo  
 german: Guajakholz-Baum, Pockholz-Baum, Heiligenholz  
 italian: Guaiaco  
 portuguese: Guaiaco

**Geographical range:** *G. officinale* Central America, from the Bahamas and the Greater Antilles through the Lesser Antilles to the north coast of South America, to Colombia and Venezuela;  
*G. sanctum* Central America, from the south of the United States of America (Florida) through the Bahamas, the Greater Antilles and south Mexico (Quintana Roo) to Costa Rica and possibly to Panama.

**Distribution by country:** *G. officinale* Anguilla, Antigua and Barbuda, Bahamas, Barbados, Colombia, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Venezuela, Virgin Islands (United Kingdom, United States of America);  
*G. sanctum* Bahamas, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama (?), Puerto Rico, United States of America.

**Protection:** CITES Appendix II (#1), since 01.07.1975 (*G. sanctum*), and 11.06.1992 (*G. officinale*)

**Use:** Medicinal and aromatic plant, timber (furniture, bowling balls, wooden tools, carvings, etc.), ornamental tree.

## Botanical drugs in trade

**Plant parts used:** Mainly heart wood and resin of the heartwood; in addition bark.

## Wood

**Pharmaceutical names:** latin: Guaiaci lignum, Lignum Guaiaci (Guajaci), Lignum sanctum, Lignum vitae  
 english: Brazil wood, guaiacum wood, pockwood, (bastard, commoner or holywood) lignum vitae  
 french: Bois de gaïac (gayac), bois de vie, bois saint, gayac  
 spanish: Guayacán (blanco, genuino, real), guayacancillo, leño de guayaco, palosanto, palo de vida  
 german: Arznei-Pockholz, Guaiakholz, Guajakholz, Guajacum-officinale-Holz, Guajacum-sanctum-Holz, Franzosenholz, Heiligenholz, Heiliges Pockholz, Pockholz

italian: Legno di guaiaco, legno santo, legno benedetto  
 portuguese: Guaiaco, lenha di guaiaco, pau santo

**Countries of export:** Colombia, **Costa Rica**, **Dominican Republic**, Guatemala, Haiti, **Honduras**, **Mexico**, Trinidad and Tobago, United States of America.  
 Re-export: Italy, Japan.

**Source:** Mainly wild collection.

**Commodities in trade:** Dried, big or ± coarsely diminished pieces of mainly the heartwood of stem or branch pieces with (Guajaci with sapwood) or without (Guajaci without sapwood) shares of sapwood (crude drug) or the same rasped or cut into small cube-like pieces (cut drug); in addition the powdered wood and essential oil.

### Characteristics:

**Crude drug:** (Fig. 1, 2) Wood pieces very variable in size and shape: *inter alia* up to 30 cm-thick pieces, free of bark, or coarsely chopped, ca. 2-7 cm long, thin fragments or 1-3 cm long, flat chips, rarely whole slices; external surface of wood free of bark, unevenly curved to undulately striped; wood heavy (sinks in water), bicoloured, sapwood yellowish-white to light brown, conspicuously separated from the greenish-brown heartwood (in transverse section the sapwood of *Guaiacum sanctum* fills a much wider section than in *Guaiacum officinale*); heartwood very hard, durable, tough, of high density, not easily divisible, resin rich, becoming darker when exposed to air and light, without growth rings, but with irregular, concentric layers due to uneven deposits of resin; splitted wood with jagged and splintered fractures;

**Cut drug:** (Fig. 3) Very minutely-cut wood shavings or rasped, often cube-like wood pieces with edges of 4-8 mm length; cut surfaces irregular, almost serrate, splintered, with fine black lines (resin ducts; hand lens!); overall appearance green-brown due to the dominating heartwood;

**Odour:** Heartwood: aromatic when heated, resembling benzoin; sapwood: almost scentless;

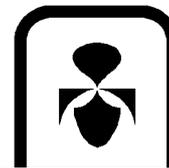
**Taste:** Heartwood: slightly rough, spicy and bitter;  
 Sapwood: tasteless.

## Resin

**Pharmaceutical names:** latin: Guaici resina, Resina Guaiaci (Guajaci), Gummi Guajaci, Guaiaci gummiresina, Guaiacum (homeopathy.)  
 english: Guaiacum resin, guaiacum (gum)  
 french: Résine de gaïac (gayac)  
 spanish: Resina de guayaco, resina de leño santo  
 german: Guaiakharz, Guajakharz, Guaiacum, Guajacum, Guajacum-officinale-Harz, Guajacum-sanctum-Harz, Pockholzharz  
 italian: Resina di guaiaco, resina di legno santo  
 portuguese: Resina de guaiaco, resina de lenha santo

**Countries of export:** Caribbean countries.

**Source:** Mainly wild collection.



**Commodities in trade:** Mainly coarse, irregular shaped resin pieces (main commodity in trade: Guaiaci resina in massis; crude drug), rarely globose granules or bowls (Guaiaci resina in lacrimis; crude drug) or smaller fragments (cut drug); in addition the powdered resin.

## Characteristics:

**Crude drug:** (Fig. 4) Guaiaci resina in massis (naturalis): pieces irregular, without precise form and variable in size, hard, brittle, easy to break, dark reddish brown, greenish brown to almost black; surface dull, grey-green coated, shiny after rubbing; fracture smooth but not even, shiny, getting a red tinge when exposed to light;

Guaiaci resina in lacrimis (granis): tears, granules or bowls hazelnut- to about walnut-sized,  $\pm$  globular, dark red-brown, external surface dirty greenish coated;

**Cut drug:** Smaller fragments, with greenish coated, glassy, shiny, red-brown splinters; see 'Crude drug' for characters;

**Odour:** Sweetish, in particular pleasantly when heated (like benzoin);

**Taste:** Spicy and rough.

## Bark

The bark is traded as Guaiaci cortex (English: Pockwood bark; French: Écorce de gaiac; German: Heiligenholzrinde, Pockholzrinde). The bark pieces are irregular, flat or somewhat domed, hard, heavy, 4-6 mm thick and about 10 cm long; the external surface is grey-brown with yellow spots, older bark also with conchoidal depressions; internal surface pale yellow, even, longitudinally striped, cross-striation with very fine and narrow stripes (hand lens!); fracture short, flaky, with numerous shiny dots. The bark smells spicy when heated, the taste is bitter and rough.

## Similar drugs/ adulterations:

Besides *Guaiacum officinale* and *G. sanctum*, also *G. coulteri* Gray is used as a source of the drugs Guaiaci lignum, Guaiaci resina and Guaiaci cortex. This species is distributed in Mexico, from Sonora, in the North, to Oaxaca, southwest of Mexico City. This implies problems of identification of the commodities in trade sourced from Mexico because *G. sanctum* occurs also in (southern) Mexico. The drugs of the three species cannot be identified macroscopically.



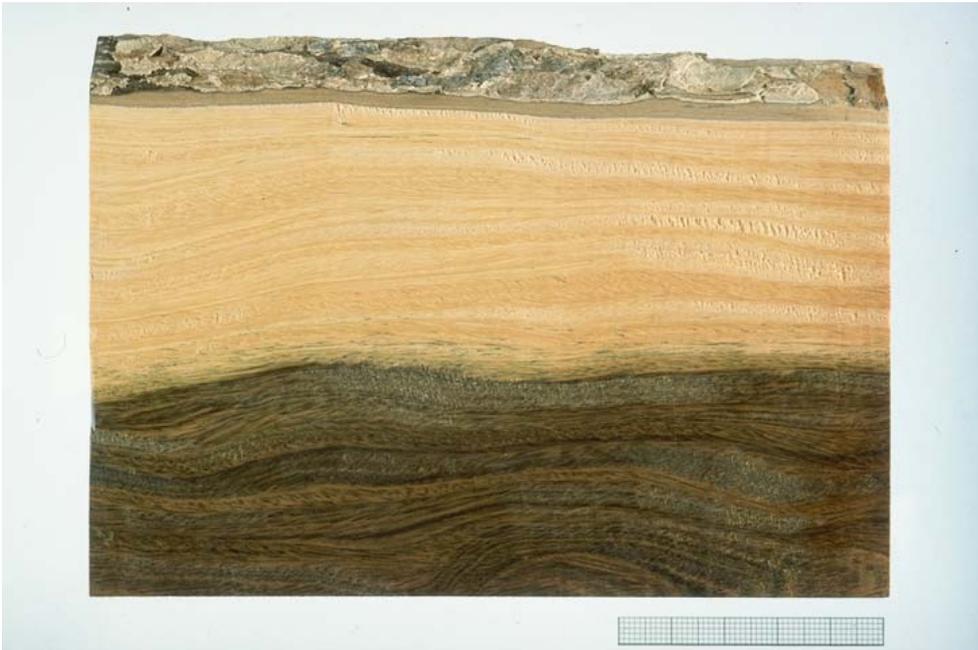


Figure1. Longitudinal section of wood with bark, sapwood and heartwood, Guaiaci lignum; species: *Guaiacum sanctum*, (copyright BfN).



Figure 2. Crude drug of wood, Guaiaci lignum; species: *Guaiacum* sp., (copyright BfN).



Figure 3. Cut drug of wood, Guaiaci lignum; species: *Guaiacum* sp., (copyright BfN).



Figure 4. Crude drug of resin, Guaiaci resina; species: *Guaiacum* sp., (copyright BfN).



- Commercial names:**
- engl.: Lignum vitae, Bastard lignum vitae, Hollywood lignum vitae  
 esp.: Guayacán blanco, Lignum vitae  
 fr.: Gaïac
- Common names:** Guayacancillo, Vera, Vera blanco
- Scientific synonyms:** *G. verticale* Gómez Ortega,  
*G. guatemalense* Planchón ex Rydberg
- Subject to CITES regulations:** All parts and derivatives, except seeds, spores, pollen (including pollinia), seedling or tissue cultures obtained in vitro, in solid or liquid media, transported in sterile containers and cut flowers of artificially propagated plants.
- Macroscopic characteristics of the wood:** Wood dark brownish green, diffuse porous, growth rings distinct. The sapwood and heartwood are very distinct. The sapwood is pale yellow in colour. The heartwood is light to dark olive (green to brownish green) with dark veins. The sapwood is wider in *G. sanctum* than in *G. officinale*. The resin smells like roses. Because of its high content in an oily resin called *guaiaco*, it has a very smooth surface, similar to that of palisander. Interlaced fibres. Perfectly visible growth rings. The vessels, rays and parenchyma are not visible to the naked eye.  
 Hardness: extremely hard, making it impossible to nail  
 Grain: uniform and fine  
 Specific weight: 1.23 g/cm<sup>3</sup>. It is one of the densest woods in trade.
- Microscopic characteristics of the wood:** Wood diffuse porous. Growth rings well-defined. Vessels exclusively solitary, few, 20/mm<sup>2</sup> with a narrow average tangential diameter of (30 –) 75 (– 175) µm, perforation plates simple. Diminutive intervascular bordered pitting. Deposits or gum present in the vessel elements. Scanty apotracheal parenchyma and vasicentric paratracheal, aliform or confluent, arranged in layers, fusiform cells frequent. Homocellular wood rays, exclusively uniseriate, 4 – 6 cells high and distributed in layers. Axial and radial parenchyma with calcium oxalate crystals. Fibretracheids with thick walls, (440 –) 590 (– 830) µm long; tracheids sometimes present.
- Characteristics of the trees:** The tree grows sometimes to 15 metres high, with a cracked bark that is greyish brown in colour. The part of the tree suitable for timber is only up to 5 metres long.
- Characteristics of trade:** The genus *Guaiacum* is usually called lignum vitae. The name *guayacán* is also used regularly to designate other species such as *Tabebuia* (Bignoniaceae), *Caesalpinia melanocarpa* (Fabaceae) and *Andropogon angustatus* (Poaceae).
- The wood of this species is of considerable commercial importance, although preference goes to *G. officinale*. It is one of the hardest woods; its high density, oil resin content and fine grain make it important for the manufacture of bearings for axels, pulleys, pivots and rollers. It is usually exported as logs, sawn wood and finished products.

**Distribution:**

Caribbean, Central America, southern North America, in the western part of the greater Caribbean region, from southern Central America and Central America to the north and the east through the larger islands and to the northeast from Costa Rica to Mexico (Yucatan) and east-northeast to Cuba, the United States of America (southern Florida), the Bahamas, Haiti and the Dominican Republic.

**Use:**

Bearings for the propeller shafts of ships, lath work of balls, cups, dishes, mallet heads, pulleys, pivots, washers, guides, rollers and wheels. It is also used to manufacture sports equipment, in the textile industry and for the preparation of medicines under the names: Guayaco gum, Guayaco resin, Guayacum, Lignum vitae and Lignum sanctum.

**Similar species:**

There are six species of trees and shrubs in the *Guaiacum* genus found in subtropical and tropical America. Lignum vitae is usually traded without use of a scientific name at the species level.

Sometimes, this species can be identified by the origin, for example: *Guaiacum unijugum* is endemic to Mexico; *Guaiacum coulteri* (synonym, *G. planchonii*) is found primarily in the Pacific Coast watershed, from northwestern Mexico to Central America. *Guaiacum coulteri palmeri* (synonym, *G. palmeri* Vail), is found only in northwestern Mexico, from northwestern Sonora to northern Sinaloa. It can also be found under the name *Guaiacum guatemalense*, which has been reported from Guatemala to Costa Rica, although it is considered to be a synonym of *G. sanctum* or a hybrid of *G. sanctum* x *G. coulteri*. In both cases, it is listed in the CITES appendices as *G. sanctum*.

The following species are also rather similar.

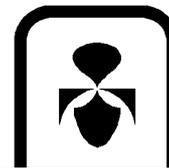
Latin name	Distribution	Common name
<i>Bulnesia arborea</i>	Colombia, Venezuela	Vera, Guayacán, Guayacán resino, Palo santo
<i>Bulnesia sarmientoi</i>	Argentina, Bolivia, Paraguay	Palo santo
<i>Gymnanthes lucida</i>	Central America, Caribbean	Ébano verde, Granadillo
<i>Tabebuia</i> spp.	Southern Florida, Brazil	Madera verde





# Hydrastis canadensis

L.



**Family:** Ranunculaceae

**Synonyms:** *Hydrastis trifolia* Raf.  
*Warnera canadensis* Miller  
*Warnera diphylla* Raf.  
*Warnera tinctoria* Raf.

**Vernacular names:**

english:	Goldenseal, ground raspberry, Indian dye, Indian turmeric, Ohio curcuma, yellow Indian paint, wild turmeric
french:	Sceau d'or, hydraste canadien
spanish:	Hidrastis, sello dorado, sello de oro
german:	Kanadische Gelbwurz, Orangenwurzel
italian:	Idraste, sigillo aureo, radice aurea, radice gialla

**Geographical range:** In the northeast of North America; from the provinces of Ontario and Quebec in Canada southwards to Georgia and Alabama and eastwards to Arkansas, Missouri, Kansas, Iowa and Nebraska.

**Distribution by country:** Canada, United States of America.

**Protection:** CITES Appendix II (#3), since 18.09.1997

**Use:** Medicinal and aromatic plant, horticultural plant.

## Botanical drugs in trade

**Plant parts used:** Mainly the dried rhizome, including secondary roots; in addition the fresh root and the dried herb

## Rhizome and roots

**Pharmaceutical names:**

latin:	Hydrastis rhizoma, Rhizoma Hydrastis, Rhizoma Hydrastis canadensis; Radix Hydrastis, Radix Warneriae canadensis, Hydrastidis rhizoma, Rhizoma Hydrastidis; Hydrastis (homeopathy), Hydrastis canadensis (homeopathy)
english:	Goldenseal root, golden root, hydrastis root, jaundice root, (Canadian) orange root, turmeric root
french:	Rhizome d'hydraste (canadien)
spanish:	Raíz de hidrastis, Rizoma de hidrastis
german:	Goldsiegelwurzel, Hydrastis-canadensis-Wurzelstock, Hydrastisrhizom, Hydrastiswurzelstock, Kanadische Gelbwurz, Kanadische Orangenwurzel
italian:	Rizoma d'idraste

**Country of export:** United States of America.

**Source:** Mainly wild-collection.

**Commodities in trade:** Dried, whole rootstock including attached roots (crude drug) or the same cut (cut drug); in addition the powdered rootstock (not subject to CITES).

**Characteristics:**

**Crude drug:** (Fig. 1) Rootstock irregularly bent, 2-6 cm long and 5-10 mm thick, knotty and sometimes almost tuber like, mainly simple, rarely branched, hard; external surface rough, dark grey-brown, transversely ringed and sometimes somewhat longitudinally wrinkled, with many fibrous roots which are up to 4-5 cm long and 1.5 mm thick, fragile, sparsely branched and often lighter in colour; the upper and lateral surfaces bear stem scars often with remains of aerial stems; the most recent aerial stem remains may be several centimetres long; fractures of roots and rootstock almost even, horny and distinctly greenish yellow (colour most vivid when freshly broken or cut);

**Cut drug:** (Fig. 2) Small, fragments of rootstock 6 mm-long; cut surface distinctly greenish yellow; mixed with numerous fine, 1-6(-10) mm-long root pieces, fractured surface also greenish-yellow;

**Odour:** Weak;

**Taste:** Very bitter, saliva turning yellow when chewed;

**Fresh root:** In homeopathy the fresh root is used. It is named *Hydrastis canadensis*.

**Herb**

The herb of *Hydrastis canadensis* is also in trade, but of minor importance. The drug is known as *Hydrastis herba* or *Herba Hydrastis* (goldenseal leaf, Gelbwurzelblätter).

**References:**

Bannerman, J.E. (1997): Goldenseal in world trade. Pressures and potentials. – *Herbalgram* 41: 51-52.

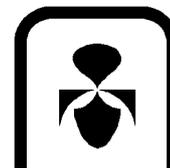
Catling, P.M. & E. Small (1994): Poorly known economic plants of Canada. 3. *Hydrastis canadensis* L. – *CBA/ABC Bulletin* 27(3): 50-51.



Figure 1. Crude drug, Hydrastis rhizoma; species: *Hydrastis canadensis*, (copyright BfN).



Figure 2. Cut drug, Hydrastis rhizoma; species: *Hydrastis canadensis*, (copyright BfN).



# Identification keys

These are the keys to identify the subfamilies and all 110<sup>1</sup> genera of Cactaceae as accepted in the CITES Cactaceae Checklist, 2nd Ed. (Hunt 1999) and in two later publications (Hunt 2000a; Kiesling & Piltz 2001), mainly based on vegetative morphology.

## How to use the determination keys

The identity of a plant is determined by a combination of several characters (features of stem, leaf, flower, fruit, size, colour, etc.). In a key each character is like a determination outline designed to facilitate a process of elimination of all but the taxon to which the plant belongs. Each key is made up of a series of pairs of opposed leads or, to be precise, of opposite characters (see hypothetical key). One feature only will fit and lead to the identified plant species or next key step (correct plant group), the other option will not fit and is therefore eliminated. For example, see hypothetical key: a globose cactus with fibrous roots (plant c) is a lead to key step 2 "*Plant globose*", because the option - "*Plant cylindric, not globose*" is ruled out. At the next stage (key step 2), the plant object is determined and identified to be "*Plant with fibrous roots, (without a taproot)*".

Hypothetical key (three characters)

- |    |  |          |
|----|--|----------|
| 1. | Plant globose .....                                | <b>2</b> |
| -  | Plant cylindric, not globose .....                 | Plant a  |
| 2. | Plant with taproot .....                           | Plant b  |
| -  | Plant with fibrous roots (without a taproot) ..... | Plant c  |

Keys must be used with caution, because they can reflect only the characters ordinarily present in a taxon, and these in turn may be only an approximation of those of any one plant. Because the combination of characters is complex, a successful use of a key requires the consideration of the whole set of characters described in each pair of leads. Therefore a synopsis of all determination features is given in the chapter "General notes about the genera" at the end of this manuscript. A complete list of the countries of origin of each gender of Cactaceae is given in the CITES Cactaceae Checklist, 2nd Ed. (Hunt 1999), together with all the synonyms.

The identification of cacti is a difficult process and patience and adequate tools are necessary. In order to follow the key steps, a magnifying glass must be used to identify all the tiny features. Also it is advantageous to look at the newspaper in which the plants may be wrapped, as a hint for the country of origin [see Lüthy & Supthut (1996) "Artificially propagated versus wild-collected succulents"].

<sup>1</sup> Additionally A.B. Doweld proposed 9 new genera [overview of Doweld's relevant publications in D. Hunt (2000b, 2001)], which are not listed in the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999) and not recognized by the International Cactaceae Systematics Group (ICSG) (interim amendments June 2001).

Proposed new genera [*taxa of currently preferred name*]:

- Bolivicactus* Doweld 2000 [*Parodia* p.p.];
- Escobariopsis* Doweld 2000 [*Mammillaria* p.p.];
- Escobrittonia* Doweld 2000 [*Coryphantha* p.p.];
- Escocoryphantha* Doweld 1999 [*Escobaria* p.p.];
- Neonavaioa* Doweld 1999 [*Pediocactus* p.p.];
- Parrycactus* Doweld 1999 [*Ferocactus* p.p.];
- Perenocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)];
- Puebloa* Doweld 1999 [*Pediocactus* p.p.];
- Ritterocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)].

There are some difficulties in implementing of the CITES Convention: the plants are often traded at a non-flowering stage or as young specimens, making it sometimes impossible to identify exactly a cactus species in sterile phase without the help from a professional botanist. However, in this publication, identification and almost all determination keys are based not only on the characters of flowers structure and the seed and fruit morphology, but also on vegetative features. Last but not least, the pictures and descriptions of cactus morphology in the introducing chapters and the glossary of scientific terms will help clarify the determination keys.

### Identification Key to the Subfamilies of Cactaceae

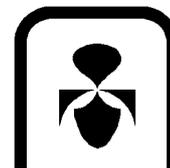
1. Areoles with visible glochids (minutely barbed spines) or glochids and areoles immersed in the plant surface (but easy to recognize by touching) ..... **Opuntioideae**
- Areoles without glochids ..... **2**
2. Plants without visible leaves (apart from the flower); occasionally with leaf-like flattened stems, mammillae or tubercles ..... **Cactoideae**
- Plants with distinct shaped, assimilating, foliage or terete leaves (at least during growth) ..... **Pereskioideae**

### Identification Key to the Subfamily Pereskioideae

- Trees, woody shrubs; scandent; well developed and flat, foliage leaves (may be deciduous after growth period); distributed in tropical America (Florida, West Indies, N-Argentina) ..... **Pereskia**
- Low caespitose shrubs, growing in tufts or forming mats; leaves terete, cylindrical; distributed in Andean cordilleras of S-Chile, S-Argentina (Patagonia) ..... **Maihuenia**

### Identification Key to the Subfamily Opuntioideae

1. Leaves foliate, broad and flat (deciduous during dry periods) ..... **2**
  - Leaves terete, not foliate ..... **3**
  2. Plants distributed in Mexico, Guatemala; flowers yellow, usually lateral ..... **Pereskiopsis**
  - Plants distributed in South America; flowers red or pink, usually terminal ..... **Quiabentia**
  3. Dwarf geophytic shrubs with large rootstocks, tuberous stems; areoles not sunken; distributed in Argentina; seeds winged all round ..... **Pterocactus**
  - Plants not as above ..... **4**
  4. Scandent shrub, no large rootstock, stems slender-cylindric, scrambling, cane-like or slightly flattened; distribution Brazil ..... **Tacinga**
  - Stems various, fleshy, tuberous or slender, not cane-like (dwarf geophytes up to shrubs or trees), occasionally with rootstocks, seeds not winged ..... **Opuntia**
- NOTE: According to researches of the International Cactaceae Systematics Group and Anderson (2001) the genus *Opuntia* as treated in CITES Cactaceae Checklist 2nd Ed. (Hunt 1999) is divided into 10 genera, based on different characters in gene sequence data, fruit-, seed- and pollen morphology ..... **5**
5. Spines with papery sheath; distribution North America ..... **Cylindropuntia**
  - Not as above ..... **6**



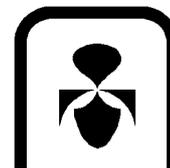
# Identification keys

6. Segmented, treelike stems (< 20m, 35 cm Ø), dimorphic shoots (cylindric stems with leave-like, flattened platyclades); unique in subfamily: pollen morphology and flowers with a ring of hairlike staminodes between the perianth and stamens; South America (BR, PY, BO, PE, AR) ..... **Brasiliopuntia**
- Not as above ..... 7
7. Areoles sunken into hairy depressions or globose cavities with small openings; distribution South America ..... **Maihueiopsis, Tephrocactus**
- Not as above ..... 8
8. Trees (<10m high) with dimorphic growth pattern (unsegmented, cylindrical main axis (stems) and asymmetrical, flattened, ovate lateral branches (segments = platyclades)); areoles distinct, not sunken into cavities. Also distinct by seed and pollen morphology; Florida to Caribbean Region ..... **Consolea**
- Not as above ..... 9
9. Distribution North America ..... 10
- Distribution South America ..... 11
10. Cushions or basal branched shrubs; stems usually segmented (segments cylindrical to club shaped) sometimes with tuberculated ribs; spines ± flattened, roughened or bulbous basally; SW USA, northern Mexico ..... **Grusonia**
- Not as above; flattened stem segments ..... **Opuntia p.p.**
11. Flattened stem segments. .... **Tunilla p.p., Opuntia p.p.**
- Cylindrical or ovoid stem segments ..... **Austrocylindropuntia, Cumulopuntia**  
..... **Miqueliopuntia, Opuntia p.p., Tunilla**

## Identification Key to the Subfamily Cactoideae

1. Plant body not globular or depressed; with elongate, single or branched, cylindrical or flat stems (cereiform) ..... 2
- Plant body single or clustering globular (cactiform), depressed or short -columnar (<1m stem length) ..... 92
- NOTE: Small, young collected specimens of columnar, shrubby or treelike cacti can be mistaken as globular species
- NOTE: Tiny, button-like plants (max. 2 cmØ); ribs or tubercles absent; areoles spineless and sparsely woolly; distribution Bolivia, Argentina ..... **Blossfeldia liliputana**
2. Epiphytic or lithophytic, mostly pendent, climbing plants. Stem leaf-like, flat, angled or cylindrical. Mostly spineless or rarely spines up to 1 cm, something with fine bristles. Often producing aerial roots ..... 3
- Columnar, terrestrial and mostly pendent, climbing plants. Stems woody and usually many ribbed ..... 31
3. Plant with segmented stems (segments usually up to 30 cm long) ..... 4
- Plants without segmented stems or long segmented ..... 9
4. Areoles only apical at stem segments ..... 5
- Areoles apical and additional lateral at stem segments ..... 8
5. Without bristles or spines ..... 6

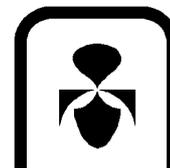
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- With bristles or spines ..... 7
  - 6. Leaf-like flattened stems; zygomorph flowers ..... (“Christmas Cactus”) **Schlumbergera**
  - Not leaf-like, terete; flowers regular mostly cream ..... **Hatiora p.p.**
  - 7. Flowers zygomorph; plants with pad-like, flattened stem segments, thickened or compressed stems. Areoles without glochids, but with setaceous spines. Distribution Southeast-Brazil only ..... **Schlumbergera opuntioides**
  - Flowers regular and red or pink ..... (“Easter Cactus”) (syn. *Rhipsalidopsis*) **Hatiora p.p.**
  - 8. Branching system mesotonic: young stem segments usually develops lateral from old segments, arising of areoles at the bases of old segments, never in apical clusters; mostly spines or bristles ..... **Lepismium**
  - Branching system acrotonic: young stems usually arising in apical clusters; mostly without spines or bristles ..... **Rhipsalis**
  - NOTE: Juvenile plants of *Rhipsalis* with spines up to 1 cm.
  - 9. Stem leaf-like flattened, 2-winged, mostly pendent or rarely climbing ..... 10
  - Stems slender, 3-4-angled or cylindrical (5-12 ribs), rarely in part 2-winged; mostly scrambling, trailing, rarely pendent ..... 16
  - 10. Stems short spiny ..... 11
  - Stems spineless (areoles only with fine bristles or wool) ..... 12
  - 11. Numerous <12 mm long spines; flowers 20-25 cm long; adventiv roots on lower side of leaf-like stems; Plant climbing with flattened stems, depressed on the trunk of host-tree; restricted to Brazil ..... (syn. *Strophocactus wittii*) **Selenicereus wittii**
  - Plant not as above; 1-3, <6 mm long spines; flowers 5-7 cm long; distribution Costa Rica ..... (syn. *Ecchremocactus p.p.*) **Weberocereus p.p.**
  - 12. Flattened stems very strongly indented (pinnatisect) resembling to fern or palm leaves; flowers 10-30 cm long ..... (syn. *Cryptocereus, Marniera*) **Selenicereus p.p.**
  - Flattened stems not strongly indented ..... 13
  - 13. Flower size 10-30 cm ..... **Epiphyllum**
  - Flower size smaller than 10 cm ..... 14
  - 14. Flowers 0,7–2,5 (3,5) cm, creamy white, mostly short funnelform or rotate ..... **Pseudorhipsalis**
  - Flowers 2,5–10 cm, funnelform, campanulate, tubular; violet, pink, orange, red, yellow, rarely white ..... 15
  - 15. Areoles with noticeable tufts of short, tan-coloured wool; complanate thick (4-6 mm) stems ..... (syn. *Lobeira macdougallii, Nopalxochia macdougallii*) **Disocactus macdougallii**
  - Areoles without noticeable tufts of short, tan-coloured wool; stems thinner than 4 mm ..... (subgen. *Nopalxochia*, subgen. *Wittia*, subgen. *Disocactus*) **Disocatus p.p.**
  - 16. Branches 3-5-angled ..... 17
  - Branches cylindrical, 5-12-ribbed or angled ..... 23
  - 17. Plants without aerial roots ..... 18
  - Plants often with aerial roots ..... 21
  - 18. Flowers diurnal, bright orange or red ..... (syn. *Heliocereus*) **Disocactus p.p.**
  - Flowers nocturnal, white ..... 19
-



# Identification keys

19. Plants with tuberous rootstock or napiform tap roots ..... 20
- Plants without tuberous rootstock or napiform tap roots; distribution Venezuela, Colombia, Central America, Caribbean Region, Florida ..... **Acanthocereus**
20. Distribution SW USA, N Mexico; epidermis with coloured spots or stripes; stems slender ..... **Peniocereus p.p.**
- Distributed in South America; epidermis not as above described ..... **Pseudoacanthocereus**
21. Pericarpel and fruits with triangular scales; usually 3-angled; generally very short bristles or spines ..... **Hylocereus**
- Pericarpel and fruits without triangular scales, spines various ..... 22
22. Slender stems; 7-25 mm Ø, usually 3-angled (rarely 4-angled or terete) ..... **Weberocereus p.p.**
- Stems 4-10 cm Ø; 4-angled ..... (syn. *Deamia*, *Nyctocereus chontalensis*) **Selenicereus p.p.**
23. Plants pendent; stem diameter max. 1 cm, zygomorphic flowers, diurnal ..... (syn. *Aporocactus*) **Disocactus p.p.**
- Plants not pendent, but sprawling or trailing; not zygomorphic flowers ..... 24
24. Plants with tuberous rootstock ..... **Echinocereus p.p.** 25
- Plants without tuberous rootstock ..... 26
25. Stems at the apex and pericarpel with long white hairy areoles ..... (syn. *Wilcoxia schmollii*) **Echinocereus schmollii**
- Stems and pericarpel without hairy areoles ..... (syn. *Wilcoxia*) **Echinocereus p.p.**
26. Stems hang down (2-5 cm Ø); flowers diurnal, orange-red, tubular-funnelform; distributed in Mexico ..... (syn. *Morangaya*) **Echinocereus pensilis**
- Stems sprawling or scrambling; flowers nocturnal ..... 27
27. Plants with aerial roots; flowers 12-40 cm in size ..... **Selenicereus p.p.**
- Plants without aerial roots ..... 28
28. Flowers short (2-5 cm in length), tubular-campanulate, creamy-white, yellow-green; distribution Cuba, Puerto Rico, Hispaniola ..... (incl. *Neoabbottia*) **Leptocereus**
- Flowers longer than 5 cm ..... 29
29. Treelike; branches segmented, 4-6 angled; distribution Caribbean Region (Cuba, Haiti) ..... **Dendrocereus**
- Branches not segmented, not angled ..... 30
30. Flowers white, funnelform, 8-22 cm in length; stems with 4-12 ribs; hairy or felted areoles at apex; distribution subgen. *Harrisia* (Florida, Caribbean region), subgen. *Eriocereus* (Brazil, Bolivien, Paraguay, Argentina) ..... (incl. *Eriocereus*) **Harrisia**
- Flowers white to pinkish, tubular-funnelform, 4-10 (-20) cm in length; stems with 7-13 ribs; distribution Mexico, Central America ..... (syn. *Nyctocereus p.p.*) **Peniocereus p.p.**
31. Columnar, tree-like or shrubby plants with spines or bristles ..... 32
- Columnar plants without spines or bristles; basal branched shrubs (up to 1,5m heigth); ribs 4-6 (irregular, monstrous) (8-15 cm Ø); distribution Mexico (Baja California) ..... (syn. *Lophocereus mieckleyanus*) **Pachycereus p.p.**
32. Flowering areoles different and more hairy / bristly than non flowering areoles (plants with cephalium) ..... 33

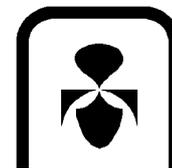
-	Flowering areoles not different to non-flowering areoles (plants without cephalium) .....	55
33.	Flowering areoles with short brown wool, proliferous when getting older, enlarged into a cone-like short branch by continuous growth; distribution Peru .....	<b>Neoraimondia</b>
-	Flowering areoles not proliferous / elongating .....	34
34.	Flowering zone apical or lateral .....	35
-	Flowering zones ring-like, cephalia discontinuous and alternating with vegetative zones, not restricted laterally or apically at the stem .....	52
35.	Flowering zone apical .....	36
	Flowering zone lateral .....	40
36.	Unbranched bottle-like stem, up to 1m; flowers nocturnal; restricted to Brazil .....	<b>Stephanocereus luetzelburgii</b>
-	Not bottle-like stems; often branched large shrubs or tree-like; distribution USA, Mexico, Andean states .....	37
37.	Stem clearly separated and constricted at the interface between vegetative zone and flowering zone (terminal cephalium). Dense compact terminal cephalium (like a bearskin) consisting of yellow (later dark brown) bristles / hairs; treelike plant with stems 15-20 cm Ø; restricted to Mexico .....	(syn. <i>Backebergia militaris</i> ) <b>Pachycereus militaris</b>
-	Stem not clearly separated or constricted at the interface between vegetative zone and flowering zone .....	38
38.	Distribution Peru; cushion forming, many basal branched shrubs (up to 1m, stems 6-8 cm Ø); ribs max. 11; white hairy apical cephalium embedded at apex; flowers diurnal, red - purple, more or less zygomorphic, tubular-funnelform .....	(syn. <i>Morawetzia</i> ) <b>Oreocereus p.p</b>
	Distribution Mexico (SW USA); tree-like plants (max. 5-15m height); ribs 5-26 (max. 20-40 cm Ø) .....	39
39.	Basal branched shrubs (up to 5m height); ribs 5-15 (up to 20 cm Ø); flowers nocturnal, pale pink – white, short tubular, funnelform-campanulate (2,5-4 cm length), pericarpel and tube naked but scaly; several small flowers offspring from one areole; disperse apical cephalium consisting of grey, 5-6 cm long flexible spines; distribution Mexico, SW USA (Arizona) .....	(syn. <i>Lophocereus</i> ) <b>Pachycereus p.p.</b>
-	Tree-like, columnar plants (max. 15m), with stems up to 40 cm Ø; ribs 17-26; red-brown, bristly apical cephalium; flowers nocturnal white, regular tubular-campanulate; distribution Mexico .....	(syn. <i>Mitrocereus ruficeps</i> ) <b>Neobuxbaumia macrocephala</b>
40.	Fertile zone not always clearly differentiated against vegetative zone; flowering areoles characterized with long woolly hairs .....	<b>Pilosocereus</b>
-	Fertile zone clearly differentiated against vegetative zone by dense hairy or bristly areoles, fertile areoles standing close together building a compact cephalium .....	41
41.	Lateral cephalium superficial .....	42
-	Lateral cephalium sunken .....	48



# Identification keys

42. Flowers diurnal ..... 43  
 - Flowers nocturnal ..... 45
43. Unbranched stems up to 1,5m; 15-30 ribs, 15-30 cm Ø;  
 distribution in Argentina ..... **Denmoza**  
 - Distribution Brazil ..... 44
44. Basal branched stems up to 1,2m; slender stems 3-8 cm Ø; 15-20 ribs;  
 young plants at stem bases with long (5-8 cm) white flexible, hairy spines;  
 distribution Brazil ..... **Micranthocereus p.p.**  
 - Mostly unbranched stems up to 75 cm, 8-17 cm Ø;  
 10-18 ribs ..... (syn. *Buiningia*) **Coleocephalocereus p.p.**
45. Distribution Mexico ..... 46  
 - Distribution Brazil or Venezuela ..... 47
46. Columnar tree-like unbranched stems up to 6-15m, up to 50-60 cm Ø,  
 12-30 (-60) ribs; vegetative areoles with short 3-5 spines and  
 20-30 grey-white long (up to 12 cm) hairs covering the whole  
 stem ..... ("Old Man Cactus") **Cephalocereus p.p.**  
 - Columnar tree-like unbranched stems 6-10m, up to 50 cm Ø,  
 by transversely grooves ± tuberculated ribs (16 or more);  
 vegetative areoles with short 5-8 (8 cm length) creamy  
 white central spines and 14-18 -white (1 cm length) radial  
 spines ..... (*Haseltonia*) **Cephalocereus p.p.**
47. Tree-like up to 8m, 15-25 cm Ø; 9 ribs; fertile areoles with long pure  
 white or brown woolly hairs ..... (syn. *Subpilocereus mortensenii*) **Cereus p.p.**  
 - Unbranched erect (up to 2-5m) or decumbent branching plants;  
 stems 4-15 cm Ø 10-17 ribs; fertile areoles with brown-white,  
 bristle-like hairs ..... **Coleocephalocereus p.p.**
48. Spiny stems covered with dense long white-grey hairs ..... 49  
 - Stems not masked with white-grey dense hairs ..... 50
49. Shrubs or tree-like up to 7m; max. 20 cm Ø; distribution Ecuador, Bolivia, Peru ..... **Espostoa**  
 - Many basal branched shrubs up to 4m, 8 cm Ø; distribution Brazil ..... **Espositoopsis**
50. Flower tube, pericarpel and fruit naked except for  
 minute scales ..... **Micranthocereus p.p.**  
 - Flower tube, pericarpel and fruit with hairs and noticeable scales ..... 51
51. Branched shrubs (2-5m); stems (3-5 cm Ø) with 11-14 tuberculated ribs;  
 flowers diurnal, red, tubular (4-5 x 1 cm); distribution Bolivia ..... **Cephalocleistocactus**  
 - Basal branched shrubs or trees (3-5m); stems 5-12 cm Ø) with  
 12-20 tuberculated ribs; flowers nocturnal, white (4,5 x 2 cm);  
 distribution Brazil ..... **Facheiroa p.p.**
52. Stem diameter < 4 cm, 7-14 ribs; flowers tubular (< 3 cm long), red,  
 orange, diurnal; erect to semi-prostrate, slender shrubs (< 2m tall);  
 distribution Brazil ..... **Arrojadoa**  
 - Stem diameter > 4 cm; stems with more than 12 ribs, flowers not as above ..... 53

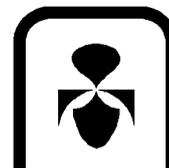
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53. Small shrubs (up to 1,5m) with prostrate-like branches, stems < 7 cm Ø, 13-14 ribs; flowers white, nocturnal; distribution Peru, Chile, Bolivia ..... **Haageocereus zonatus**
- Trees or shrubs (4-8m) with basitonically branched, columnar stems ..... **54**
54. Stems 12-18 ribs; flowers white with green tube; distribution Brazil ..... **Stephanocereus leucostele**
- Stems 22-27 ribs; flowers pink; distribution Mexico ..... (syn. *Neodawsonia*) **Cephalocereus p.p.**
55. Pericarpel of the flowers naked (without spines, bristles) or with scales only ..... **56**
- Pericarpel of the flowers with spines, bristles or hairs, scales conspicuous or minute ..... **66**
56. Flower size < 2,5 cm; up to 9 flowers per areole, fruits blueberry-like; thick spines; 5-9 ribs; many branched shrubs up to 4-5m; distribution Mexico, Guatemala ..... (“Blueberry Cactus”) **Myrtillocactus**
- Flower size > 2,5 cm; usually 1 flower per areole ..... **57**
57. Flower size 3 cm; pericarpel with papery triangular scales; many branched, tree-like up to 7m; 7-8 ribs; distribution Mexico ..... **Escontria**
- Flower size > 3 cm; pericarpel and flower tube scaly (but not papery scales) ..... **58**
58. Pericarpel with noticeable broad imbricate scales; areoles of pericarpel without bristles or hairs ..... **59**
- Pericarpel without scales or scales not imbricate ..... **61**
59. Shrubs 1-4m; slender stems 1-9 cm Ø; 8-14 ribs; distribution Brazil ..... **Brasilicereus**
- Tree-like plants 4-10m; not distributed in Brazil ..... **60**
60. 7-34 ribs; distribution Chile, Bolivia, Peru ..... **Browningia**
- 8-9 ribs; distribution Paraguay, Argentina, Bolivia ..... **Stetsonia**
61. Massive columnar or few branched, giant tree-like plants up to 5-16m; pericarpel scales pronounced decurrent; distribution in SW USA – NW Mexico or Mexico only ..... **62**
- Pericarpel scales if existing not decurrent; distribution not in SW USA – NW Mexico ..... **63**
62. Areoles of flower tube and pericarpel felted without spines or bristles; fruit pulp red; distribution in SW USA – NW Mexico ..... (“Saguaro Cactus”) **Carnegia**
- Areoles of flower tube and pericarpel naked; fruit pulp white; restricted to Mexico ..... **Neobuxbaumia p.p.**
63. Tree-like up to 8m; stem branches segmented; stems 11-22 ribs; flowers nocturnal, white (outside brown); slender tubular-salverform; pericarpel and tube with naked areoles and numerous scales; restricted to Galapagos Islands ..... **Jasminocereus**
- Plants not as above; shrubs; stem branches not segmented; not distributed on Galapagos Islands ..... **64**
64. Stem tissue darkening when cut; flowers nocturnal, pale green-yellow or white; pericarpel and tube blue-waxy, with fleshy or small scales and small areoles (with bristles or felted hairs); distribution Brazil ..... **Cipocereus**
- Stem tissue not darkening when cut; flowers pericarpel naked (without hairs, bristles or spines) and / or with few small scales ..... **65**
-



# Identification keys

65. Flowers stout, tubular, campanulate-salverform (5-8 cm length) ..... (*Monvillea* p.p.) ***Praecereus***  
 - Flowers tubular-funnelform, large (10-30 cm length) ..... (*Monvillea* p.p.) ***Cereus* p.p.**
66. Stems conspicuous segmented ..... **67**  
 - Stems unsegmented ..... **69**
67. Stems with 3-8 ± angled ribs (branches 4-8 cm Ø) ..... **68**  
 - Stems with 3-16 ribs (branches 6-15 cm Ø); distribution Ecuador, Peru, Colombia ..... ***Armatocereus***
68. Distribution Peru; flowers (8-11 cm long) ..... ***Calymmanthium***  
 - Distribution Cuba, Puerto Rico, Cayman Islands, Haiti, Dom. Republ.; flowers (2-5 cm long) ..... ***Leptocereus* p.p.**
69. Diameter of stem or branches < 5 cm ..... **70**  
 - Diameter of stem or branches > 5 cm ..... **77**
70. Distributed only on Galapagos Islands (Ecuador); basal branching, fleshy stems (20-60 x 3-5 cm; very dense spiny ribs 16-22) with yellow spines (<5 cm) darkening in old age ..... ***Brachycereus***  
 - Not distributed on Galapagos Islands; stem and spines not as above ..... **71**
71. Decumbent, rope-like stems; spirally oriented tubercles (mammillae), bipartite areoles (without groove); zygomorphic red flowers; distribution Mexico (Baja California) ..... (syn. *Cochemiea*) ***Mammillaria* p.p.**  
 Plants not as above ..... **72**
72. Distribution Mexico (Baja California) and USA (SW California); many basal branched, low shrubs (1-1,5m); stems (3-6 cm Ø); humped ribs (20-25); flowers lateral at stem, diurnal, pale yellow, campanulate (2 x 2 cm) ..... ***Bergerocactus***  
 - Distribution South America ..... **73**
73. Distribution Brazil ..... **74**  
 - Distribution not Brazil, but Bolivia, Peru, Chile, Argentina or Uruguay ..... **75**
74. Few branched; erect low shrubs (2-3m); stems 1,5-6 cm Ø; low, rounded ribs (10-20); flowers nocturnal, tubular-salverform (4-7 cm long) ..... ***Leocereus***  
 - Basal branched shrubs (0,5-1m); erect trailing; stems 2-3 cm Ø; humped ribs (9-18); flowers nocturnal, elongated tubular-funnelform (tube 6-8, perianth 4 cm long) ..... ***Arthrocereus***
75. Flowers diurnal, coloured orange, yellow, red, tubular and partly ± zygomorphic ..... ***Cleistocactus* p.p.**  
 - Flowers not as above ..... **76**
76. Stems (< 3 cm Ø); tuberculated ribs (5-12); napiform taproot; flowers diurnal, yellow, orange, purple-red, campanulate; distribution Bolivia, Peru, Chile ..... (syn. *Erdisia*) ***Corryocactus* p.p.**  
 - Stems (4 cm Ø), 4-6 ribs humped (areoles between humps); flowers nocturnal white, tubular - narrow funnelform; distribution restricted to Bolivia ..... ***Samaipaticereus***

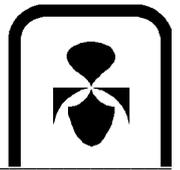
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77. Distribution NE Brazil; dense spiny stems (5-7 cm  $\emptyset$ ); low ribs (17-20)  $\pm$  tuberculated, nocturnal white flowers tubular (3 cm long) ..... (syn. *Zehntnerella*) ***Facheiroa* p.p.**
- Distribution not Brazil; plant not as above ..... **78**
78. Distribution North to Central America, extending to Venezuela and Colombia ..... **79**
- Distribution South America (andean countries: Ecuador, Bolivia, Peru, Chile, Argentina) ..... **84**
79. Stem tissue yellow, restricted to Mexico ..... **80**
- Stem tissue not yellow; distribution North to Central America, extending to Venezuela and Colombia ..... **81**
80. Flowers, nocturnal, campanulate (2-5 cm), cream whitish, acroton branched, tree-like (4-5m tall), stems (5-10 cm  $\emptyset$ );  $\pm$  humped ribs (7-12); 5-9 radial spines (5-30 mm long), 0-1 central spine; pericarpel and tube with imbricate scales and bristly spines or hairs ..... (incl. *Heliabravoia*) ***Polaskia***
- Flowers nocturnal – diurnal, tubular-campanulate (7,5 cm long, 6 cm  $\emptyset$ ); ascending, climbing shrubs (3-5m), stems (6-8 cm  $\emptyset$ ); tuberculated ribs (7-9ribs), areoles brown felted; 1 central spine (<5 cm lang), 0-5 radial spines ..... (*Hertrichocereus*) ***Stenocereus* p.p.**
81. Flowers lateral, diurnal,  $\pm$  zygomorphic narrowly tubular (7,5-12 cm long, < 4 cm $\emptyset$ ), bright red (humming bird pollinated); spread climbing shrubs (2-3m); more or less tuberculated ribs (5-8); areoles white felted, radial spines 11-14, central 1-4 ..... (*Rathbunia*) ***Stenocereus***
- Flowers  $\pm$  not zygomorphic, but not bright red; tree-like or creeping plants ..... **82**
82. Creeping, sprawling shrubs (10-200 cm tall), stem (4-9 cm $\emptyset$ ), 8-12 ribs, areoles hairy and dense spiny, 20 radial spines, 1 central spine (dagger-like flattened and downwards bended, 3 cm long); flowers nocturnal, white, narrowly tubular and salverform (10-14 cm long, 4-6 cm  $\emptyset$ , tube 4-6 mm  $\emptyset$ ), tube and pericarpel minute scaly and with spiny, felted areoles; Mexico (Baja Californica) ..... (*Machaerocereus*) ***Stenocereus* p.p.**
- Not creeping shrubs, but erect, columnar trees or tree-like shrubs ..... **83**
83. Stems ribbed or with tuberculated ribs (3-17 ribs; 10-35 cm  $\emptyset$ ); areoles white or brown (yellow) felted and often dense spiny (0-20 radial spines, 1-10 central spines up to 5 cm long; flowers apical or lateral, nocturnal (extending diurnal), white - pink, tubular-funnelform (5-7,5 cm length, 3-7 cm  $\emptyset$ ) or campanulate (2,5-8 cm long); pericarpel and tube usually spiny (sometimes felted to few bristly), broad imbricate (*Ritterocereus*) or decurrent scales; fruit spiny; distribution Mexico, SW USA, Central America, West Indies, Colombia, Venezuela ..... ***Stenocereus* p.p.**
- NOTE: Triangular, sharp ribs 5-8; fruit not spiny but few scales; sometimes numerous flowers in chain-like orientation on ribb (apical extending lateral); restricted to Mexico ..... ***Isolatocereus***
- Stems (8-30 cm $\emptyset$ ), ribs (3-7->20; areoles usually broad and in some species linked by felted hairs (groove); 6-12 radial spines, 1-3 central spines (1-12 cm long), lateron deciduous; flowers apical-lateral, mainly nocturnal, white or yellow, funnelform-campanulate (2,5-5 cm  $\emptyset$ , 5-10 cm long), tube and pericarpel with numerous scales, bristles and felted axils; SW-USA, Mexico, Guatemala, Honduras ..... ***Pachycereus* p.p.**
-



# Identification keys

84. Flowers  $\pm$  zygomorphic to tubular, bright coloured red, orange, yellow ..... 85  
 - Flowers regular, funnelform or campanulate ..... 87
85. Mature fruits pulpy, indehiscent or opening at one side ..... **Cleistocactus** p.p.  
 - Mature fruits dry, capsule-like, dehiscent ..... 86
86. Fruits opening at base; pericarpel and tube with numerous small scales (pronounced decurrent) and hairy ..... (syn. *Arequipa*) **Oreocereus** p.p.  
 - Fruits opening at apex; pericarpel and tube with numerous imbricate scales and woolly / hairy areoles ..... **Weberocereus seiboldianus**
87. Yellow-orange coloured stem-tissue by cutting; spines up to 24 cm long; tuberculated ribs (5-12); flowers diurnal, campanulate; yellow, orange, purple-red ..... **Corryocactus** p.p.  
 - Stem-tissue not colouring yellow by cutting; plant not as above ..... 88
88. Flower tube not developed ..... 89  
 - Flower tube well developed ..... 90
89. Flower funnelform (10-13 cm long, 10 cm  $\varnothing$ ); erect or semi-prostrate, solitary to basal or candelaber-like branching, columnar stems (0,2-10m tall, 6-70 cm  $\varnothing$ ); ribs or more or less tuberculated ribs (ribs (6-25); dense spiny areoles (10-50 radial spines, 0-4 central spines up to 14 cm); flowers subapical, diurnal, whitish, yellow, pink, red; pericarpel and tube densely hairy with small numerous scales; Bolivia, Argentina, Chile ..... (syn. *Helianthocereus*) **Echinopsis** p.p.  
 - Flower short campanulate (2-6 cm long, 5-7 cm  $\varnothing$ ); tree-like or shrubby plants (7-25 cm  $\varnothing$ ; 9-16 ribs); broad areoles noticeable woolly or hairy and strong spiny; central spines elongated (up to 18 cm); flowers diurnal, short-campanulate, white or pale pink; pericarpel and short tube with dense scales and woolly hairs and bristles; distribution Chile, Peru ..... **Eulychnia**
90. Flowers (7-24 cm long, 10-14 cm  $\varnothing$ ); fruits hairy, brownish-green, dry pulp, dehiscent; erect or semi-prostrate, solitary to basal or candelaber-like branching, columnar stems (0,2-12m tall, 5-60 cm  $\varnothing$ ); ribs or tuberculated ribs (ribs (4->25); spines (2-15 radial spines, 1-6 central spines); flowers subapical, nocturnal (partly still open at morning); white, pale pink to yellowish, funnelform to tubular-funnelform; pericarpel many scales and hairy; Ecuador, Peru, Bolivia, Argentina, Chile ..... (syn. *Trichocereus*) **Echinopsis** p.p.  
 - Flowers (5-10 cm long); fruits not as above ..... 91
91. Pericarpel and tube with pronounced decurrent scales ..... **Haageocereus**  
 - Pericarpel and tube with numerous imbricate scales ..... **Weberbauerocereus** p.p.
92. Stem with leaf- or scale-like tubercles in a rosette- or cone-like arrangement ..... 93  
 - Stem without leaf- or scale-like tubercles ..... 97
93. Plants more or less semi-geophytic; tubercles scale-like, broadly triangular or tubercles flattened at apex ..... 94  
 - Tubercles elongated (length up to 15 cm) and triangular, with papery long spines (flattened central spine to 15 cm) on the top of tubercles; distribution Mexico ..... **Leuchtenbergia principes**
94. Tubercles arranged in a more or less open rosette; with or without spines ..... 95

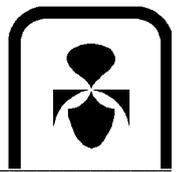
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- Tubercles appressed as in a cone or globular bulb; young areoles with 10-12 (5 mm long) bristles; distribution Mexico ..... ***Pelecyphora strobiliformis***
  - 95. Plants without spines; distribution Mexico and SW USA ..... ***Ariocarpus***
  - Stem apex with spines at the top of tubercles; spines in old age deciduous ..... **96**
  - 96. Rhomboid-pyramidal tubercles spirally disposed with dry apical tips; depressed globose to short cylindrical (<8,5 cm Ø, 3-8 cm tall); ± taproot; distribution Mexico ..... ***Strombocactus disciformis***
  - Leaf-like triangular tubercles (0,5-2,5 cm broad, 1-1,5 cm long); adaxial flattened, abaxial keeled) oriented in a rosette-like arrangement; sub-geophytic, depressed globose (8-20 cm Ø, <10 cm tall); conspicuous taproot; distribution Mexico ..... ***Obregonia denegrii***
  - 97. Ribs, tuberculated ribs or tubercles arranged in more or less vertical rows ..... **98**
  - Tubercles (mammillae) arranged in spirally rows or absent ..... **139**
  - 98. Fertile zone clearly differentiated against vegetative zone; flowering areoles restricted to a dense hairy or bristly compact terminal cephalium ..... **99**
  - Fertile zone not differentiated against vegetative zone; no terminal cephalium existing ..... **100**
  - 99. Stems short columnar to globose (9-40 cm Ø; incl. cephalium (<1m) up to 1,5m in height); ribs (8-20); areoles often more or less sunken into the ribs; areoles with strong spines (4-15 radial spines, up to 3,5 cm long; 1 (-4) central spine). Cylindrical cephalium white woolly with red or white bristles; flowers small (up to 2,5 cm long) narrow tubular, diurnal, red or pink, not fragrant; pericarpel and tube naked; fruits red, pink, white. Distribution Caribbean Region, Mexico, Surinam, Guyana, Central America, Colombia, Venezuela, Ecuador, Peru, Brazil ..... ***Melocactus***
  - NOTE: Only 4 species in App. I (*Melocactus conoideus*, *M. deinacanthus*, *M. glaucescens*, *M. paucispinus*: all restricted to Brazil): Young specimens without cephalium cannot easily be identified.
  - Stems (depressed) globose (5-30 cm Ø, 2-10 cm in height), rarely semi-geophytic; ribs (8-25) distinct or ± tuberculated; spiny areoles (3-14 central and radial spines) not sunken into (tuberculated) ribs. Depressed cephalium white woolly with brown or red bristles; flowers tubular-funnelform (7 cm long), nocturnal, white, fragrant; fruits white. Distribution Brazil, Bolivia, Paraguay ..... ***Discocactus***
  - 100. Plants without spines or nearly so ..... **101**
  - Plants with spines ..... **107**
  - 101. Stem ribs transversely wrinkled; distribution Mexico ..... ***Aztekium* 102**
  - Stem ribs not transversely wrinkled; distribution Mexico, SW USA, Texas, Bolivia ..... **103**
  - 102. Plant clustering (5-6 cm Ø); ribs (9-11) flattened, transversely wrinkled; taproot ..... ***Aztekium ritteri***
  - Plant solitary (10 cm Ø, 9 cm height); sharply ribbed, ribs 10-15; no taproot ..... ***Aztekium hintonii***
  - 103. Plant surface more or less densely covered with tiny tufts of minute white hairs, in exception epidermis naked ("nuda" forms) ..... ***Astrophytum* p.p. 104**
  - Plant surface not covered with tiny tufts of minute white hairs ..... **105**
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# Identification keys

104. Tiny tufts of minute white hairs arranged in curves around the areoles; semi-geophytic – depressed globose (2-5 cm height above ground, 10 cm  $\emptyset$ ); 7-8 longitudinal grooves marking the flattened, pale to dark green ribs; flower yellow with red throat; distribution USA (Texas), Mexico ..... ***Astrophytum asterias***
- NOTE: Possible look-alike confusion with: *Frailea castanea* Backeberg (syn. *Frailea asterioides* Werdermann) (brown-greenish surface without minute hairy spots; 9-14 ribs; areoles with few radial spines curved downwards, distribution Brazil, Uruguay); *Matucana madisoniorum* (Hutchinson) Rowley (grey-green globose plants at stem apex with hardly visible tuberculated ribs (7-12); surface without minute hairy spots; red flowers; distribution Peru) or *Euphorbia obesa* Hooker (App. II) (family Euphorbiaceae; spineless globose plant with milk sap, distribution South Africa).
- Tiny tufts of minute white hairs completely covering the whole plant surface; globular to short-columnar (up to 60 cm height, 5-25 cm  $\emptyset$ ); 5-10 distinct ribbed stems; flower yellow; distribution Mexico ..... ***Astrophytum myriostigma***
105. Stems distinctly, sharply ribbed (ribs 18-20); globular to short-columnar (10-20 cm height, 15 cm  $\emptyset$ ), almost solitary; stem dull blue-green, covered with thick waxy secretions. Spiny areoles only at apex and deciduous; usually 3 spines (3-12 mm long, curved, slightly tortuous); distribution Mexico ..... ***Geohintonia***
- Semi-geophytic stems with flattened tuberculated ribs and thick taproots; plants not as above ..... **106**
106. Plants (8-10 cm  $\emptyset$ , 5-7 cm in height); 5-13, flat and broad,  $\pm$  transversely grooved, tuberculated ribs (flat tubercles disposed in more or less vertically rows); surface blueish-green; areoles at the apex of tubercles, spineless but densely felted (cream-white wool); flowers diurnal, campanulate, white-pink; distribution Mexico, SW USA ..... ***Lophophora***
- Plants (3-5 cm  $\emptyset$  and high); 5-8, flat tuberculated ribs with rounded podaria; sunken areoles between the humps (podaria), only felted wool visible; flowers diurnal, regular salverform, yellow-orange; distribution restricted to Bolivia ..... ***Cintia***
107. Distribution South-America ..... **108**
- Distribution restricted to Mexico and / or USA ..... **130**
108. Distribution Brazil; globose to short columnar plants ..... **109**
- Distribution not Brazil ..... **114**
109. Singled stemmed, globose or short-columnar (8-20 cm  $\emptyset$ , 5-120 cm) plants; plant surface rough papillate or smooth, grey-greenish, often covered with white waxy scales; young specimens with dark red-brownish epidermis; tuberculated ribs or sharp ribs (15-40); areoles spiny and felted (0,5 cm-3,5 cm); flowers yellow, diurnal, funnellform (1-3 cm  $\emptyset$ , 1-3,5 cm long); pericarpel and tube densely brownish woolly-bristly and with few small scales; 3 spp. restricted to Brazil ..... ***Uebelmannia***
- Plants not as above ..... **112**

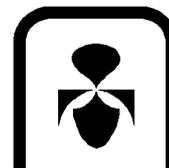
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110. Stem-cortex with conspicuous large mucilage cells; plants (6-10 cm Ø, 50 cm tall) with dark green tubercles in dispersed ribs (up to 40); areoles woolly with 2-6 spines (up to 2 cm length) oriented down- and upwards ..... (syn. *U. meninensis*) ***Uebelmannia gummifera* 110**
- Stem-cortex without conspicuous large mucilage cells; plants not as above ..... **111**
111. 3-4 spines dark brown to black or grey-yellow (1,5-3,5 cm long), projecting the rib like a crest; sharply ribbed (<30 ribs) plants (20 cm Ø, 120 cm tall) with; epidermis rough and greyish; old areoles at basal part of the stem continuous joined together, which contrast sharply to the separated young, woolly areoles at apex ..... ***Uebelmannia pectinifera***
- NOTE: A look-alike of *Uebelmannia pectinifera* is *Parodia magnifica* (syn. *Eriocactus magnificus*, *Notocactus magnificus*), which is also a globular plant with combelike, continuous joined areoles on ribs and distributed in Brazil. Whereas *Parodia magnifica* is characterized by soft bristly areoles and large (5,5 cm Ø) yellow, funnellform flowers, *Uebelmannia pectinifera* shows strong spiny areoles and smaller green-yellow, tubular-funnelform flowers (1,6 cm long, 2 cmØ).
- 6-8 brown-white downwards oriented spines (<0,5 cm length), tuberculated ribs (up to 18); brownish-green plants (up to 8 cm Ø, <10 cm tall); areoles hardly felted ..... ***Uebelmannia buiningii***
112. Dwarf, globose or short columnar, single stemmed or clustering plants (3-18 cm tall, 2-5 cm Ø); plant surface greyish green – brownish; (weakly) ribs (10-33) or tuberculated ribs, the tubercles sometimes oriented in spirally rows; areoles felted and short spined (central spines never hooked, radial spines sometimes depressed or curved downwards); flowers diurnal (cleistogamous or briefly opening), only yellow, funnel-salverform (2-3 cm long, 2-5 cm Ø); pericarpel and short tube with dense red-brownish bristles and cream-white wool; distribution Brazil, Bolivia, Paraguay, Uruguay, Argentina ..... ***Frailea***
- Plants in combination of features not as above ..... **113**
113. Flowers (13-25 cm long, 8-35 cm Ø) ..... ***Echinopsis* p.p.**
- Flowers smaller ..... ***Parodia* p.p.**
114. Plants with taproots and / or subterranean stembase ..... **115**
- Plants without taproots and / or subterranean stembase ..... **122**
115. Distribution Chile ..... **116**
- Distribution not Chile ..... **118**
116. Flowers lateral ..... (syn. *Lobivia* p.p.) ***Echinopsis* p.p.**
- Flowers apical ..... **117**
117. Pericarpel and tube ± naked (with few mostly hairless scales); Solitary or basal branching, clustering plants, globose to short-columnar, ascending or procumbent stems (2-20 cm Ø, 8-100 cm tall); rarely semi-geophytic; taproots (occasionally a thin string connecting stem and taproot); plant surface often greyish by dense waxy covering; stem apex usually dense white felted; ribs or tuberculated ribs usually in vertically rows (rarely ribs and tubercles ± spirally oriented); flowers immersed at apex, diurnal, yellow (rarely redish), short salver-funnelform (2-4 cm Ø and length) ..... ***Copiapoa* p.p.**
- Tube (and pericarpel) not naked, but with bristles or spines ..... ***Eriosyce* p.p.**
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# Identification keys

118. Pericarpel naked (without hairs, bristles or spines) but more or less scaly ..... 119  
 NOTE: Dwarf, flattened globose , (1,3-3 cm Ø, 0,5-1,5 cm high); stem apex sunken with felted, wooly areoles; ± tuberculated ribs in vertically rows (up to 40); flowers pink, apical, short-funnelform to rotate (2 cm Ø, 1 cm long) ..... **Yavia**
- Pericarpel scaly and hairy / bristly ..... 120
119. Flowers funnelform-campanulate (2,5-7 cm Ø) ..... **Gymnocalycium**
- Flowers campanulate (2-3 cm Ø) ..... (syn. *Weingartia*) **Rebutia p.p.**
120. Flowers campanulate-funnelform; plants flattened-globose or short columnar (7-15(-40) cm tall, 10-20-(25) cm Ø), single or rarely basal branched (cushion-like) with napiform taproots; tuberculated ribs (7-35); areoles elongated with ± pectinate spines (10-30 radial spines in combelike arrangement and often sideways weaved), central spines absent or 1-2; flowers in a subapical ring; diurnal, red, pink or yellow; regular; areoles of pericarpel and short tube with small decurrent scales; scale axils sparsely woolly; restricted to Peru (3800 – 4200m a.s.l.) ..... **Oroya**
- Flowers funnel-salverform, plants not as above ..... 121
121. Flowers (1,7-3,3 cm long), apical, diurnal yellow; erect or semi-prostrate short-columnar plants with basal branches forming clumps or dense colonies; few napiform taproots; soft fleshy stems, cylindric stems 5-15 cm in height, 2-3 cm Ø) ribs 10-13, bristly and spiny; pericarpel scaly and hairy; distributed Peru ..... **Mila**
- Plants not as above; solitary or clustering, globose to short-columnar (0,8-17 cm Ø, 0,8-20 cm tall); taproots; tuberculated ribs (<30); stems not soft fleshy; areoles linear combined with pectinated spines; flowers (2,5-4,5 cm Ø, 2-4 cm long), usually near stem base or lateral, diurnal, pale pink, yellow, orange, red or crimson; pericarpel and tube with scales; scale axils with hairs or bristles ..... (syn. *Sulcorebutia*) **Rebutia**
122. Flowers ± zygomorphic (except one species *M. aureiflora* App. II); restricted to Peru ..... **Matucana**
- Flowers regular ..... 123
123. Pericarpel and tube naked or mostly hairless ..... 124
- Pericarpel and tube hairy / bristly ..... 125
124. Flowers short funnelform-campanulate (2,5-7 cm Ø, 3-7 cm long); pericarpel and tube with large scales ..... **Gymnocalycium pp.**
- Flowers short salver-funnelform (2-4 cm Ø and long); pericarpel without large scales or with very few narrow scales ..... **Copiapoa p.p.**
125. Flowers with red stigmas ..... 126
- Flowers without red stigmas ..... 127
126. Pericarpel and tube with aristate, imbricate scales, spines or bristles and hairs; flowers rotate-campanulate (3-6 long, 3-10 cm Ø); erect or semi-prostrate, short-columnar plants (30-60 cm); stems (5-8 cm Ø) soft fleshy stems; stems simple or few branched at base; thin fibrous root system; tuberculated ribs 6-12; spines mostly more or less hooked; S Argentina, S Chile ..... **Austrocactus**
- Plants not as above; pericarpel and tube dense bristly with small scales; flowers tubular to shortly funnelform (5-8 cm long, 4-8 cm Ø); solitary or clustering, globose to short columnar plants (5-100 cm tall, 2-25 cm Ø); stems ribbed and slightly tuberculated by transversely furrows (6-40 ribs);

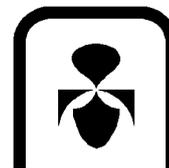
- usually ribs arranged in vertically rows; sharply ribbed in *Malacocarpus*, *Wigginsia*; usually areoles on top of tubercles, but sometimes tuberculated ribs with humps below areoles (*Malacocarpus*, *Wigginsia*); areoles felted and bristly or spiny (spines strong or short, needle-like, hooked or dagger-like; 4-60 radial spines, 0-4 central spines) ..... (syn. *Malacocarpus*, *Wigginsia*, *Eriocactus*, *Brasilicactus*, *Brasiliparodia*, *Notocactus*) ..... **Parodia p.p.**
127. Flowers lateral ..... **128**  
 - Flowers apical ..... **129**
128. Flowers (2,5-25 cm long, 3,5-12 cm Ø) ..... (incl. *Lobivia*) **Echinopsis p.p.**  
 - Flowers (3-4 cm long, 2,5-4,5 cm Ø) ..... **Rebutia p.p.**
129. Plants 5-40 cm Ø; flowers coloured (red, pink, yellow, whitish); fruits fleshy, berry-like, opening at base ..... **Eriocyce p.p.**  
 - Plants 2-5 cm Ø; flowers yellow; fruits dry, capsule-like, indehiscent or rupturing irregularly ..... **Frailea p.p.**
130. Plants with undulated ribs ..... **131**  
 - Plants without undulated ribs ..... **132**
131. Undulated ribs (25-100); (depressed) globose plants (4-20 cm Ø, 5-12 cm tall); areoles white felted and widely distanced; large upwards oriented central spines (mostly flexible-papery, flattened, up to 8 cm length) and smaller radial spines; flowers diurnal, pink-striped white, pink or yellow, short funnelform (1,5-2,5 cm Ø and length); restricted to Mexico ..... **Stenocactus**  
 - Undulated ribs (8-13); areoles more or less elongated and grooved above; felted furrow with or without nectar-secreting glands; flowers apical appear from the adaxial groove ..... **Thelocactus p.p.**
132. Stem epidermis sparsely to densely covered with tiny spots of minute white hairs; plants single stemmed; 4-9 ribs; restricted to Mexico ..... **Astrophytum p.p.**  
 - Stem epidermis without tiny spots of minute white hairs ..... **133**
133. Plants with subterranean tapering stembase to (napiform) taproot or tuberous rootstock ..... **134**  
 - Plants with fibrous roots ..... **135**
134. Stigma greenish ..... **Echinocereus p.p.**  
 - Stigma not green; flexible, flattened papery spines ..... (syn. *Ancistrocactus*, *Echinomastus*, *Glandulicactus*) **Sclerocactus p.p.**
135. Areoles with nectar glands; globose to cylindric plants (12-80 cm Ø, 10->300 cm tall; cluster up to 3-5m Ø); ribs thick and prominent (8-40); large areoles more or less felted when young; spines well developed, either straight or curved (central spines mostly coloured (red – yellow), hooked and horizontally striped, up to 15 cm length); flowers funnelform-campanulate (2,5-7,5 cm Ø and length) ..... **Ferocactus**  
 - Areoles without nectar glands ..... **136**



# Identification keys

136. Plants mostly clustering; short columnar low shrubs (stems <1m long), soft fleshy cylindrical stems (< 10 cm Ø); tuberculated ribs (5-22 ribs); pericarpel and tube with aristate scales, spines, bristles, hairs and felted wool; flowers funnelform, diurnal; green stigma; distributed in Mexico, SW USA ..... ***Echinocereus* p.p. 137**
- Plants not as above ..... **138**
137. At stem apex each areole with 4-7 dark (brownish-black) central spines (up to 10 cm long), few of them are stronger and interlacing; erect cylindrical few basal branching (clustering) stems (up to 30 cm height, 10 cm Ø); ca. 10 tuberculated ribs; distribution only Baja California Norte (Mexico) ..... ***Echinocereus ferreirianus* var. *lindsayi***
- Areoles at stem apex without dark central spines ..... ***Echinocereus* p.p.**
138. Plants mostly solitary; stems 4-12 cm Ø; spines mostly papery, flexible, completely obscuring the stem surface; scales of pericarpel not aristate ..... ***Sclerocactus* p.p.**
- Plants mostly clustering (cushions 30-120 cm Ø); stems 1-10 cm Ø; spine never obscuring stem surface; pericarpel and tube with aristate scales, spines, bristles, hairs and felted wool; flowers funnelform, diurnal; green stigma ..... ***Echinocereus* p.p.**
139. Distribution South-America ..... **140**
- Distribution North-America ..... **147**
140. Plants with (napiform) taproots or subterranean stembase; sometimes tuberous root connected to the stembase by a thin subterranean neck ..... **141**
- Plants without (napiform) taproots or subterranean stembase ..... **145**
141. White felted areoles at "axil" of the upper side of tubercles; ca. 16 spirally disposed, humped tuberculated ribs, divided into triangular-conical tubercles; flowers diurnal, white or pale pink, funnelform (2-2,5 cm Ø and length); short pericarpel naked without scales or areoles; distribution Argentina, Chile, Bolivia, Peru ..... ***Neowerdermannia***
- Plants not as above ..... **142**
142. Plants with more or less pectinated spines ..... **143**
- Plants without more or less pectinated spines ..... (syn. *Weingartia*) ***Rebutia***
143. Distribution Bolivia ..... (syn. *Sulcorebutia* p.p.) ***Rebutia* p.p.**
- Distribution not Bolivia, but Chile ..... **144**
144. Plants > 5 cm Ø ..... ***Copiapoa* p.p.**
- Plants < 5 cm Ø ..... (syn. *Thelocephala* p.p.) ***Eriogyne* p.p.**
145. Areoles entire ..... **146**
- Areoles bipartite; distribution Venezuela, Colombia ..... ***Mammillaria* p.p.**
146. Flowers near stem base or lateral; spines ± bristle-like, not strong or hooked ..... ***Rebutia* p.p.**
- Flowers apical; spines strong or short, needle-like, hooked or dagger-like ..... ***Parodia* p.p.**
147. Areoles entire (no spatial separation of spiny and flowering part); no hairs or bristles at base (axil) of tubercle ..... **148**
- Areole bipartite (spatial separation of spiny and flowering part); no hairs or bristles at base (axil) of tubercle ..... **151**

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148. Plants (1,5-6 cm Ø, high); areoles densely spiny; spines obscuring tubercles (19-38, 1-8 mm), the uppermost curved and clavate-like spines are developed as glands (lateron deciduous) ..... ***Epithelantha***  
 - Plants not as above; no clavate-like spines are developed as glands ..... 149
149. Solitary or clustering, dwarf globose to short columnar (1,5-15 cm tall, 2-10 cm Ø); tubercles conical; areoles white woolly; usually white spines (acicular or tortuous, pungent or flexible; 6-28 radial spines, 0-4 central spines, rarely tipped black or entirely brown-black); juvenile plants densely covered with short whitish, more or less pectinate radial spines, preserving in *Turbincarpus pseudopectinatus* (syn. *Pelecyphora pseudopectinata*), *Turbincarpus valdezianus* (syn. *Pelecyphora valdeziana*); flowers apical, diurnal, short funnellform, white, magenta or yellowish (2-4 cm long, 2 cm Ø), pericarpel and tube naked or with very few scales; distribution Mexico ..... ***Turbincarpus***  
 - Solitary or branching; mostly semi-geophytic; stems globose to short columnar (1-15 cm Ø, 1-22 cm tall), tuberculated; young areoles at stem apex ± woolly; spines (white, creamy, brownish or black; 3-30 radial spines, 1-10 mm; 0-8 central spines, 1-7 cm); flowers apical, diurnal, white, pink or green-yellow, campanulate (1-3 cm Ø, 1-3 cm long); pericarpel naked, but tube with short fleshy, hairless scales; distribution W and SW USA ..... ***Pediocactus* 150**
150. Not semi-geophytic; strong spines camouflage plant surface (15-30 radial spines, 0,6-19 mm; 3-11 central spines, 1-3 cm) ..... ***Pediocactus* p.p.**  
 - More or less semi-geophytic (except *P. sileri*); spines not camouflage plant surface (except *P. paradinei*, *P. sileri*;) ..... ***Pediocactus* p.p.**
151. Areole bipartite, with or without (felted) groove; tubercle with hairs / bristles ..... 152  
 - Areole elongated (long-areoles): spiny and flowering part ± short distant separated; flowers not at tubercle axil; axil without hairs / bristles ..... 164
152. Areole without felted groove ..... 153  
 - Areole with felted groove or naked groove (felted hairs lateron deciduous) ..... 159
153. Areoles with short white hairs and black or black tipped white spines (7-8 radial spines (5-10 mm), 1 central spine (4-5 mm long); pericarpel immersed into hairy axil; Mexico (Oaxaca) ..... ***Ortegocactus***  
 - Densely spined (white, pale pink bristly spines (5-9 mm long) obscuring tubercles; 4-12 central spines, numerous (>50) radial spines) ..... 154
154. Seed smooth, not pitted (reticulate); restricted to Mexico ..... ***Mammilloydi***  
 - Seed pitted (reticulate) not smooth ..... ***Mammillaria* 155**
155. Radial spines not pectinated but in other orientation; usually with central spines ..... ***Mammillaria* p.p.**  
 - Radial spines ± pectinated, without central spines; distribution Mexico ..... ***Mammillaria* p.p. 156**  
 NOTE: Look-alike cacti of low-growing, globose *Mammillaria* species with pectinated radial spines are *Pelecyphora aselliformis*, *Turbincarpus pseudopectinatus*, *Rebutia* p.p.
156. Plants with milky sap ..... ***Mammillaria* p.p. 157**  
 - Plants with watery sap ..... ***Mammillaria* p.p. 158**
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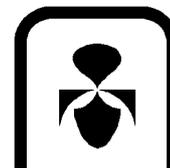


# Identification keys

157. Radial spines 2-4, up to 2 mm length, camouflage the stemsurface; flowers pale pink - white with pink midstripe; solitary, globose-cylindric, semi-geophytic plants ..... (syn. *Solisia pectinata*) ***Mammillaria pectinifera***
- Radial spines <25, up to 5 mm long; flowers yellow – white (outer petals with red edges or tips); solitary, globose-cylindric plants ..... (syn. *Mammillaria pectinifera* fa. *solisioides*) ***Mammillaria solisioides***
158. Axils naked; white spines all radial (30-40); flowers pale pink - white; solitary, globose (1-3 cm Ø) ..... ***Mammillaria sanchez-mejoradaea***
- Axils with short wool, especially in flowering zone; white spines all radial (17-25); flowers cerise to pale magenta; solitary, depressed globose (2,5-4,5 cm Ø) ..... ***Mammillaria hernandezii***
159. Compressed, hatchet-like tubercle with pectinated spines; restricted to Mexico ..... ***Pelecypora aselliformis***
- Tubercles not hatchet-like compressed, but gibbose, cylindrical, terete or rhomboid ..... **160**
160. Solitary or rarely basal branched plants with two different growing phases: Youth form [depressed globose; 6 cm Ø; pyramidal to cuneiform (3 mm wide, 5 mm long) tubercles oriented in spirally rows; pectinated spiny areoles (15-20 radial spines (6 mm), 0 central spine) totally camouflage the plant surface]; Adult form [from 4-5 cm height plant body becoming ovoid (max. 6 cm Ø, 8 cm tall); pyramidal tubercles larger (7 mm wide, 15 mm long) and grooved on upper side]; spines (15-20 radial spines more circular; 4 central spines (≤ 2,2 cm long; the lowermost spine thicker and spread out)]; axils naked and without nectar-secreting glands; distribution Mexico ..... ***Coryphantha werdermannii***
- Plants not as above ..... **161**
161. Plant single or clustered, semi-geophytic, cylindrical (1-2 cm Ø, 3-4 cm high); tubercles 2-3 mm long; areoles with short (ca. 4 mm long) cream-yellow spines (18 radial spines; the upper spines turn upwards); flowers (1,5 cm Ø), pink-purple with lighter margins; fruits green; distribution USA (Texas) ..... (syn. *Escobaria nelliae*) ***Escobaria minima***
- Plants not as above ..... **162**
162. Plant clustering and caespitose (up to 50 cylindrical stems; 0,5-2 cm Ø, 6 cm high), not semi-geophytic; tubercles 2-3 mm long; areoles with fine cream-white spines (20 radial spines, the upper spines turn upwards, 6 mm long); flowers (1 cm Ø), cream with brown or magenta midvein; fruits green; distribution USA (Texas) ..... ***Escobaria sneedii***
- Plants not as above ..... **163**
163. Fruits green-yellow, berry-like, indehiscent, naked or with few apical scales; seed coat cells tabular; solitary or clustering, globose to short columnar (3-20 cm Ø, 5-30 cm tall); spirally tuberculated; tubercles large, elongated, terete or rhomboid and grooved above; felted furrow (with or without nectar-secreting glands) ± interconnecting areole at tip of tubercle and woolly (rarely naked) axil (with or without nectar-secreting glands); spines (7-30 radial spines, 0,4-2,2 cm; 0-4 central spines straight, curved or hooked, 2-3,5 cm); flowering areoles bipartite; flowers white, yellow, pink, funnellform - campanulate (1-7 cm Ø, 1,5-5 cm long); pericarpel and tube naked or scaly with hairy axils; distribution SW USA, Mexico ..... ***Coryphantha***

- 
- Fruits green, pink, red, berry-like, naked or with few apical scales; seed coat cells pitted; small (flat) globose to short columnar plants (1-7 cm Ø, 3-20 cm height); single stems or often clustering; tubercles (2 mm-2,5 cm long) in spirally rows; areoles elongated from tubercle tip to its axils, groove connecting areole at tubercle-apex with axil; areoles spiny (usually radial spines, the upper spines mostly stronger, turning upwards); flowers apical, arising singular at axils (upper adaxial part of the tubercle), flower diurnal, yellow-green, cream, pink, purple, brown; regular, short funnelform (1,5-2,5 cm Ø; except *Neobesseya* 2,5-5 cm Ø); short pericarpel naked; distribution USA, Mexico, Canada, Cuba  
 ..... (incl. *Cochiseia*; *Neobesseya*; *Neolloydia* p.p.; *Thelocactus* p.p.) **Escobaria**
  - 164. Solitary or basal branching, globose to short-columnar (5-7 cm Ø, 7-15 cm tall); fibrous roots; tuberculate; ovoid tubercles spirally disposed; areoles more or less elongated and grooved above; felted groove not interconnecting spiny tubercle apex and axil; flowers arising at end of groove not at axil); straight or curved spines at tubercle tip (13-20 radial spines, 6-13 mm length; 0-6 central spines, 2-3 cm length); flowers diurnal, whitish to pink; funnelform - salverform ( $\leq 6$  cm Ø, 3 cm length); pericarpel and tube naked with few small scales; distribution SW USA, Mexico ..... **Neolloydia**  
 NOTE: Solitary or clustering, globose to short columnar stems (<6 cm height, 2-7 cm Ø); distinct  $\pm$  fleshy tubercles (<5 mm long) arranged in rows; areoles arranged at tubercle tips, not bipartite (without furrow / groove) but areoles more or less elongated; usually dense spinelle; witloof nectar-secreting glands; flowers at tubercle tip, apical at stem, diurnal, white-pinkish or yellowish to reddish, short funnelform (15-20 mm length and Ø); fruits green to purplish brown; seeds black to brown, pitted.  
 Separated from *Escobaria* by distinctive gene sequence data and lacking bipartite areoles (without furrow / groove); restricted to Mexico ..... **Acharagma**
  - Plants not as above ..... **165**
  - 165. Spines in  $\pm$  dispersed arrangement, not obscuring plant surface; spines never hooked or papery; dry fruits opening at base ..... **Thelocactus p.p.**
  - Dense spines obscuring plant surface; central spines (0-11) flattened-papery or recurved to hooked ..... **Sclerocactus p.p.**

## General notes to the genera



From genera *Acanthocalycium* – *Yungasocereus*; 110<sup>2</sup> accepted genera (including 11 provisionally accepted genera - set in italic script) according to „CITES Cactaceae Checklist 2<sup>nd</sup> Ed.“ (HUNT 1999) and HUNT (2000a), KIESLING & PILTZ (2001).

Detailed information about the genera in: BACKEBERG (1958-1962), BACKEBERG (1976), BARTHLOTT & HUNT (1993), BENSON (1982), KRAINZ (1956-1975), RAUH (1979) Citation of Author names according to “CITES Cactaceae Checklist 2<sup>nd</sup> Ed.“ (Hunt 1999).

***Acanthocalycium* Backeberg 1936**

The genus is only provisionally accepted, possibly it belongs to *Echinopsis* (HUNT 1999).

Globular, depressed globose to short-columnar, solitary rarely clustering plants (<60 cm tall, 10-15 cm Ø); tuberculated ribs (18-20); spines (6-20 radial spines, 1-4 central spines); flowers funnelform (<5 cm Ø), white, red, pale pink-yellow; pericarpel and tube with aristate scales. 1-3 spp.; Argentina.

***Acanthocereus* (Engelmann ex Berger) Britton & Rose 1909**

syn. *Monvillea* p.p. Britton & Rose 1920

Erect to scandent or lateron overhanging, tree-like shrubs (<4m); stems segmented or not, 3-5 rarely flattened ribs (olive-green shoots < 9 cm Ø); big sized, white hairy areoles with many spines (5-8 red-brownish radial spines, 1-3 grey-brown-black central spines); flowers funnelform, large (12-25 cm length, 6-12 cm Ø), nocturnal, white; pericarpel and tube with spiny scales. 1-6 spp.; USA, Mexico, Central America (GT, BZ, HN, NI, SV, CR, PA), Caribbean Region (CU, WI, TT, AN), Colombia, Venezuela.

***Acharagma* (N.P.Taylor) Glass 1997**

Solitary or clustering, globose to short columnar stems (<6 cm height, 2-7 cm Ø); distinct ± fleshy tubercles (<5 mm long) arranged in rows; areoles arranged at tubercle tips, not bipartite (without furrow / groove); usually densely spined; without nectar-secreting glands; flowers at tubercle tip, apical at stem, diurnal, white-pinkish or yellowish to reddish, short funnelform (15-20 mm length and Ø); fruits green to purplish brown; seeds black to brown, pitted. Separated from *Escobaria* by distinctive gene sequence data and lacking bipartite areoles (without furrow / groove). 2 spp.; Mexico.

***Ariocarpus* Scheidweiler 1838**

syn. *Neogomesia* Castañeda 1941, *Roseocactus* Berger 1925

Semi-geophytic, depressed globose, solitary or rarely branching plants (5-25 cm Ø); subterranean stembase tapering into stout rootstock; tubercles ± triangular in rosette-like orientation or spiralled; areoles usually spineless and bipartite; flowers white, yellow-green, pink or red, short funnelform; pericarpel and tube naked. 6 spp.; Mexico, SW USA (Texas). App. I: *A. agavoides*, *A. bravoanus*, *A. fissuratus*, *A. kotschoubeyanus*, *A. retusus*, *A. scaphirostris*.

***Armatocereus* Backeberg 1938**

syn. *Lemaireocereus* p.p. Britton & Rose 1909,

Trees or shrubs ascending or erect (3-12m); stems segmented (constricted annually), ± humped ribs 3-16 (6-15 cm Ø); flowers nocturnal, tubular-salverform (8-12 cm); pericarpel with minute scales and bristly areoles; fruit spiny. 10-13 spp., Peru, Ecuador, Colombia.

***Arrojadoa* Britton & Rose 1920**

syn. *Pierrebraunia* Esteves Pereira 1997

Slender, few branched, erect to semi-prostrate shrubs (<2m tall); stems (<4-10 cm Ø); 7-14 ribs; flowering zone in ring-like cephalia, alternating with vegetative growth; flowers diurnal, tubular (<3 cm long), red, orange; pericarpel and tube naked. 4 spp.; Brazil.

***Arthrocareus* Berger 1929**

Basal branched shrubs 0,5-1m; erect trailing; slender stems (2-3 cm Ø); ribs 9-18 ± humped, flowers elongated tubular-funnelform (white - purple) (tube 6-8 cm, perianth 4 cm long); areoles of pericarpel and tube densely with minute scales (brownish 2 mm long) covered by numerous spines and hairs. 4 spp.; Brazil.

<sup>2</sup> Additionally A.B. Doweld proposed 9 new genera [overview of Doweld's relevant publications in D. Hunt (2000b, 2001)], which are not listed in the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999) and not recognized by the International Cactaceae Systematics Group (ICSG) (interim amendments June 2001).

Proposed new genera [*taxa of currently preferred name*]:

- Boliviacactus* Doweld 2000 [*Parodia* p.p.];
- Escobariopsis* Doweld 2000 [*Mammillaria* p.p.];
- Escobrittonia* Doweld 2000 [*Coryphantha* p.p.];
- Escocoryphantha* Doweld 1999 [*Escobaria* p.p.];
- Neonavaoja* Doweld 1999 [*Pediocactus* p.p.];
- Parrycactus* Doweld 1999 [*Ferocactus* p.p.];
- Perenocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)];
- Puebloa* Doweld 1999 [*Pediocactus* p.p.];
- Ritterocactus* Doweld 1999 [*Parodia* p.p. (*Notocactus* p.p.)].

***Astrophytum* Lemaire 1839**

Globular to short-columnar (5-150 cm tall, <30 cm Ø), rarely semi-geophytic; almost solitary stems; ribs 4-9; surface sparsely to densely covered with tiny tufts of minute white hairs, in exception epidermis naked ("nuda" forms); felted areoles spineless or spiny; flowers apical, funnel-salverform (2,5-8 cm Ø and length), diurnal, yellow or yellow with red throat; pericarpel and short tube woolly and densely covered with imbricate scales (scale apex ending in a black spine). 4 spp.; Mexico, SW USA. App. I: *A. asterias*.

***Austrocactus* Britton & Rose 1922**

Erect or semi-prostrate, short-columnar plants (30-60 cm); stems soft fleshy; stems simple or few branched at base; stems 5-8 cm Ø; thin fibrous root system; tuberculated ribs 6-12; spines mostly ± hooked; flowers rotate-campanulate (3-6 long, 3-10 cm Ø); pericarpel and tube with imbricate triangular, aristate scales, spines or bristles and hairy; red-violet stigma. 3-5 spp.; S-Argentina, S-Chile.

***Austrocylindropuntia* Backeberg 1938 p.p.**

Roots tuberous; stem cylindrical with indefinite growth (sometimes segmented); leaves terete (>4 mm long) ± persistent (lateron deciduous). 11 spp.; South America (PE, BO, AR, EC). (Further information see *Opuntia*.)

***Aztekium* Bödeker 1929**

Plant gray-green; solitary or clustering globular stems (stems: 2-10 cm Ø, 3-10 cm tall); woolly apex sunken; ribs 8-15, transversely wrinkled; areoles almost contiguous and woolly with 1-3 short deciduous spines (3-13 mm long); flowers diurnal, tubular-funnelform (1-2 cm long, 1-3 cm Ø); pericarpel and tube naked. 2 spp.; Mexico. App. I: *A. ritteri*.

***Bergerocactus* Britton & Rose 1909**

Many basal branched, low shrubs (1-1,5m), stems 3-6 cm Ø; thickened rootstock; ribs 20-25, ± humped; flowers appearing lateral at stem, size 2 x 2 cm; tube and pericarpel with many scales, felted hairs and spines; pale yellow diurnal flowers rotate-campanulate. 1 spec.; coastal ranges of Mexico (Baja California) and USA (SW California).

***Blossfeldia* Werdermann 1937**

Button-like, dwarf plants; ribs, tubercles and spines absent, but with felted areoles; flowers diurnal, white to pale yellow, rotate (0,5-1,5 cm Ø); pericarpel sparsely woolly. 1 spec.; Bolivia, Argentina.

***Brachycereus* Britton & Rose 1920**

Columnar erect or ascending stems (20-60 x 3-5 cm); basal branching stems forming clumps or dense colonies; low, very dense spiny ribs 16-22; fleshy stems; yellow spines darkening with age (<5 cm), flowers tubular - narrow funelform, nocturnal white (9 cm); pericarpel and tube with dense spiny areoles and minute scales. 1 spec.; Ecuador (restricted to Galapagos Islands).

***Brasilicereus* Backeberg 1938**

Columnar, erect, slender, less woody, climbing shrubs (1-4m tall, <2 cm Ø); stems 8-14 ribs; felted areoles with 12-18 bristly radial spines (6-10 mm) and 1(-4) bristly central spines (<4 cm); flower nocturnal, pale yellow-green, short tubular-campanulate (6 cm long); areoles of pericarpel naked to few scales and bristles. 2 spp.; Brazil.

***Brasiliopuntia* (Schumann) Berger 1926**

Segmented, treelike stems (<20m, 35 cm Ø), dimorphic shoots (cylindric stems with leave-like, flattened platyclades); unique in subfamily: pollen morphology and flowers with a ring of hairlike staminodes between the perianth and stamens. 1 spec.; South America (BR, PY, BO, PE, AR). (Further information see *Opuntia*.)

***Browningia* Britton & Rose 1920**

syn. *Azureocereus* Akers & Johnson 1949, *Castellanosia* Cárdenas 1951, *Gymnanthocereus* Backeberg 1937, *Gymnocereus* Backeberg 1959

Trees or shrubs (<10m); ribs 7-34; flowers nocturnal, white, tubular-funnelform; pericarpel and tube naked. 5-11 spp.; Peru, Bolivia, Chile, Paraguay.

***Calymmanthium* Ritter 1962**

Tree-like shrubs (3-8m), segmented branches (4-8 cm Ø); stems with 3-4 angled-winged ribs; ribs ± humped; concealed development of the perianth (enclosed by the pericarpel-tube); flowers nocturnal, white - pale green, tubular-campanulate (tube 8-11 cm long, 3-5 cm Ø); each areole of pericarpel with (brownish) white felt or bristly spines and one extreme minute (<1 mm long) scale. 1 spec.; Peru.

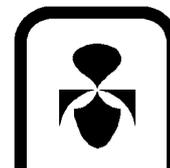
***Carnegiea* Britton & Rose 1908**

Columnar or few branched, erect trees (<16m); stems many ribbed (12-30); flowers nocturnal to diurnal, white, funelform-campanulate (9-12 cm long, 5-6 cm Ø); pericarpel and tube felted, without spines or bristles. 1 spec.; USA, Mexico.

***Cephalocereus* Pfeiffer 1838**

syn. *Haseltonia* Backeberg 1949, *Neodawsonia* Backeberg 1949, *Pilocereus* Lemaire 1839

Columnar, tree-like, unbranched stems (6-15m, <50-60 cm Ø); 12-30 (-60) ribs; vegetative areoles with short 3-5 spines and 20-30 gray-white long (up to 12 cm) hairs covering the whole stem "Old Man Cactus"; flowers nocturnal, tubular-campanulate; pericarpel and tube sparsely woolly, hairy and with tiny scales. 3-5 spec.; Mexico.

***Cephalocleistocactus* Ritter 1959**

The genus is only provisionally accepted, possibly it belongs to *Cleistocactus* (HUNT 1999).

Branched shrubs (2-5m); stems (3-5 cm Ø) with 11-14 tuberculated ribs; ± dispersed lateral cephalia: floriferous areoles with flexible, hairy spines (5-6 cm long); flowers diurnal, red, tubular (4-5 x 1 cm). 1 spec.; Bolivia.

***Cereus* Miller 1754**

syn. *Mirabella* Ritter 1979, *Monvillea* pp. Britton & Rose 1920, *Piptanthocereus* (Berger) Riccobono 1909, *Subpilocereus* Backeberg 1938

Erect or ascending, usually candelaber-like branched trees or shrubs (<12m); stems distinct ribbed (3-14 ribs); spines various in number and size; flowers nocturnal, white to reddish, pink, yellow, long tubular-funnelform (13-30 cm long); pericarpel and tube with few small scales and naked. 23-35 spp.; South America (BR, AR, UY, BO, VE, PY, GY, SR), Caribbean Region (TT, AN).

***Cintia* Knize & Riha 1996**

The genus is only provisionally accepted, possibly it belongs to *Rebutia* (HUNT 1999).

Solitary semi-geophytic plants (3-5 cm Ø and height); napiform taproot (10-12 cm long); 5-8 flat tuberculated ribs with rounded podaria; spineless areoles sunken between the gibbous humps (podaria), only felted wool visible; flowers diurnal, regular salverform, yellow-orange. 1 spec.; Bolivia.

***Cipocereus* Ritter 1979**

syn. *Floribunda* Ritter 1979

Columnar shrubs; stems ribbed (4-21); stem tissue darkening when cut; areoles dense spined or spineless; flowers nocturnal (still opening to morning), pale green-yellow or white; pericarpel and tube blue-waxy, with fleshy or small scales and small areoles (with bristles or felted hairs. 5 spp.; Brazil.

***Cleistocactus* Lemaire 1861**

syn. *Akersia* Buining 1961, *Bolivicereus* Cárdenas 1951, *Borzicactella* Ritter 1981, *Borzicactus* Riccobono 1909, *Clistanthocereus* Backeberg 1937, *Hildewintera* Ritter 1966, *Loxanthocereus* Backeberg 1937, *Maritimocereus* Akers & Buining 1950, *Seticereus* Backeberg 1941, *Seticleistocactus* Backeberg 1963, *Winteria* Ritter 1962, *Winterocereus* Backeberg 1966

Ascending or erect, columnar, slender, usually basal branching shrubs (<2m tall); ribs 5-30; bristly spines few to numerous; flowers subapical - lateral, diurnal, coloured orange, yellow, red, (closed) tubular to partly ± zygomorphic (<10 cm long); pericarpel and tube dense narrow scaly and hairy. 33-50 spp.; Peru, Brazil, Paraguay, Bolivia, Argentina, Ecuador.

***Coleocephalocereus* Backeberg 1938**

syn. *Buiningia* Buxbaum 1971

Erect unbranched or decumbent branching (0,75-5m tall) shrubs; stems (4-15 cm Ø); 10-17 ribs; superficial lateral-cephalium; flowering areoles with brown-white, bristle-like hairs; flowers tubular to campanulate-funnelform (<6 cm Ø); pericarpel and tube naked. 6 spp.; Brazil.

***Consolea* Lemaire 1862**

Trees (<10m length) with dimorphic growth pattern (unsegmented, cylindrical main axis (stems) and asymmetrical, flattened, ovate lateral branches (segments = platyclades); areoles distinct, not sunken into cavities. Also distinct by seed and pollen morphology. 9 spp.; Florida to Caribbean Region. (Further information see *Opuntia*.)

***Copiapoa* Britton & Rose 1922**

syn. *Pilocopiapoa* Ritter 1961

Solitary or basal branching, clustering plants, globose to short-columnar, ascending or procumbent stems (2-20 cm Ø, 8-100 cm tall, clusters <1m Ø); rarely semi-geophytic; fibrous roots or taproots (occasionally a thin string connecting stem and taproot); plant surface often greyish by dense waxy covering; stem apex usually dense whitefelted; ribs or tuberculated ribs usually in vertically rows (rarely ribs and tubercles spirally oriented); flowers immersed at apex, diurnal, yellow (rarely pale red), short salver-funnelform (2-4 cm Ø and length); pericarpel with few mostly hairless scales. 20-25 spp.; Chile.

***Corryocactus* Britton & Rose 1920**

syn. *Erdisia* Britton & Rose 1920

Columnar erect, ascending - procumbent shrubs or trees (1-5m height); basal branching cylindrical stems (stout - slender: 3-20 cm Ø); yellow-orange coloured stem-tissue (only *Corryocactus*); napiform taproot (only *Erdisia*); spines up to 24 cm; 4-12 tuberculated ribs (areoles between the humps); flowers diurnal, rotate-campanulate; yellow, orange, purple-red; pericarpel and tube with numerous scales and bristly areoles. 12-34 spp.; Peru, Bolivia, Chile.

***Coryphantha* (Engelmann) Lemaire 1868**

syn. *Cumarinia* Buxbaum 1951, *Lepidocoryphantha* Backeberg 1938, *Neolloydia* p.p. Britton & Rose 1922

Solitary or clustering, globose to short columnar (3-20 cm Ø, 5-30 cm tall); fibrous roots or taproot; spirally tuberculated; tubercles large, elongated, terete or rhomboid and grooved above; felted furrow (with or without nectar-secreting glands) ± interconnecting areole at tip of tubercle and woolly (rarely naked) axil (with or without nectar-secreting glands); spines (7-30 radial spines, 0,4-2,2 cm; 0-4 central spines straight, curved or hooked, 2-3,5 cm); flowering areoles bipartite; flowers white, yellow, pink, funnelform - campanulate (2-7 cm Ø, 2-5 cm long); pericarpel and tube naked or scaly with hairy axils; green-yellow fruits. 41-54 spp.; Mexico, SW USA. App. I: *C. werdermannii*.

**Cumulopuntia Ritter 1980**

Segmented, strongly spined, cushion-like, caespitose shrubs; segments globose, ovoid; ephemeral tiny leaves; fleshy fruits distinctive in enclosing dry seeds (lacking pulp). 20 spp.; South America (BO, AR). (Further information see Opuntia.)

**Dendrocereus Britton & Rose 1920**

The genus is only provisionally accepted, possibly it belongs to *Acanthocereus* (HUNT 1999).

Tree-like (<10m, trunk <60 cm Ø); branches segmented, erect to pendent, 4-6 angled, crenated ribs; flowers nocturnal, white, funnellform (10-14 cm Ø); pericarpel and tube with spiny, deciduous scales. 1-2 spp.; Cuba, Haiti.

**Denmoza Britton & Rose 1922**

Unbranched, globose to short columnar, solitary stems (<1,5m tall, 15-30 cm Ø); 15-30 ribs; flowers in lateral cephalia, diurnal, red, tubular to slightly zygomorphic; pericarpel and tube densely hairy, bristly. 1 spec.; Argentina.

**Discocactus Pfeiffer 1837**

Stems mostly unbranched, rarely semi-geophytic, globose to depressed-globose (5-30 cm Ø, 2-10 cm tall), flattened, disc-shaped in old age; ribs (8-25) distinct or mostly tuberculated; spiny areoles (3-14 central and radial spines) at top of tubercles; depressed cephalium white woolly with brown or red bristles; flowers tubular-funnelform (7 cm long), nocturnal, white, fragrant. 6-7 spp.; Brazil, Bolivia, Paraguay. App. I: *D. bahiensis*, *D. ferricola*, *D. heptacanthus*, *D. horstii*, *D. placentiformis*, *D. pseudoinsignis*, *D. zehntneri*.

**Cylindropuntia (Engelmann) F. Knuth 1936**

Unique in the presence of papery sheaths on the spines; also distinguished in cylindrical stem segments and seeds. 33 spp.; North America (SW USA, MX, Carribean Region, 1 spec. (*C. tunicata*) introduced as medical plant in South America (CL, EC). (Further information see Opuntia.)

**Disocactus Lindley 1845**

syn. *Aporocactus* Lemaire 1860, *Bonifazia* Standley & Steyermark 1944, *Chiapasia* Britton & Rose 1923, *Heliocereus* (Berger) Britton & Rose 1909, *Lobeira* Alexander 1944, *Nopalxochia* Britton & Rose 1923, *Pseudonopalxochia* Backeberg 1958, *Wittia* Schumann 1903, *Wittiocactus* Rauschert 1982

Climbing, pendent, epiphytic or epilithic shrubs; aerial roots; stems initially terete becoming 2-angled; margin of flattened-winged ribs crenate, lobed; spines absent or bristly; flowers diurnal, red, orange, yellow, white, pink to blueish, slender tubular, short or long funnellform. 16 spp.; Mexico, Brazil, Colombia, Venezuela, Ecuador, Peru, Central America (CR, PA, HN, NI, GT, SV). App. I: *D. macdougallii*.

**Echinocactus Link & Otto 1827**

syn. *Echinofossulocactus* Lawrence 1841, *Emorycactus* Doweld 1996, *Homalocephala* Britton & Rose 1922, *Meyerocactus* Doweld 1996

Solitary (only one species basal branching), globose to columnar plants (30-120 cm Ø, 15-300 cm tall); sharply ribbed (8-50 ribs); usually stem apex densely yellow woolly or white felted; areoles large (in one species areoles upwards groove-like elongated); spines straight to strong curved, sometimes stout, depressed or horizontal striped (red, brown, yellow, 1-4 central spines, 5-11 radial spines; 2-6 cm length); flowers diurnal, yellow or pale pink, funnellform-campanulate, (3-8 cm Ø, 2-6 cm length), apical or in subapical ring; pericarpel and short tube covered with dense wool and imbricate scales (scale apex ending in a black spine). 6 spp.; USA, Mexico.

**Echinocereus Engelmann 1848**

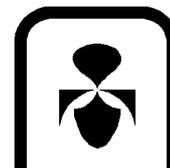
syn. *Morangaya* Rowley 1974, *Wilcoxia* Britton & Rose 1909

Basal branching (clustering) or solitary, short columnar low shrubs; soft fleshy cylindrical stems (<1m long, < 10 cm Ø); rarely semi-geophytic with subterranean stembase; usually fibrous roots or napiform taproots (*Wilcoxia*); ribbed or rarely with indistinct tuberculated ribs (5-22 ribs); pericarpel and tube with scales, spines, bristles, hairs and felted wool; flowers funnellform or campanulate, diurnal; usually green stigma; fruits densely spined, berry-like. 54-59 spp.; USA, Mexico. App. I: *E. ferreirianus* var. *lindsayi*, *E. schmollii*.

**Echinopsis Zuccarini 1837**

syn. *Acantholobivia* Backeberg 1942, *Chamaecereus* Britton & Rose 1922, *Helianthocereus* Backeberg 1949, *Hymenorebutia* Fric ex Buining 1939, *Leucostele* Backeberg 1953, *Lobivia* Britton & Rose 1922, *Neolobivia* (Backeberg) Y. Ito 1950, *Pseudolobivia* (Backeberg) Backeberg 1942, *Reicheocactus* Backeberg 1942, *Setiechinopsis* (Backeberg) De Haas 1940, *Soehrensia* Backeberg 1938, *Trichocereus* (Berger) Riccobono 1909

Solitary to basal or candelaber-like branching cluster, erect or semi-prostrate, tree-like, shrubby, globose to short columnar stems (0,15-12m tall, 1-70 cm Ø); rarely semi-geophytic with subterranean stembase extending into taproot (*Lobivia*); 4-50 sharp ribs or ± tuberculated ribs (vertically or spirally rows); tubercles often humped and slightly oblique in orientation (*Lobivia*); spiny felted areoles (2-50 radial spines, 0,5-2 cm long; 0-8 central spines, 1,2-14 cm long, sometimes hooked), rarely pectinated spines (*E. famatinensis*); flowers subapical to lateral, nocturnal (partly still open at morning), white to pale pink, tubular-funnelform to salverform (2,5-25 cm long, 3,5-14 cm Ø); flowers diurnal (*Helianthocereus*, *Lobivia*) bright coloured (yellow, red, magenta, orange, pink), pericarpel and tube with hairs, bristles and narrow (decurent) scales. 61-129 spp.; Bolivia, Argentina, Paraguay, Peru, Chile, Uruguay, Ecuador.

***Epiphyllum* Haworth 1812**syn. *Phyllocactus* Link 1829

Climbing, pendent, epiphytic or epilithic, branched shrubs; aerial roots; stems initially terete becoming 2-angled; margin of flattened-winged ribs crenate; spines absent or on terete stems only; flowers usually nocturnal (rarely still open at morning), white, yellow or pale pink, tubular-funnelform with elongated tube (10-30 cm long); pericarpel with decurrent scales and naked areoles. 8-19 spp.; USA, Mexico, Central America (BZ, NI, CR, HN, GT, PA), Caribbean Region (CU, KY, JM, DO, TT, PR, VI, WI), South America (EC, CO, PE, GF, GY, BR, SR, BO, AR, PY, UY).

***Epithelantha* Weber ex Britton & Rose 1922**

Dwarf globose plants (1,5-6 cm  $\varnothing$ , high); single or clustering; stem apex immersed and woolly; tubercles small (1 mm long); areoles densely spiny; spines camouflage tubercles (19-38, 1-8 mm long, cream, pale grey, yellow); the uppermost, curved and clavate-like spines are developed as glands (lateron deciduous). Flowers apical; small (6-8 mm  $\varnothing$ ), diurnal, white, pale orange-pink, campanulate; pericarpel and tube naked. Fruits red, berry-like and dry withered rest of flower deciduous. 1-2 spp.; USA (Texas) – N-Mexico.

***Eriosyce* Philippi 1872**syn. *Chileorebutia*, *Delaetia* Backeberg 1962, *Horridocactus* Backeberg 1938, *Islaya* Backeberg 1934, *Neochilenia* Backeberg ex Doelz 1942, *Neoporteria* Britton & Rose 1922, *Pyrrhocactus* Berger 1929, *Rodentiophila* Backeberg 1959, *Thelocephala* Y.Ito 1957

Solitary or rarely branched, (depressed) globose to short columnar (1,5-40 cm  $\varnothing$ , 70 cm tall), rarely semi-geophytic; fibrous roots or taproots (with or without neck-like junction between root and stem); 7-30(-40) tuberculated ribbed (ribs  $\pm$  notched between the areoles or humped) or divided into elongated or isodiametric tubercles; tuberculated ribs in vertically rows (or slightly spiraled); spiny and woolly areoles; spines various or pectinated (*Thelocephala*); flowers lateral or apical, diurnal, orange, red, yellow, pink, whitish, campanulate; perianth curved outwards (*Eriosyce* s.str.) or tubular-funnelform; perianth curved inwards (*Neoporteria*); flowers usually one per areole (rarely more than one); pericarpel and tube with scales; tube apex with thick bristly spines (*Eriosyce* s.str.) or tube and pericarpel with thin flexible bristles. 34-35 spp.; Chile, Peru, Argentina.

***Escobaria* Britton & Rose 1923**syn. *Cochiseia* Earle 1976, *Neobesseya* Britton & Rose 1923, *Neolloydia* p.p. Britton & Rose, *Thelocactus* p.p. (Schumann) Britton & Rose 1922

Small (flat) globose to short columnar plants (1-7 cm  $\varnothing$ , 3-20 cm height); single stems or often clustering, rarely semi-geophytic; fibrous roots or taproots; tubercles (2 mm-2,5 cm long) in parastiches; areoles elongated from tubercle tip to its axils, groove connecting areole at tubercle-apex with axil; areoles spiny (usually radial spines, the upper spines mostly stronger, turning upwards); flowers apical, arising singular at axils (upper adaxial part of the tubercle); diurnal, yellow-green, cream, pink, purple, brown; regular, short funnelform (1-2,5 cm  $\varnothing$ ; except *Neobesseya* 2,5-5 cm  $\varnothing$ ); short pericarpel naked; fruits pink, red (*Escobaria* s.str.) or green (*Pseudocoryphantha*); dry rest of flower left at fruit. 18-25 spp.; USA, Mexico, Canada. App. I: *E. minima*, *E. sneedii*.

***Escontria* Rose 1906**

any branched, tree-like (<7m); 7-8 ribs; flower pale yellow, tubular-campanulate (3 cm  $\varnothing$ ); pericarpel with papery triangular scales. 1 spec.; Mexico.

***Espostoa* Britton & Rose 1920**syn. *Binghamia* Britton & Rose 1920, *Pseudoespostoa* Backeberg 1934, *Thrixanthocereus* Backeberg 1937, *Vatricania* Backeberg 1950

Columnar shrubs or trees (<7m); many ribbed stems (<20 cm  $\varnothing$ ); flowering areoles in lateral cephalium; flowers nocturnal, white to pale reddish, tubular-campanulate; pericarpel and tube scaly and hairy. 9-16 spp.; Ecuador, Bolivia, Peru.

***Espostopsis* Buxbaum 1968**syn. *Gerocephalus* Rttter 1968

Many basal branched shrubs (<4m); many ribbed stems (<8 cm  $\varnothing$ ); flowers in lateral cephalium; flowers nocturnal, white, short tubular-campanulate (<4 cm); pericarpel and tube naked with few tiny scales. 1 spec.; Brazil.

***Eulychnia* Philippi 1860**syn. *Phillipicereus* Backeberg 1942

Trees or shrubs (7-25 cm  $\varnothing$ ; 9-16 ribs); broad areoles noticeable woolly or hairy and strong spiny; central spines elongated (up to 18 cm); flowers diurnal, short-campanulate, white or pale pink; pericarpel and short tube with dense scales and woolly hairs and bristles. 5-7 spp.; Chile, Peru.

***Facheiroa* Britton & Rose 1920**syn. *Zehntnerella* Britton & Rose 1920

basal branched shrubs or trees (3-5m); dense spiny stems 5-12 cm  $\varnothing$ , low ribs 12-25;  $\pm$  tuberculated; flowering zone undifferentiated (*Zehntnerella*) or differentiated a lateral cephalium; flowers nocturnal, white, tubular (2-4,5 cm long); pericarpel and tube white hairy and bristly with numerous imbricate scales (1-4 mm long). 3 spp.; Brazil.

**Ferocactus Britton & Rose 1922**

syn. *Bisnaga* Orcutt 1926

Solitary or rarely clustering, (depressed) globose to cylindrical plants (12-80 cm Ø, 10->300 cm tall; cluster <3-5m Ø); ribs thick and prominent (8-40); large areoles ± felted when young, and with nectar-glands; spines well developed, either straight or curved (central spines mostly coloured (red – yellow), hooked and horizontally striped, up to 15 cm length); subapical flowers diurnal, pale yellow to red, short funnellform-campanulate (2,5-7,5 cm Ø and length); pericarpel with hairless scales. 23-27 spp.; SW USA, Mexico.

**Frailea Britton & Rose 1922**

Dwarf, globose or short columnar, single stemmed or clustering plants (2-5 cm Ø, 3-18 cm tall); rarely semi-geophytic with subterranean stembase; plant surface greyish green – brownish; (weakly) ribs (10-33) or tuberculated ribs, the tubercles sometimes oriented in spirally rows; areoles felted and short spined (central spines never hooked, radial spines sometimes depressed or curved downwards); flowers funnellform-campanulate (2-5 cm Ø), yellow and diurnal (cleistogamous or briefly opening); pericarpel and short tube with dense red-brownish bristles and cream-white wool. 11-17 spp.; Brazil, Bolivia, Paraguay, Uruguay, Argentina.

**Geohintonia Glass & Fitz Maurice 1991**

Globular to short-columnar (10-20 cm height, 15 cm Ø), almost solitary; stem dull blue-green, covered with thick waxy secretions; strongly, distinct ribbed (ribs 18-20). Plant almost spineless, except near apex; spiny areoles 2-3 mm apart and deciduous; usually 3 spines (3-12 mm long, curved, slightly tortuous); areoles at apex woolly with long white hairs; flowers diurnal, pink, funnellform (2-4 cm Ø); pericarpel and tube naked. 1 spec.; Mexico.

**Grusonia F. Reichenbach ex Britton & Rose 1919**

syn. *Corynopuntia* F. Knuth 1936, *Marenopuntia* Backeberg 1950, *Micropuntia* Daston 1947

Cushions or basal branched shrubs; stems usually segmented (segments cylindrical to club shaped) sometimes with tuberculated ribs; spines ± flattened, roughened or bulbous basally. 17 spp.; SW USA, northern Mexico. (Further information see *Opuntia*.)

**Gymnocalycium Pfeiffer ex Mittler 1844**

syn. *Brachycalycium* Backeberg 1942

Solitary or rarely clustering, (depressed) globose to short columnar, green or coloured (brownish) plants (3-50 cm Ø, 2-60 cm tall); several species semi-geophytic; fibrous roots; stem apex with ± navel-like depression; ribs or tuberculated ribs (5-32), sometimes ± divided by transversely grooves into large, stout rounded or ± polyedrical tubercles; ribs and tuberculated ribs often humped between the areoles; dense felted - hairy areoles often without central spines, radial spines (5-)10-15(>30); flowers diurnal, white, pale pink or crimson red, funnellform-campanulate (2,5-7 cm Ø, 3-7 cm long), pericarpel and tube with hairless, large ovate scales. 42-69 spp., Argentina, Bolivia, Brazil, Paraguay, Uruguay.

NOTE: grafted colour-mutations of *Gymnocalycium mihanovichii* are supermarket plants and belong not to CITES restrictions.

**Haageocereus Backeberg 1934**

syn. *Peruocereus* Akers 1947

Erect, creeping or decumbent shrubs (< 2m tall); 10-25 ribs (5-15 cm Ø); areoles strong spiny, elongated central spines and numerous radial spines; flowers nocturnal or diurnal (white, pinkish, red), tubular-funnelform (5-10 cm long); pericarpel and tube with scales (pronounced decurrent) and felted or woolly hairy areoles. 13-21 spp.; Peru.

**Harrisia Britton 1908**

syn. *Eriocereus* Riccobono 1909, *Roseocereus* Backeberg 1938

Trees or shrubs (<7m), erect or scandent, rarely prostrate (*H. earle*); trunks with slender, pendent stems (3-6 cm Ø) with ribs (4-12); flowers nocturnal, funnellform (10-20 cm long); pericarpel and tube with felted and bristly areoles and triangular scales. 14-20 spp.; USA, Brazil, Paraguay, Uruguay, Argentina, Bolivia, Caribbean Region (BS, HT, DO, JM, CU, KY, PR)

**Hattiora Britton & Rose 1915**

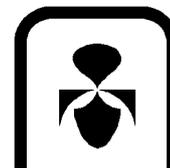
syn. *Epiphyllopsis* (Berger) Backeberg & Knuth 1936, *Pseudozygocactus* Backeberg 1938, *Rhipsalidopsis* Britton & Rose 1923

Erect to pendent, many branched, epiphytic or epilithic shrubs; stems segments (<5 cm long) flattened, angled, winged or terete; stem segments develops from apical areole-clusters; areoles usually clustered at segment apex and soft spiny or spineless; flowers rotate, campanulate, pink, cream-white, red; pericarpel naked; "Easter Cactus" (*Rhipsalidopsis*). 5 spp.; Brazil.

**Hylocereus (Berger) Britton & Rose 1909**

syn. *Wilmattea* Britton & Rose 1920

Climbing, pendent, epiphytic or epilithic, many branched shrubs; aerial roots; stems (2-3 ribs) 3-angled or 2-winged (<5m long); margin of ribs often crenate; areoles with or without few short spines; flowers nocturnal, white, yellow or rarely red, funnellform to tubular-funnelform (<30 cm long); pericarpel with broad triangular scales and naked areoles. 11-18 spp.; Mexico, Central America (CR, NI, PA, GT, BZ, HN, SV), Caribbean Region (CU, JM, DO, WI, VI, TT, AN), South America (Venezuela, Guyana, Surinam, Peru, Colombia).

***Isolatocereus* (Backeberg) Backeberg 1942**

Candelabra-like trees (5-15m high); stems erect, covered by grey-blueish wax (5-15 cm Ø); triangular, sharp ribs 5-8; areoles becoming confluent in age (especially flowering areoles in chain-like orientation on ribs); spines yellowish-white (1-4 central spines, <5 cm long; 6-9 radial spines, <1 cm long); flowers numerous at and beneath stem apex (apical extending lateral), nocturnal and lasting to morning, tubular to funnellform (<5 cm long, 2,5 cm Ø), greenish-white; pericarpel with few scales, but without (or very few) bristles or spines; fruit ovoid (3-4 cm long), red pulp, naked (but few scales). Separated from *Stenocereus* by distinctive gene sequence data. 1 spec.; Mexico.

***Jasminocereus* Britton & Rose 1920**

Tree-like up to 8m; branches segmented, 11-22 ribs; areoles with numerous (10-25) long (1-8 cm) spines. 1 spec.; Ecuador (restricted to Galapagos Islands).

***Lasiocereus* Ritter 1966**

Columnar, branched tree-like shrubs (1,5-4m tall); stems tuberculated ribs (10-21, 4,5-7 cm Ø); areoles usually white felted (floriferous areoles slightly differentiated with orange felted hairs); yellow to orange radial spines (8-20), 0 central spine; flowers subapical, nocturnal, white, tubular-funnelform (<5-6 cm long). 2 spp.; Peru.

***Leocereus* Britton & Rose 1920**

Few branched erect, low shrubs (2-3m); stems slender (1,5-6 cm Ø); ribs 10-20 (low, rounded); areoles of pericarpel and tube densely with minute scales (brownish 2 mm long) covered by numerous spines and hairs; nocturnal flowers white, tubular-salverform (4-7 cm). 1 spec.; Brazil.

***Lepismium* Pfeiffer 1835**

syn. *Acanthorhopsalis* (Schumann) Britton & Rose 1923, *Acanthorhopsalis* Kimnach 1983, *Lymanbensonia* Kimnach 1984, *Pfeiffera* Salm-Dyck 1845

Scandent, erect or pendent, branched, epiphytic or epilithic shrubs; stems segments flattened, angled, winged or ribbed; branching system mesotonic: young stem segments usually develops lateral from old segments, arising of areoles at the bases of old segments, never in apical clusters; areoles dispersed on whole segment surface, not clustered at segment apex; mostly spines or bristles; flowers rotate, campanulate, pink, cream-white, red; pericarpel with or without spines. 14-15 spp.; Bolivia, Argentina, Brazil.

***Leptocereus* (Berger) Britton & rose 1909**

syn. *Neoabbottia* Britton & Rose 1921

Trees or shrubs; ascending or erect (up to 5m); stems segmented and many branched; 3-8 angled humped ribs (2-6 cm Ø); flowers tubular-campanulate (2-4 cm), diurnal or nocturnal, white, pale green, yellow or pink; spiny or naked pericarpel without scales. 4-15 spp.: Caribbean Region (CU, PR, HT, DO, KY).

***Leuchtenbergia* Hooker 1848**

Solitary or rarely clustering, globular to short-columnar, glaucous plant (<50 cm; tubercle-less trunk 5-15 cm Ø); napiform rootstock; tubercles spiraled, elongated, triangular (10-12 cm); areoles apical; spines (8-14) pale yellow, papery, flexible (10-15 cm); flower from areole of young tubercle apex; funnellform, yellow (<8 cm Ø); pericarpel and tube with scales and scarcely woolly. 1 spec., Mexico.

***Lophophora* J. Coulter 1894**

Solitary or clustering, semi-geophytic, flattened-globular plants with taproots; apex sunken; soft fleshy stems (< 10 cm Ø); 5-13, flat and broad, ± transversely grooved, tuberculated ribs (flat tubercles disposed in ± vertically rows); surface blueish-green; areoles at the apex of tubercles, spineless but densely felted (cream-white wool); flowers diurnal, campanulate, white-pink; pericarpel and tube naked. 2 spp.; Mexico, SW USA

NOTE: The main trade relevance is based on *Lophophora* as a source of the hallucinogenic drug, mescaline. *Lophophora* also known under the Indian name of "peyotl".

***Maihuea* (Philippi ex F.A.C. Weber) Schumann 1898**

Caespitose, cushion forming shrubs; succulent stems fleshy, segmented (segments terete, cylindrical, globose, <10 cm length, <2 cm Ø); leaves small, terete, deciduous or sub-persistent; areoles felted and spiny; flowers solitary, white, yellow, regular, without tube; pericarpel with broad scales. 2 spp.; S-Argentina, S-Chile.

***Mahueniopsis* Spegazzini 1925**

syn. *Puna* Kiesling 1982, *Pseudotephrocactus* Fric & Schelle 1932-1933

Densely branched cushions; roots tuberous; stem segments indistinct, ovoid (2-20 cm length); areoles sunken in hairy depressions; spines often flattened. 18 spp.; South America (PE, BO, AR, CL). (Further information see *Opuntia*.)

***Mammillaria* Haworth 1812**

Syn *Bartschella* Britton & Rose 1923, *Cactus* L. 1753, *Chilita* Orcutt 1926, *Cochemiea* (K. Brandege) Walton 1899, *Dolichothele* (Schumann) Britton & Rose 1923, *Krainzia* Backeberg 1938, *Leptocladodia* Buxbaum 1954, *Mamillopsis* Morren ex Britton & Rose, *Neomammillaria* Britton & Rose 1923, *Oehmea* Buxbaum 1951, *Phellosperma* Britton & Rose 1923, *Porfiria* Bödeker 1926, *Pseudomammillaria* Buxbaum 1951, *Solisia* Britton & Rose 1923

Plants flat-globose, globose, short cylindrical, semi-geophytic, elongated (e.g. *Cochemiea*: rope-like stems up to 2m long), erect or decumbent; stems solitary or clustering (ca. 1-25 cm Ø, 1-40 cm tall, clusters 1m Ø), tuberculated; usually with watery juice, some species with milk; tubercles (mammillae) terete, angled, sometimes flattened or elongated (e.g. *Dolichothele*:

mammilla up to 7 cm long), never grooved on upper surface; on top of tubercles usually dense spiny areoles; all alike or sometimes with central spines, which can be very different (coloured, hooked, glandular) from the radial. Areoles bipartite (without interconnecting groove), the abaxial vegetative part at tip of mammary, and the adaxial floriferous part in axil; axils naked or felted, hairy or bristly, but without glands. Flowers arising in a subapical ring; single, diurnal, coloured (white, yellow, red, pink, brownish, greenish), small or middle-sized (1-6 cm Ø), regular or zygomorph (*Cochemia*), (tubular)-funnelform; pericarpel and tube naked; fruits berry-like, cylindric red; withered rest of flower persistent. Main difference between *Mammilloidya* is in the seed, which is in *Mammillaria* pitted (reticulate), not smooth as in *Mammilloidya*. 145-173 spp.; Mexico, USA, Central America (GT, HN, NI), Caribbean Region (JM, HT, VI, AN, BS, PR, WI), Colombia, Venezuela. App. I: *M. pectinifera*, *M. solisioides*.

***Mammilloidya* Buxbaum 1951**

Plants flat-globose, globose to short cylindric (ca. 15 cm Ø, 10-20 cm tall); solitary or clustering; densely spined (white, pale pink bristly spines (5-9 mm long) camouflage tubercles; 4-12 central spines, numerous (>50) radial spines); areoles bipartite (the abaxial vegetative part at tip of mammilla, and the adaxial floriferous part in axil); distinct rounded-cylindric tubercles (mammillae) (1 cm long) without a interconnecting groove between vegetative and floriferous part of areoles; axils with pale bristly hairs. Flowers arising in a subapical ring; single, diurnal, pale green –pale pink, small funnelform (1,5 cm Ø; 2-3 cm long); pericarpel and tube naked, sometimes immersed into axil; fruits cylindric red-pink; withered rest of flower deciduous. Main difference between *Mammillaria* is in the seed, which is in *Mammilloidya* smooth, not pitted (reticulate) as in *Mammillaria*. 1 spec.; Mexico.

***Matucana* Britton & Rose 1922**

syn. *Eomatucana* Ritter 1965, *Submatucana* Backeberg 1959

Solitary or basal branching, globose to short-columnar plants (stems 5-20 cm Ø, 5-75 cm long); ascending or procumbent; by transversely grooves ± tuberculated, low ribs (7-30); areoles densely to sparsely spiny or spines absent (spines of *M. madisoniorum* easily breaking off and look-alike with *Astrophytum asterias*); flowers diurnal (red, pink, orange, yellow), usually apical and slender tubular, ± zygomorphic (bird-pollinated) (3-4 cm Ø, 6-10 cm long), or regular-funnelform in a subapical ring (4 cm Ø, 4-6 cm long); scales of pericarpel and tube with wool in the axils or naked. 15-17 spp.; Peru.

***Melocactus* Link & Otto 1827**

Stems mostly unbranched, short columnar to globose (9-40 cm Ø; incl. cephalium (<1m) up to 1,5m tall); strongly ribbed and spiny; ribs (8-20); areoles often ± sunken into the ribs; areoles with strong spines (3,5 cm long, 1(-4) central spine, 4-15 radial spines); cylindrical cephalium white woolly with red or white bristles; flowers small (up to 2,5 cm long) narrow tubular, diurnal, red or pink, not fragrant; pericarpel and tube naked. 29-33 spp.; Caribbean Region, Mexico, Surinam, Guyana, Central America, Colombia, Venezuela, Ecuador, Peru, Brazil. App. I: *M. conoideus*, *M. deinacanthus*, *M. glaucescens*, *M. paucispinus*.

***Micranthocereus* Backeberg 1938**

syn. *Austrocephalocereus* Backeberg 1938, *Siccobaccatus* Braun & Esteves Pereira 1990

Basal branched shrubs (<1,2m); slender stems (3-8 cm Ø); 15-20 ribs; young plants at stem bases with long (5-8 cm) white flexible, hairy spines; flowering areoles in lateral cephalia (superficial or sunken); flowers tubular (2-5 cm); pericarpel and tube naked except for minute scales. 9 spp.; Brazil.

***Mila* Britton & Rose 1922**

Erect or semi-prostrate short-columnar plants with basal branches forming clumps or dense colonies; few napiform taproots; soft fleshy, cylindric stems 5-15 cm in height, 2-3 cm Ø) ribs 10-13, bristly and spiny; diurnal yellow flowers funnelform-campanulate (1,7-3,3 cm long); pericarpel scaly and hairy. 3-4 spp.; Peru.

***Miqueliopuntia* Fric ex F.Ritter 1980**

Erect branched, thicket shrubs (<1,5m high); stem segments cylindrical (7-20 cm long), glaucous when young; tubercles prominent; leaves fleshy with pointed red tips; bristly areoles strongly spined (spines <8 cm long). 1 spec.; Chile. (Further information see *Opuntia*.)

***Myrtillocactus* Console 1897**

Tree-like, many branched shrubs (<4-5m); 5-9 ribs; flower diurnal, short funnelform - rotate (<2,5 cm); up to 9 flowers per areole; pericarpel and tube less woollyfruits blueberry-like. 4 spp.; Mexico, Guatemala.

***Neobuxbaumia* Backeberg 1938**

syn. *Rooksbya* (Backeberg) Backeberg 1959

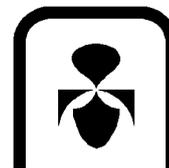
Solitary or branched, columnar trees; many ribbed; flowers nocturnal, tubular-campanulate; pericarpel and tube naked. 9 spp.; Mexico.

***Neolloydia* Britton & Rose 1922**

Solitary or basal branching, globose to short-columnar (5-7 cm Ø, 7-15 cm tall); fibrous roots; ± tuberculated ribs or ovoid tubercles spirally disposed; bipartite areoles ± elongated and grooved above; felted groove not interconnecting spiny tubercle apex and axil; flowers arising at end of groove not at axil); straight or curved spines at tubercle tip (13-20 radial spines, 6-13 mm length; 0-6 central spines, 2-3 cm length); flowers diurnal, whitish to pink; funnelform - salverform (≤6 cm Ø, 3 cm length); pericarpel and tube naked with few small scales. 1-2 spp.; SW USA, Mexico.

***Neoraimondia* Britton & Rose 1920**

syn. *Neocardenasia* Backeberg 1949



Columnar, usually basal branched shrubs or trees (<10m); 4-8 ribs (<40 cm Ø); vegetative areoles large, brown felted and usually long spiny (spines <25 cm long); flowering areoles with short brown wool, proliferous when getting older, enlarged into a cone-like short branch by continuous growth (<15 cm long); flowers 1-2 per areole, white to pale pink, short-funnelform; pericarpel and tube densely covered with scales, bristles and hairs. 2 spp.; Peru, Bolivia.

#### ***Neowerdermannia* Fric 1930**

Solitary, depressed globose stems (4-12 cm Ø); semi-geophytic with subterranean stembase and stout rootstock; ca. 16 spirally disposed, humped tuberculated ribs, divided into triangular-conical tubercles; white felted areoles at "axil" of the upper side of tubercles; spines (radial spines 6-10, 1,5 cm long; 0-1 central spine 4 cm long); flowers diurnal, white or pale pink, funnelform (2-2,5 cm Ø and length); short pericarpel naked without scales or areoles. 2 spp.; Argentina, Chile, Bolivia, Peru.

#### ***Obregonia* Fric 1925**

Usually solitary, sub-geophytic, depressed globose (8-20 cm Ø, <10 cm tall); taproot; plant surface grey-green; stem apex flattened, woolly; leaf-like triangular tubercles (0,5-2,5 cm broad, 1-1,5 cm long; adaxial flattened, abaxial keeled) oriented in a rosette-like arrangement; areoles at tip of tubercles with felted hairs and 2-4 ± curved spines (1-1,5 cm long), both (hairs, spines) deciduous later on; flowers apical, diurnal, white to pale pink, funnelform (2 cm Ø, 3 cm long); pericarpel and tube naked and without scales. 1 spec.; Mexico. App. I: *O. denegrii*.

#### ***Opuntia* Miller 1754**

syn. *Austrocylindropuntia* Backeberg 1938, *Brasiliopuntia* (Schumann) Berger 1926, *Consolea* Lemaire 1862, *Corynopuntia* F. Knuth 1936, *Cumulopuntia* Ritter 1980, *Cylindropuntia* (Engelmann) F. Knuth 1936, *Grusonia* F. Reichenbach ex Britton & Rose 1919, *Maihueniopsis* Spegazzini 1925, *Marenopuntia* Backeberg 1950, *Nopalea* Salm-Dyck 1850, *Platyopuntia* p.p. (Engelmann) Ritter 1979, *Puna* Kiesling 1982, *Tephrocactus* p.p. Lemaire 1868

According to researches of the International Cactaceae Systematics Group and Anderson (2001) the genus *Opuntia* as treated in CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999) is divided into 10 genera: *Austrocylindropuntia*, *Brasiliopuntia*, *Consolea*, *Cumulopuntia*, *Cylindropuntia*, *Grusonia*, *Maihueniopsis*, *Miqueliopuntia*, *Opuntia* (sub *strictum*), *Tephrocactus*. Distinctive features: gene sequence data, flower-, pollen-, fruit- and seed morphology.

#### ***Opuntia* Miller 1754 sub *strictum***

syn. *Nopalea* Salm-Dyck 1850, *Platyopuntia* p.p. (Engelmann) Ritter 1979

Basal branched shrubs or treelike (<10m), erect or caespitose; stems segmented, cylindric, flattened or subglobose, not dimorphic; leaves terete to conical; felted areoles with glochids and various spines (acicular, papery, subulate); flowers rotate to funnelform or rarely ± zygomorphic, without tube, red, pink, yellow, white; pericarpel stem-like with areoles, scales, glochids. 182 spp.; North to South America, Caribbean Region and global widely introduced.

Trees, basal branched shrubs, erect or caespitose; stems usually segmented, cylindric, flattened or subglobose, rarely ribbed or tuberculated; leaves terete; felted areoles with glochids and various spines (acicular, papery, subulate); flowers rotate to funnelform or rarely ± zygomorphic, without tube, red, pink, yellow, white; pericarpel stem-like with areoles, scales, glochids. 161-350 spp.; North to South America, Caribbean Region and global widely introduced.

#### ***Oreocereus* (Berger) Riccobono 1909**

syn. *Arequipa* Britton & Rose 1922, *Arequipiopsis* Kreuzinger & Buining 1941, *Morawetzia* Backeberg 1936

Mostly basal branching shrubs (2-3m in height); erect, cylindrical stems; tuberculated ribs (10-25 ribs); areoles often with white long interlacing hairs; diurnal, orange - red flowers ± zygomorphic (perianth limb ± oblique), tubular-funnelform (± narrow); pericarpel and tube with numerous small scales (pronounced decurrent) and hairy. 5-9 spp.; Peru, Bolivia, Argentina, Chile.

#### ***Oroya* Britton & Rose 1922**

Plants flattened-globose or short columnar (10-20-(25) cm Ø, 7-15-(40) cm in height), single or rarely basal branched (cushion-like) with napiform taproots. Many tuberculated ribs (7-35); areoles elongated with pectinate spines (10-30 radial spines in combelike arrangement and often sideways weaved), central spines absent or 1-2. Flowers in a subapical ring; red, pink, yellow; regular, campanulate-funnelform. Areoles of pericarpel and short tube with small decurrent scales; scale axils sparsely woolly. 1-2 spp.; Peru (3800-4200m a.s.l.).

#### ***Ortegocactus* Alexander 1961**

Small (3-4 cm Ø) globose to short cylindric, blueish silver-green plants with fibrous roots; usually basal branched and clustering; broad tubercles flattened (up to 12 mm Ø); areoles with short white hairs, and black or black tipped white spines (7-8 radial spines 5-10 mm; 1 central spine 4-5 mm long); fertile areoles bipartite (divided into spiny vegetative tubercle (mammillae) and single flowering, woolly axil); flowers funnelform (2-3 cm length, 1,8-2,5 cm Ø), diurnal, yellow; stigma green-yellow; short pericarpel immersed into axil, so pericarpel naked, without areoles, scales or hairs; fruits berry-like, orange-red; dry rest of flower left at fruit. 1 spec.; Mexico (Oaxaca).

#### ***Pachycereus* (Berger) Britton & Rose 1909**

syn. *Anisocereus* Backeberg 1938, *Backebergia* Bravo 1953, *Lemaireocereus* p.p. Britton & Rose 1909, *Lophocereus* (Berger) Britton & Rose 1909, *Marginatocereus* (Backeberg) Backeberg 1941, *Mitrocereus* p.p. (Backeberg) Backeberg, *Pseudomitrocereus* Bravo & Buxbaum 1961, *Pterocereus* MacDougall 1954

Columnar, candelaber-like trees or shrubs (3-18m); acrotonic or basal branching stems (stem 8-30 cm Ø; trunk up to 1m Ø), (broad rounded or humped) ribs (3-7->20; areoles usually broad and in some species linked by felted hairs (groove); 6-12 radial spines, 1-3 central spines (1-12 cm long), lateron deciduous; flowering areoles similar to the non-flowering areoles, or

dissimilar (*Backebergia militaris*); flowers apical-lateral, mainly nocturnal, white or yellow, funnellform-campanulate (2,5-5 cm Ø, 5-10 cm long), tube and pericarpel with numerous scales, bristles and felted axils. 12 spp.; Mexico, USA, Guatemala, Honduras. App. I: *P. militaris* (syn. *Backebergia militaris*).

***Parodia* Spegazzini 1923**

syn. *Brasilicactus* Backeberg 1942, *Brasiliparodia* Ritter 1979, *Eriocactus* Backeberg 1942, *Erioccephala* Backeberg 1938, *Malacocarpus* Salm-Dyck 1849, *Notocactus* (Schumann) Fric 1928, *Wigginsia* D.M.Porter 1964

Solitary or clustering, globose to short columnar plants (5-100 cm tall, 2-25 cm Ø); stem apex ± woolly; stems ribbed and slightly tuberculated by transversely furrows (6-40 ribs); usually ribs arranged in vertically rows, spirally oriented in *Brasilicactus*; sharply ribbed in *Malacocarpus*, *Wigginsia*; usually areoles on top of tubercles, but sometimes tuberculated ribs with humps below areoles (*Malacocarpus*, *Wigginsia*); areoles felted and bristly or spiny (spines strong or short, needle-like, hooked or dagger-like; 4-60 radial spines, 0-6 central spines) or bristly; flowers apical, diurnal, tubular to shortly funnellform, yellow, pink, orange, greenish (1,5-8 cm long, 1-5,5 cm Ø); red stigma (*Malacocarpus*, *Wigginsia*, *Notocactus*); pericarpel and tube naked or dense bristly and with small scales. 60-66 spp.; Argentina, Bolivia, Brazil, Uruguay, Paraguay.

***Pediocactus* Britton & Rose 1913**

syn. *Navajoa* Croizat 1943, *Pilocanthus* B.W.Benson & Backeberg 1957, *Toumeyia* Britton & Rose 1922, *Utahia* Britton & Rose 1922

Solitary or branching; mostly semi-geophytic with subterranean tapering stembase and / or taproot; stems globose to short columnar (1-15 cm Ø, 1-22 cm tall), tuberculated; young areoles at stem apex ± woolly; spines (white, creamy, brownish or black; 3-30 radial spines, 1-10 mm; 0-8 central spines, 1-7 cm); flowers apical, diurnal, white, pink or green-yellow, campanulate (1-3 cm Ø, 1-3 cm long); pericarpel naked, but tube with short fleshy, hairless scales. 6-8 spp.; W and SW USA. App. I: *P. bradyi*, *P. knowltonii*, *P. paradinei*, *P. peeblesianus*, *P. sileri*.

***Pelecyphora* Ehrenberg 1843**

syn. *Encephalocarpus* Berger 1929

Semi-geophytic, solitary or rarely in old age clustering (branching basal or lateral at ground level), globose to short cylindric (2-6 cm Ø; 1-4 cm height above ground, stem in all <10 cm long); napiform taproots; tubercles spiralled and diverse: hatchelike, lateral flattened, truncate in *P. asselliformis*, or in *P. stroboliiformis* triangular, slightly keeled on lower surface, resembling a pine cone); areoles bipartite with an interconnecting groove between spiny tubercle apex and floriferous axil at tubercle base; axils woolly; spines either pectinated (<60 combelike spines, <1 mm) and persistent in *P. asselliformis*, or with radiated 7-14 flexible, whitish deciduous spines (<5 mm); flowers, diurnal, magenta, short funnellform-campanulate (1-3 cm Ø); pericarpel without scales or hairs. 2 spp.; Mexico. App. I: *P. asselliformis*, *P. stroboliiformis*.

***Peniocereus* (Berger) Britton & Rose 1909**

syn. *Cullmannia* Distefano 1956, *Neoevansia* Marshall 1941, *Nyctocereus* (Berger) Britton & Rose 1909

Prostrate to ascending or scandent, branched shrubs (1-4m tall); one or numerous tuberous rootstocks (<60 cm Ø, <60kg); slender stems (1-3 cm Ø, <2m long), 3-10 ribbed or angled; areoles usually with few spines (2-9 radial spines, 1-5 central spines); flowers nocturnal (still opening to morning), tubular-salverform (1,5-15 cm long), white, greenish, pale yellow or pink; pericarpel with spiny and bristly areoles. 13-18 spp.; USA, Mexico, Central America (GT, NI, SV, CR).

***Pereskia* Miller 1754**

syn. *Rhodocactus* (Berger) F.Knuth 1936

Trees, shrubs or woody scrambling plants (<8m); fibrous or tuberous roots; plants not decidedly succulent: stems slender, branching with broad foliage leaves (deciduous); flowers solitary or clustered, regular without tube (1-8 cm Ø), white, pink, orange; pericarpel naked or with few scales, bristles or hairs. 16-17 spp.; tropical America (USA (Florida), Mexico, Central America, Caribbean Region to Argentina).

***Pereskopsis* Britton & Rose 1907**

Trees-like or scrambling, few branched shrubs; stems slender with foliage ovoid or round leaves; areoles with glochids and spines; flowers regular yellow or red; pericarpel with broad leaf-like scales. 6-7 spp.; Mexico, Honduras, Guatemala.

***Pilosocereus* Byles & Rowley 1957**

syn. *Pseudopilocereus* Buxbaum 1968

Trees or shrubs (<10m); ribs (3-)4-30; areoles usually with woolly hairs (at least flowering areoles); flowers nocturnal, tubular-campanulate (4-10 cm long); pericarpel and tube naked or with few tiny scales. 34 spp.; USA, Mexico, Caribbean Region (AN, BS, CU, KY, JM, DO, PR, VI, WI, TT), Central America (GT, HN), South America (BR, VE, CO, EC, PE, PY, GY)

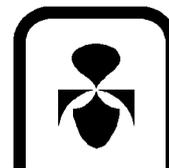
***Polaskia* Backeberg 1949**

syn. *Chichipia* Backeberg 1950, *Lemaireocereus* p.p. Britton & Rose 1909, *Heliabravoa* Backeberg 1956

Tree-like (4-7m); many branched, stems sharply ribbed (< 10 cm Ø) with deep vertically furrows, 7-12 ribs ± humped; areoles uniflowering; campanulate flowers (2-5 cm) cream white – pale pink (diurnal, nocturnal); small pericarpel (at least on fruit) with imbricate scales and bristly spines or hairs; stem tissue yellow; young specimens (*Polaskia* s.str.) blueish waxy. 2 spp.; Mexico.

***Praecereus* Buxbaum 1968**

syn. *Monvillea* p.p. Britton & Rose 1920



Columnar, branched trees; 8-11 humped ribs; flowers nocturnal, white, pale yellow or pink; with decurrent, broad naked scales. 2 spp.; South America.

***Pseudoacanthocereus* Ritter 1979**

Tree-like, basal branched shrubs (<2m); 2-5 angled or 5-7 ribbed, erect to pendent stems; 5-20 spines (rarely 1-3 central spines); flowers white, tubular - funnelform (<16 cm long, 6-8 cm Ø); pericarpel and tube with spiny and felted areoles. 2 spp.; Venezuela, Colombia, Brazil.

***Pseudorhipsalis* Britton & Rose 1923**

Pendent, epiphytic shrubs; stems flattened, 2-winged and leaf-like (basal and initially terete); margins of stem-wings crenate; areoles without spines; flowers short funnelform to rotate (<3 cm Ø); pericarpel with few small scales. 4-6 spp.; Mexico, Caribbean Region (JM, HT), Central America (CR, PA, GT, BZ, HN, NI, SV), South America (BR, VE, CO, EC, PE, BO).

***Pterocactus* Schumann 1897**

Small, basal branched shrubs; napiform rootstock; stem segments terete, globose or clavate; areoles with glochids and few bristles; flowers terminal, funnelform without tube (flower immersed into the stem apex); pericarpel stem-like with areoles. 9 spp.; Argentina.

***Pygmaocereus* Johnson & Backeberg 1957**

The genus is only provisionally accepted, possibly it belongs to *Echinopsis* (HUNT 1999).

Short columnar, basal branched, low clusters (<10 cm tall); stems ribbed (12-14 ribs, ca. 2 cm Ø); flowers nocturnal, white, tubular-salverform (<6 cm long); pericarpel hairy. 2-3 spp.; Peru.

***Quiabentia* Britton & Rose 1923**

Trees or shrubs (<4m); stems terete, fleshy with foliage ovoid, ovate to spatulate leaves; areoles with glochids and numerous spines or spineless; flowers regular, crimson (<4 cm long, <8 cm Ø); pericarpel with leaves. 2 spp.; Brazil, Bolivia, Argentina, Paraguay.

***Rauhocereus* Backeberg 1957**

The genus is only provisionally accepted, possibly it belongs to *Browningia* (HUNT 1999).

Usually basal branching, columnar, erect trees (<4m); 5-6 tuberculated ribs (8-15 cm Ø), ribs divided by sharp longitudinally and transversely furrows; areoles woolly and with few spines (4 short radial spines, 2-4 central spines, <5 cm long, on young areoles red tipped); flowers apical, nocturnal, white, campanulate (8-10 cm long, <5 cm Ø); pericarpel densely covered with narrow, hairy scales. 1 spec.; Peru.

***Rebutia* Schumann 1895**

syn. *Aylostera* Spegazzini 1923, *Digitorebutia* Buining 1940, *Mediolobivia* Backeberg 1934, *Spegazzinia* Backeberg 1933, *Sulcorebutia* Backeberg 1951, *Weingartia* Werdermann 1937

Solitary or clustering, globose to short-columnar (0,8-17 cm Ø, 0,8-20 cm tall); fibrous roots or taproots (*Weingartia* p.p., *Sulcorebutia* p.p., *Mediolobivia*); tubercles or tuberculated ribs (<30) arranged in vertically or spirally rows; areoles linear (*Sulcorebutia*), orbicular or ovoid (*Weingartia*, *Rebutia* s.str.), ± felted; white or coloured radial and not almost central spines (0,5-35 mm); linear areoles often combined with pectinated spines (*Sulcorebutia*); flowers arising apical (*Weingartia*), or usually near stem base or lateral, diurnal, pale pink, yellow, orange, red or crimson, tubular-salverform or funnelform (2,5-4,5 cm Ø, 2-4 cm long); pericarpel and tube with scales; scale axils naked (*Weingartia*) or with hairs or bristles. 24-41 spp.; Bolivia, Argentina, Peru.

***Rhipsalis* Gaertner 1788**

syn. *Erythrorhipsalis* Berger 1920

Usually pendent, epiphytic plants; stems terete, ribbed, angled, winged and usually segmented; segments usually arising in apical clusters; mostly without spines or bristles (juvenile plants of *Rhipsalis* with spines up to 1 cm); flowers small, rotate, white - pale yellow; pericarpel naked or with few bristles. 35 spp., USA, Mexico, Caribbean Region, South and Central America, Old World (trop. Africa, South Africa, Madagascar, Comores, Sri Lanka, Seychelles).

***Samaipaticereus* Cárdenas 1952**

Tree-like or shrubs (up to 3m), less branched and unsegmented, erect stems (4 cm Ø), 4-6 ribs humped (areoles between humps); flowers tubular - narrowly funnelform (5 cm long), nocturnal white, pericarpel and tube with strongly decurrent scales (1,5 cm long) and sparsely hairs and bristly spines. 1 spec.; Bolivia.

***Schlumbergera* Lemaire 1858**

syn. *Epiphyllanthus* Berger 1905, *Epiphyllum* Pfeiffer 1837, *Zygocactus* Schumann 1890

Erect to pendent, many branched, epiphytic or epilithic shrubs; stems segments flattened, angled or terete; areoles spiny or spineless; flowers regular to zygomorph, white, yellow, orange, red, pink; „Christmas Cactus“. 6 spp.; Brazil.

***Sclerocactus* Britton & Rose 1922**

syn. *Ancistrocactus* Britton & Rose 1923, *Coloradoa* Boissvain & Davidson 1940, *Echinomastus* Britton & Rose 1922, *Glandulicactus* Backeberg 1938, *Hamatocactus* Britton & Rose 1922, *Toumeyia* Britton & Rose 1922

Usually solitary or rarely few basal branched, (depressed) globose to short columnar (4-15 cm Ø, 3-45 cm tall); some species semi-geophytic; fibrous roots or taproot (*Ancistrocactus*, *Toumeyia*); tuberculated ribs (8-21) or tubercles; tubercles mostly 6-12 mm long vertically, 6-9 mm broad, protruding 3-6 mm; areoles circular to elliptic prolonged, sometimes (*Echinomastus*, *Ancistrocactus*) grooved above (felted / woolly furrow without nectar-secreting glands, except *Glandulicactus*); coloured spines

(3-20 radial spines, 0,6-20 mm; 0-8 straight, curved, hooked or papery-flattened central spines, 1-9 cm); flowers occurring apical or in a subapical ring, diurnal, white, yellow, green, pink, red, funnellform-campanulate (2-2,5 cm  $\varnothing$  and length); pericarpel and tube scaly with or without hairy scale axils. 18-20 spp.; USA, Mexico. App. I: *S. brevipilatus* ssp. *tobuschii*, *S. erectocentrus*, *S. glaucus*, *S. mariposensis*, *S. mesa-verdae*, *S. papyracanthus*, *S. pubispinus*, *S. wrightiae*.

**Selenicereus (Berger) Britton & Rose 1909**

syn. *Cryptocereus* Alexander 1950, *Deamia* Britton & Rose 1920, *Marniera* Backeberg 1950, *Mediocactus* pp. Britton & Rose 1920, *Strophocactus* Britton & Rose 1913

Climbing, pendent, epiphytic or epilithic shrubs; aerial roots; winged to ribbed stems (2-12 ribs, <5m long); margin of flattened-winged ribs crenate, lobed, to deeply cleft (pinnatifid, e.g. *Marniera*); areoles with or without few short bristly spines; flowers nocturnal, white, yellow or rarely red, funnellform to tubular-funnelform (<30 cm long); pericarpel with broad triangular scales and naked areoles. 18-27 spp.; USA, Mexico, Central America (BZ, NI, CR, HN, GT), Caribbean Region (CU, KY, JM, DO, PR, VI, WI), South America (EC, CO, PE, GF, GY, BR, SR, BO, AR).

**Stenocactus (Schumann) A.W.Hill 1933**

syn. *Echinofossulocactus* sensu Britton & Rose 1922

Solitary or rarely clustering, (depressed) globose plants (4-20 cm  $\varnothing$ , 5-12 cm tall); usually thin and sinuate / undulated ribbed (25-100 ribs), except *S. coptonogonus* (10-14 tuberculated ribs); areoles white felted and widely distanced; large upwards oriented central spines (mostly flexible-papery, flattened, up to 8 cm length) and smaller radial spines; flowers diurnal, pink-striped white, pink or yellow, short funnellform (1,5-2,5 cm  $\varnothing$  and length); pericarpel with hairless scales. 7-10 spp.; Mexico.

**Stenocereus (Berger) Riccobono 1909**

syn. *Hertrichocereus* Backeberg 1950, *Lemaireocereus* p.p. Britton & Rose 1909, *Machaerocereus* Britton & Rose 1920, *Marshallocereus* Backeberg 1950, *Rathbunia* Britton & Rose 1909, *Ritterocereus* Backeberg 1942

Trees or basal branching shrubs (2-15m), sometimes spread climbing (*Rathbunia*, *Hertrichocereus*) or creeping - sprawling (*Machaerocereus*); stems ribbed or with tuberculated ribs (3-17 ribs; 4-35 cm  $\varnothing$ ); often young shoots with grey-blueish wax covering (*Ritterocereus*, *Hertrichocereus*); stems sometimes yellow fleshy (*Hertrichocereus*); areoles white or brown (yellow) felted and often dense spiny (0-20 radial spines, 1-10 central spines up to 5 cm long; 1 central spine dagger-like flattened and downwards bended (*Machaerocereus*)); flowers apical or lateral nocturnal or diurnal- white - pink, tubular-funnelform (5-7,5 cm length, 3-7 cm  $\varnothing$ ) or campanulate (2,5-8 cm long) to narrowly tubular-salverform (10-14 cm long, 4-6  $\varnothing$ , tube 4-6 mm  $\varnothing$ , *Machaerocereus*); or diurnal, scarlet red (hummingbird pollinated: *Rathbunia*),  $\pm$  zygomorphic, narrowly tubular (7,5-12 cm long, < 4 cm  $\varnothing$ , *Rathbunia*); pericarpel and tube usually spiny (sometimes felted to few bristle), with minute scales (*Rathbunia*) or broad imbricate (*Ritterocereus*) or decurrent scales. 19-24 spp., Mexico, USA, Central America (GT, HN, NI, SV), Caribbean Region (CR, CU, HT, DO, JM, PR, TT, AN), Colombia, Venezuela.

**Stephanocereus Berger 1926**

Columnar, erect, solitary (*S. luetzelburgii*) or few branched (*S. leucosteles*) tree-like shrubs (1-5m tall); ribs 12-20; flowers in ring-like cephalia, apical (*S. luetzelburgii*) or alternating with vegetative growth (*S. leucosteles*); flowers tubular-funnelform (5-10 cm); pericarpel and tube naked or with few tiny scales. 2 spp.; Brazil.

**Stetsonia Britton & Rose 1920**

Columnar, candelaber-like branched trees (5-10m); 8-9 ribs; flower nocturnal, white - pale pink, tubular-funnelform (15 cm long, 9-10 cm  $\varnothing$ ); pericarpel and tube with many broad scales. 1 spec.; Bolivia, Argentina, Paraguay.

**Strombocactus Britton & Rose 1922**

Solitary, depressed globose to short cylindrical (<8,5 cm  $\varnothing$ , 3-8 cm tall);  $\pm$  taproot; plant surface grey-green; rhomboid-pyramidal tubercles spirally disposed with dry apical tips; young areoles with 4-5 bristly spines (1,5 cm long) and felted hairs, both (hairs, spines) deciduous later on; flowers apical, diurnal, white-yellow, funnellform (2,5-3,2 cm  $\varnothing$  and length); pericarpel and tube only with rounded scales. 1 spec.; Mexico. App. I: *S. disciformis*.

**Tacinga Britton & Rose 1919**

Erect, few branching climbing or creeping shrub; stems terete or flattened (platyclades like *Opuntia*), succulent fleshy, unsegmented or segmented (0,5-10m long); leaves tiny (<5 mm long, deciduous); areoles with glochids with few or without spines; flower around stem tip nearly terminal, yellow-green, brown to violet; orange-red; pericarpel and tube stem-like with areoles. Especially species with platyclades can only be distinguished from *Opuntia* by gene sequence data 6 spp.; Brazil.

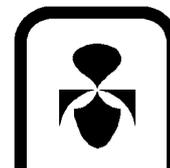
**Tephrocactus p.p. Lemaire 1868**

Small branched shrubs (branches in vertically rows); stem with distinct cylindrical or ovoid segments; areoles sunken into globose cavities with small openings; encryptic glochids. 6 spp.; Argentina. (Further information see *Opuntia*).

**Thelocactus (Schumann) Britton & Rose 1922**

syn. *Torreyocactus* Doweld 1998

Solitary or clustering, depressed globose or rarely short columnar (5-20 cm  $\varnothing$ , 5-20 cm tall); low or even indistinct ribs or undulated tuberculated ribs (8-13), often spiraled and divided into large, stout  $\pm$  polyedrical tubercles; areoles  $\pm$  elongated and grooved above; felted furrow with or without nectar-secreting glands; flowers apical appearing from the adaxial groove, diurnal yellow, red, pink, funnellform to campanulate (6-10 cm  $\varnothing$ , 5-7 cm long); pericarpel with imbricate scales. 10-12 spp.; Mexico, SW USA.

**Turbinicarpus (Backeberg) Buxbaum & Backeberg 1937**

syn. *Bravocactus* Doweld 1998, *Gymnocactus* Backeberg 1938, *Kadenicarpus* Doweld 1998, *Lodia* Mosco & Zanovello 2000<sup>3</sup>, *Neolloydia* pp. Britton & Rose 1922, *Normanbokea* Kladiwa & Buxbaum 1969, *Rapicactus* Buxbaum & Oehme 1942, *Thelocactus* pp. (Schumann) Britton & Rose 1922

Solitary or clustering, dwarf globose to short columnar (1,5-15 cm tall, 2-10 cm Ø); often semi-geophytic; roots fibrous or napiform, sometimes tuberous root connected to the stem by a thin subterranean neck (syn. *Gymnocactus* p.p.); tubercles conical; areoles white woolly; usually white spines (acicular or tortuous, pungent or flexible; 6-28 radial spines, 0-4 central spines, rarely tipped black or entirely brown-black); juvenile plants densely covered with short whitish, ± pectinate radial spines, preserving in *Turbinicarpus pseudopectinatus* (syn. *Pelecypora pseudopectinata*), *Turbinicarpus valdezianus* (syn. *Pelecypora valdeziana*); flowers apical, diurnal, short funnelform, white, magenta or yellowish (2-4 cm long, 2 cm Ø), pericarpel and tube naked or with very few scales. 16-24 spp.; Mexico. App. I: *T. alonsoi*, (*T. bonatzii*), (*T. booleanus*), *T. beguinii*, *T. gielsdorffianus*, (*T. hoferi*), *T. horripilus*, (*T. jauernigii*), *T. knuthianus*, *T. laui*, *T. lophophoroides*, *T. mandragora*, (*T. X mombergeri*), *T. pseudomacrolele*, *T. pseudopectinatus*, (*T. rioverdensis*), *T. saueri*, *T. schmidickeanus*, *T. subterraneus*, (*T. swoboda*), *T. valdezianus*, *T. viereckii*, *T. ysabelae*, (*T. zaragozae*)

**Uebelmannia Buining 1967**

Singled stemmed, globose or short-columnar (8-20 cm Ø, 5-120 cm) plants; plant surface rough papillate or smooth, grey-greenish, often covered with white waxy scales; young specimens with dark red-brownish epidermis; tuberculated ribs or sharp ribs (15-40); areoles spiny and felted (0,5 cm-3,5 cm); flowers yellow, diurnal, funnelform (1-3 cm Ø, 1-3,5 cm long); pericarpel and tube densely brownish woolly-bristly and with few small scales. 3 spp.; Brazil (Minas Gerais). App. I: *U. buiningii*, *U. gummifera*, *U. pectinifera*.

**Weberbauerocereus Backeberg 1941**

Tree-like (2-6m height); sharply transversely grooved, tuberculated 15-25 ribs (6-15 cm Ø); broad areoles noticeable woolly or hairy and strong spiny, elongated central spines and numerous radial spines; flowers nocturnal (white, brownish-red), regular, tubular-funnelform (5-10 cm length); pericarpel and tube with numerous imbricate scales and woolly / hairy areoles. 7-8 spp.; Peru, Chile.

**Weberocereus Britton & Rose 1909**

syn. *Eccremocactus* Britton & Rose 1913, *Werckleocereus* Britton & Rose 1909

Slender, climbing, pendent, epiphytic or epilithic shrubs; aerial roots; stems (2-5 ribs), terete, angled or flattened; margin of ribs entire, crenate to deeply cleft (pinnatifid); areoles small with or without few bristly spines; flowers nocturnal, white or pale yellow, funnelform (3-10 cm long); pericarpel with bristly areoles. 9 spp.; Mexico, Central America (NI, CR, PA, GT), Ecuador.

**Yavia Kiesling & Piltz 2001**

The monotypic genus is newly described by R. Kiesling and J. Piltz (2001) and therefore not yet mentioned in "CITES Cactaceae Checklist 2<sup>nd</sup> Ed" (HUNT 1999).

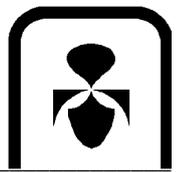
Dwarf, flattened globose, single-headed plant (1,3-3 cm Ø, 0,5-1,5 cm high); subterranean stem with 1 -2 large taproots (2-3 cm Ø, 2-7 cm long). Stem apex sunken with felted, woolly areoles. More or less tuberculated ribs in vertically rows (up to 40); areoles (1 mm long, 0,5 mm wide); ± pectinate, pale reddish spines (8-15); flowers pink, apical, short-funnelform to rotate (2 cm Ø, 1 cm long); pericarpel naked. 1 spp.; Argentina (restricted to the northern part close to the bolivian border).

**Yungasocereus Ritter 1980**

Columnar, branched trees (4-5m tall); rounded ribs (6-10, 6-7 cm Ø), 4-12 spines (1,5-3 cm long); flowers apical, campanulate (5-6 cm long), white. 1 spec.; Bolivia.

<sup>3</sup> In supplement to the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999), Lüthy (2000) replaced the monotypic genus *Lodia* Mosco & Zanovello 2000 (App. I) (*Lodia mandragora* (Fric ex A.Berger) Mosco & Zanovello) to synonymy as *Turbinicarpus mandragora* (Fric ex A.Berger) A. Zimmermann 1991 ssp. *mandragora*.





## Checklist to Cactaceae - Taxa listed on CITES Appendix I

Taxa controlled by the provisions of CITES Appendix I under their currently accepted names or any of their synonyms (see also HUNT 1999,2000b, 2001)

**Ariocarpus spp.** (syn. *Neogomesia*, *Roseocactus*): *A. agavoides*, *A. bravoanus*, *A. fissuratus*, *A. kotschoubeyanus*, *A. retusus*, *A. scaphirostris*

**Astrophytum asterias** (syn. *Echinocactus asterias*)

**Aztekium ritteri**

**Coryphantha werdermannii** (syn. *Mammillaria werdermannii*, *Coryphantha densispina*)

**Discocactus spp.:** *D. bahiensis*, *D. ferricola*, *D. heptacanthus*, *D. horstii*, *D. placentiformis*, *D. pseudoinsignis*, *D. zehntneri*

**Disocactus macdougallii** (syn. *Lobeira macdougallii*, *Nopalxochia macdougallii*)

**Echinocereus:** *E. ferreirianus* ssp. *lindsayi* (syn. *E. lindsayi*), *E. schmollii* (syn. *Cereus schmollii*, *Wilcoxia schmollii*)

**Escobaria:** *E. minima* (syn. *Coryphantha nellieae*, *Escobaria nellieae*), *E. sneedii* (syn. *Coryphantha sneedii*, *Escobaria sneedii* ssp. *leei*)

**Mammillaria:** *M. pectinifera* (syn. *Solisia pectinata*), *M. solisioides*

**Melocactus:** *M. conoideus*, *M. deinacanthus*, *M. glaucescens*, *M. paucispinus*

**Obregonia denegrii**

**Pachycereus militaris** (syn. *Backebergia militaris*, *Cephalocereus militaris*, *Mitrocereus militaris*, *Pachycereus chrysomallus*)

**Pediocactus:** *P. bradyi* (syn. *Pediocactus bradyi* ssp. *despainii*, *P. bradyi* ssp. *winkleri*, *P. despainii*, *P. winkleri*), *P. knowltonii*, *P. paradei*, *P. peeblesianus* (syn. *Peeblesianus* var. *fickeisenii*, *Navajoa peeblesiana*, *Toumeyia peeblesiana*, *Utahia peeblesiana*), *P. sileri* (syn. *Echinocactus sileri*, *Utahia sileri*)

**Pelecypora spp.** (syn. *Encephalocarpus*): *P. aselliformis*, *P. strobiliformis*

**Sclerocactus:** *S. brevihamatus* ssp. *tobuschii* (syn. *Ancistrocactus tobuschii*, *Ferocactus tobuschii*), *S. erectocentrus* (syn. *Echinomastus erectocentrus*, *Neolloydia erectocentra*, *Echinomastus acunensis*, *E. krausei*), *S. glaucus* (syn. *Ferocactus glaucus*, *S. brevispinus*, *S. wetlandicus*, *S. wetlandicus* ssp. *ilseae*), *S. mariposensis* (syn. *Echinocactus mariposensis*, *Echinomastus mariposensis*, *Neolloydia mariposensis*), *S. mesa-verdae* (syn. *Coloradoa mesae-verdae*, *Echinocactus mesae-verdae*, *Ferocactus mesae-verdae*, *Pediocactus mesae-verdae*), *S. papyracanthus* (syn. *Echinocactus papyracanthus*, *Mammillaria papyracantha*, *Pediocactus papyracanthus*, *Toumeyia papyracantha*), *S. pubispinus* (syn. *Echinocactus pubispinus*, *Ferocactus pubispinus*), *S. wrightiae* (syn. *Pediocactus wrightiae*)

**Strombocactus spp.:** *S. disciformis*

**Turbincarpus spp.** (syn. *Gymnocactus*, *Normanbokea*, *Lodia*<sup>4</sup>, *Rapicactus*): *T. alonsoi*, (*T. bonatzii*), (*T. booleanus*), *T. beguinii*, *T. gielsdorfianus*, (*T. hoferi*), *T. horripilus*, (*T. jauernigii*), *T. knuthianus*, *T. laui*, *T. lophophoroides*, *T. mandragora*, (*T. X mombergeri*), *T. pseudomacrolele*, *T. pseudopectinatus*, (*T. rioverdensis*), *T. saueri*, *T. schmiedickeanus*, *T. subterraneus*, (*T. swoboda*), *T. valdezius*, *T. viereckii*, *T. ysabelae*, (*T. zaragozae*)

**Uebelmannia spp.:** *U. buiningii*, *U. gummifera*, *U. pectinifera*

NOTE: In supplement to the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999), A.B.Doweld proposed 14 new genera (cf D.Hunt (2000b, 2001)), which are not recognized in the CITES Cactaceae Checklist.

Proposed new genera [*taxa of currently preferred name*]:

**Bravocactus** [*Turbincarpus* p.p.];

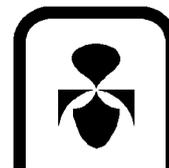
**Kadenicarpus** [*Turbincarpus* p.p.];

**Neonavajoa** [*Pediocactus* p.p.].

**Puebloa** [*Pediocactus* p.p.].

<sup>4</sup> In supplement to the CITES Cactaceae Checklist 2<sup>nd</sup> Ed. (Hunt 1999), Lüthy (2000) replaced the monotypic genus *Lodia* Mosco & Zanovello 2000 (App. I) (*Lodia mandragora* (Fric ex A.Berger) Mosco & Zanovello) to synonymy as *Turbincarpus mandragora* (Fric ex A.Berger) A.Zimmermann 1991 ssp. *mandragora*.





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<http://www.cactus-mall.com/index.html> ..... The Cactus and Succulent plant Mall  
<http://www.bcsc.org.uk/>..... The British Cactus and Succulent Society  
<http://cactus-mall.com/dkg/> ..... Deutsche Kakteengesellschaft e.V.  
<http://cactus.at/> ..... Gesellschaft Österreichischer  
 Kakteenfreunde  
<http://ourworld.compuserve.com/homepages/SKGASC> ... Schweizerische Kakteengesellschaft

*Bradleya*. - Yearbook of the British Cactus and Succulent Society.

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*Haseltonia*. - Yearbook of the Cactus and Succulent Society of America.

*Kakteen und andere Sukkulente*. – Editor: "Deutsche Kakteengesellschaft e.V. ", "Gesellschaft Österreichischer Kakteenfreunde", "Schweizerische Kakteengesellschaft"

*Piante Grasse*. - Editor: Associazione Italiana die Amatori delle Piante Succulente.

*Succulenta*. - Maanblad van de Nederlands-Belgische Vereniging van Liefhebbers van Cactussen en andere Vetplanten.

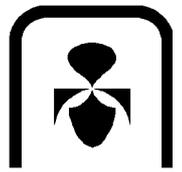
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### Acknowledgements

The authors wish to thank Dr. Ger van Vliet (CITES Secretariat) for comments and amendments. As well as Dr. David R. Hunt and Dr. Jonas Lüthy for their helpful informations.

In grateful memory we are indebted to the recently died Prof. Dr Werner Rauh for his permission to use the figures.

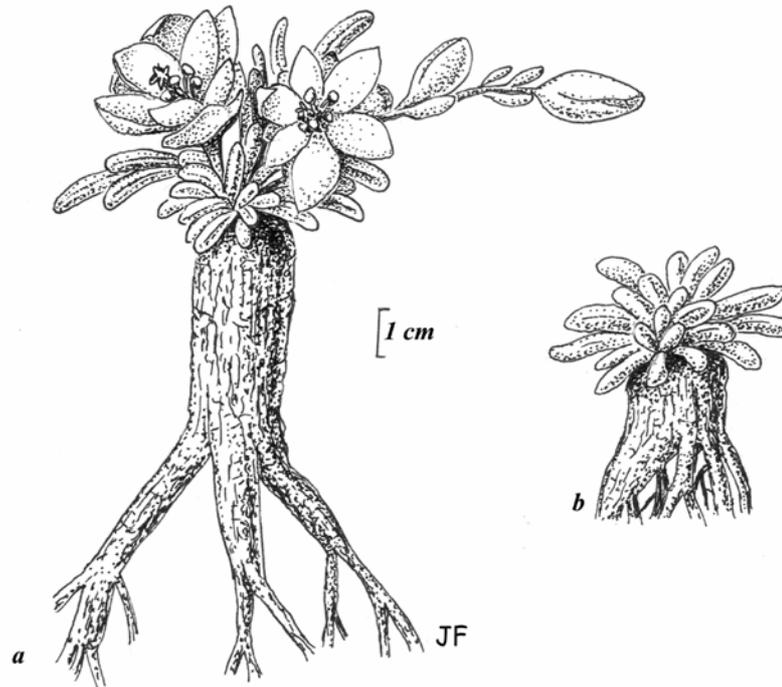


# Lewisia maguirei

Holmgren

**Common name:** engl.: Maguire's Lewisia  
esp.:  
fr.:

**Scientific synonyms:** None



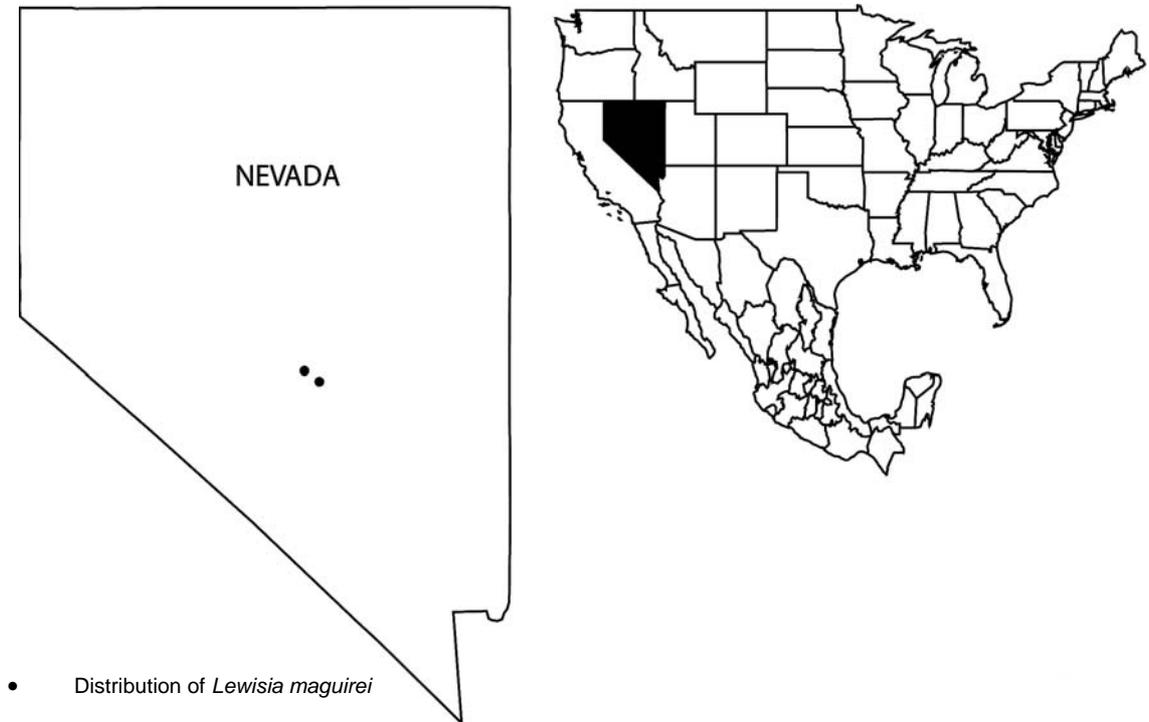
**Illustration:** a. *Lewisia maguirei* in flower.  
b. vegetative growth.

## Characteristics:

- Vegetative:** Plant 5 cm in height, perennial from a fleshy, long-branched taproot, caudex short, thick, bearing at its crown numerous rosette leaves, the older ones erect and withering without falling; leaves rose-colour suffused, 1-2 cm long x 1.5-3.5 mm wide, linear oblanceolate, obtuse, fleshy with prominent midrib. Leaves dying away soon after flowering time.
- Inflorescence:** Several short scapes, 1.5-2 cm long, two or three flowered cyme, rarely with a single flower, bracts oblong, 3-5 mm long x 2.5-3.5 mm wide; flowers 2-3 cm in diameter, pinkish suffused, with 7-9 silvery scarious pink-tinged 7-9 petals, 8-12 mm in length x 4-6 mm wide, 3-4 sepals.
- Similar species:** *Lewisia rediviva* Pursh – leaves differ in being less cylindrical than *L. maguirei* and flowers have 6-9 sepals and 12-19 petals which are larger ( 15-35 mm) than in *L. maguirei*. The flowers are usually single on a cyme where as in *L. maguirei* there are 2 or 3.

**Distribution:**

Nevada, USA in Nye County in the Quinn Canyon and Grant Ranges in open, gravelly clay on south facing slopes in limestone derived soils at 2280 m elevation in pinyon-juniper woodland.

**Threats:**

Potential damage by grazing, recreation and illegal collecting by rock garden hobbyists.

**References:**

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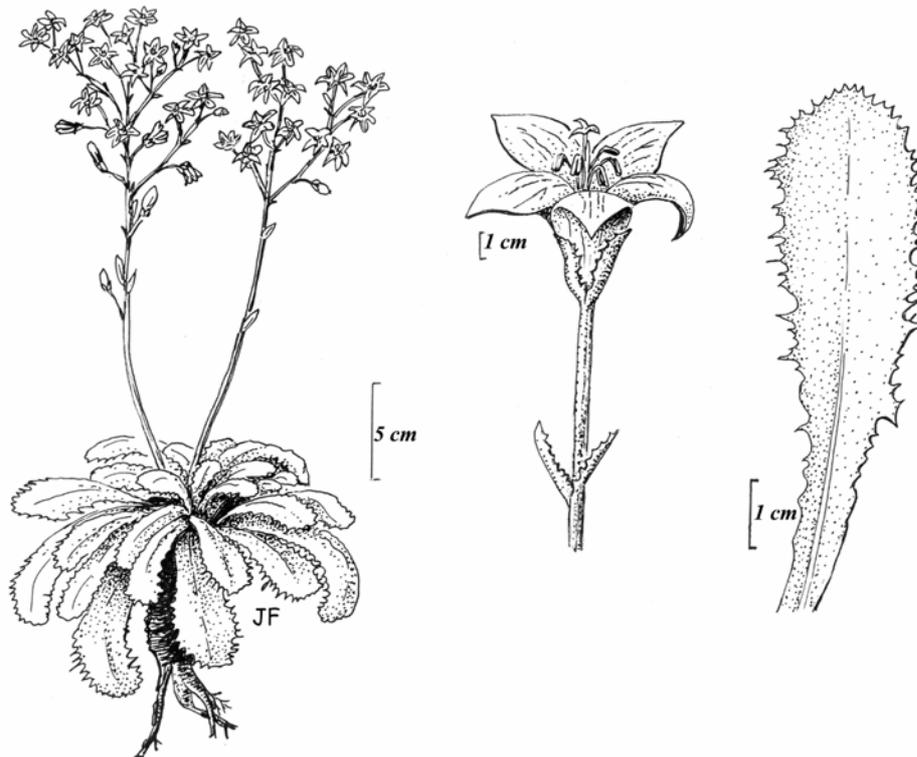
# Lewisia serrata

Heckard &amp; Stebbins



**Common name:** engl.: Saw-toothed Lewisia.  
 esp.:  
 fr.:

**Scientific synonyms:** None



**Illustration:** a. *Lewisia serrata*, habit of plant in flower.  
 b. flower.  
 c. leaf.

**Characteristics:**

- Vegetative:** Evergreen perennial, 5-25 cm in height when in flower, with flattish rosette of basal leaves from usually short caudex which may reach 10cm in length, fleshy, few-branched roots. Basal leaves narrowly obovate 2-10 cm long and 10-20 mm wide, fleshy, flattish on upper surface, rounded, tapering gradually to base. Leaves distinctly toothed.
- Inflorescence:** Several loose, many flowered panicles, 10-20 cm in height, flowers 1.5 cm in diameter, petals white or pale pink, veined darker reddish pink, elliptic, 5-6 mm long, 2.5-3 mm wide, seeds blackish, 1.2-1.5 mm long, shiny.
- Similar species:** *Lewisia cantelovii* J.T. Howell also has toothed leaves, but these are less coarse and more regular than in *L. serrata*, which has individual teeth that are more broadly triangular. The leaf bases in *L. serrata* also taper more abruptly. The inflorescences of *L. serrata* are more compact.

**Distribution:**

Placer and El Dorado Counties in north eastern California, USA in shady mossy cliffs of steep gorges in the American River watershed in the Sierra Nevada.

**Threats:**

Potential horticultural collecting by rock garden enthusiasts and hydroelectric dam development projects.

**References:**

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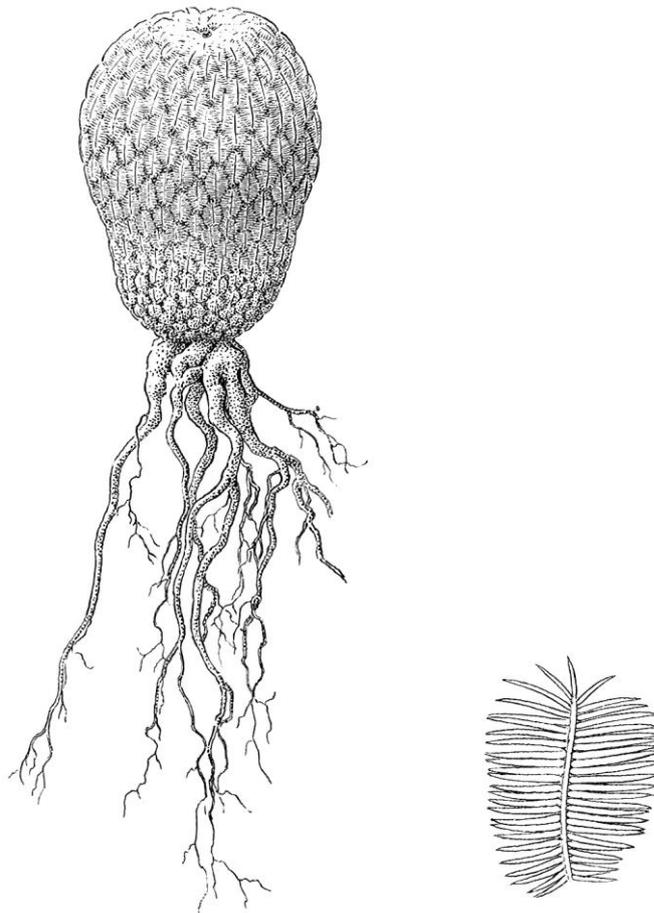
# Mammillaria pectinifera

F. A. C. Weber 1898

**Common names:** none

**Scientific synonyms:** →*Pelecyphora pectinata* B. Stein 1885  
 = *Solisia pectinata* (B. Stein) Britton & Rose 1923  
 = *Neomammillaria pectinata* (Stein) Fosberg 1931  
 →*Pelecyphora aselliformis* var. *pectinifera* Rümpler 1885

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Very cryptic in habitat, the flattened apex hardly emerging from the substrate and the dense, white spination blending with the limestone gravel of the habitat. Stem and tubercles of a hard consistence. The very distinctive, pectinate arrangement of the spines is shared with a few other Mexican cacti.

**Roots:** Fibrous, from a napiform stem base.

**Stem:** Single, depressed globose with considerable underground portion, to cylindroid (in cultivation), up to 8 cm high and 3-4 cm Ø, apex sunken, densely covered with spines. Stem may contain a milky

- 
- Tubercles: sap.  
Small, tightly arranged, firm, hatchet-shaped, laterally compressed, truncate, ca. 5 mm long 3-4 mm wide, dark green, axils naked.
- Areoles: Linear, without wool.
- Spines: 35-60, all radial, pectinate and appressed, arranged in two rows on either side of linear areole, 1-2 mm long, bristle-like, stiff, white.
- Flowers: Broadly funnelform, 1.5-2 cm long, 2-3 cm wide, white or pale pink, arising from the side of the stem, quite far from the apex.
- Fruits: Whitish green to red, 7-8 mm long, 4-5 mm Ø, non-fleshy, with dried perianth persisting.
- Seeds: Black, 1.2 mm long, shortly cap-shaped, seedcoat pitted.
- Distribution:** State of Puebla, Mexico.



**Trade:** Reported from a few localities in the State of Puebla; occurrence in the state of Oaxaca needs to be confirmed (Arias & al. 1997, Anderson & al. 1994). 19 populations are reported in CITES document PC 11 Inf. 15 with between 145 and over 4'000 individuals. Stated to be threatened by collectors in the proposal for listing in App. I (USA 1983). Despite of heavy collecting over a long period, the species seems to survive and is evidently reproducing effectively, even extending its area into disturbed ground; actual threats are mining rock for construction, dumping of rubbish, collecting of plants for horticulture and grazing of cattle and goats (Anderson & al. 1994). Habitats are reported to be threatened by alteration of land use, as the species occurs on semi-arable land and near urban areas (Glass 1998). Today the species is in moderate demand, registered international trade is only in small shipments of artificially propagated specimens. It is well introduced for a long time and extensively propagated from seeds and thus quite common in collections. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Resembles some other Mexican cacti (none of them having milky sap) with very similar, pectinate spine arrangement, of which *Turbincarpus pseudopectinatus* has about the same dimensions, but the spines are hardly overlapping on the side of the stem, as in *M. pectinifera* (and the flowers arise from the centre of the stem apex). *Pelecyphora aselliformis* has considerably longer areoles (up to 9 mm long), and the spines don't overlap either. *Mammillaria sanchez-mejoradae* (CITES App. II) has not as strongly elongated areoles (1,3 mm) and distinctly plumose spines. The closely related and somewhat similar *Mammillaria solisioides* has oval areoles and less (only ca. 25), but longer (ca. 5 mm) spines per areole.

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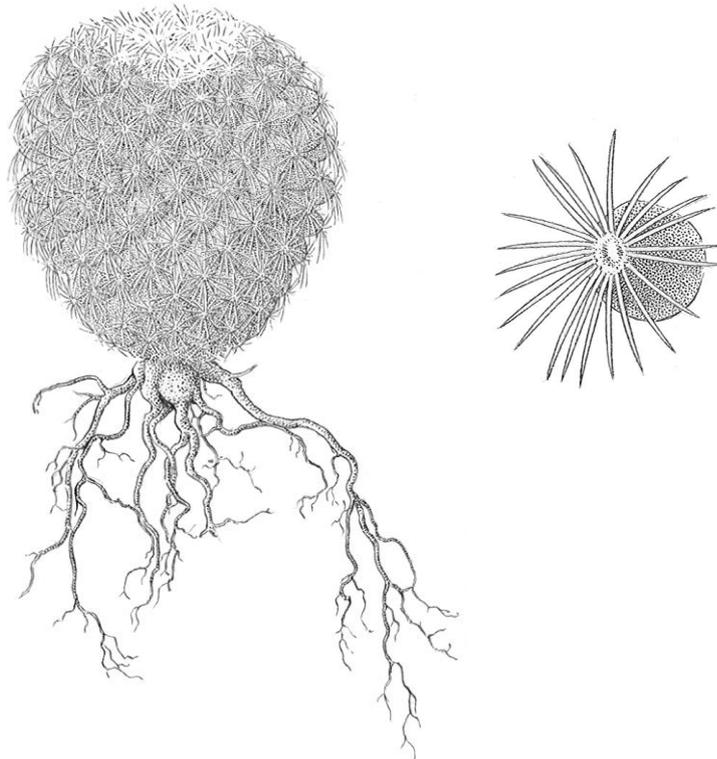
# Mammillaria solisioides

Backeberg, 1952

**Common names:** none

**Scientific synonyms:** = *Mammillaria pectinifera* f. *solisioides* (Backeberg) Sanchez-Mejorada 1980

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



- Characteristics:** Quite cryptic in habitat, the flattened apex hardly emerging from the substrate and the dense, white spination blending with the limestone gravel of the habitat. Stem and tubercles of a hard consistence.
- Roots:** Fibrous.
- Stem:** Single, in habitat depressed globose to nearly flattened, with considerable underground portion. In cultivation becoming globose to even shortly columnar, ca. 4 cm Ø, but commonly only 2 cm Ø, apex sunken.
- Tubercles:** Shortly conical, pale green, firm.
- Areoles:** Oval, ca. 1 mm long with some brownish, dehiscent wool.
- Axils:** Naked.
- Spines:** Ca. 25, all radial, radiating pectinately and appressed, to 5 mm long, curved, white.
- Flowers:** 1.4 cm long, 1.5 cm Ø, funnelform-campanulate, yellow, arising from the side of the stem, quite far from the apex.
- Fruits:** Barely exerted beyond the tubercles, whitish-green, thin skinned, with dried perianth persisting.
- Seeds:** Black, 0.8 mm long, shortly cap-shaped, seed coat weakly pitted.

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**Distribution:** States of Puebla and Oaxaca, Mexico.



**Trade:** Reported from between south of Petlalzingo in the state of Puebla and Huahuapan de Leon in the state of Oaxaca (Arias & al. 1997). 14 populations are reported in CITES document PC 11 Inf. 15 with between 900 and nearly 5'000 individuals. Stated to be threatened through collection in the proposal for listing in App. I (USA 1983), but more recently reported to be seriously threatened through housing developments within the expanding area of the city of Huahuapan de Leon (Glass 1998). The species is locally still common. Today demand is moderate, registered international trade is usually in small shipments of artificially propagated specimens. The species is well introduced for a long time and widely propagated from seeds. It is quite common in collections. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Could be confused with other "white Mammillarias", especially with younger specimens of members of Series *Supertextae*, which lack central spines. Has most probably been confounded with *M. huitzilopochtli* (CITES App. II) in Bravo-Hollis & Sanchez-Mejorada (1991). Could further be confused with non-flowering *Mammillaria lasiacantha* (CITES App. II), which has a significantly higher number of spines (up to ca. 90), arranged in various series (layers). The closely related *Mammillaria pectinifera* has linear areoles and strongly pectinate spines (up to 60, 1-2 mm long), combined with laterally compressed, hatched-shaped tubercles.

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Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Management and Scientific Authorities of Mexico (2001): Comments by Mexico on the Proposal to Transfer Mexican Cactaceae from Appendix I to II.



**Illustration top left**

Crude drug, Adonidis herba; species: *Adonis vernalis*, (copyright BfN).

**Illustration bottom right**

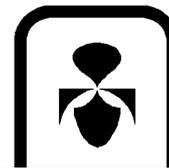
Cut drug, Salep tuber; species: *Orchis* spp., (copyright BfN).



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Introduction .....	5
Definitions .....	5
Plant parts used .....	6
Overview of plant morphology with respect to medicinal and aromatic plants .....	6
Pharmaceutical names .....	9
Plant sources .....	12
Commodities of botanical drugs .....	12
CITES and medicinal and aromatic plants .....	13
Abbreviations .....	15
Acknowledgements .....	15
Recommended reading .....	16





## Introduction

Besides the large number ornamental plants of which the trade is regulated by CITES, most of them orchid and cactus species, medicinal and aromatic plants are another important plant group within CITES. The trade in medicinal and aromatic plant species is a worldwide phenomenon.

Medicinal and aromatic plant species are not restricted to certain plant families but are found across the whole plant kingdom. These plant species have one feature in common in international trade: they are not shipped as living plants, but as (mainly dried) parts or derivatives thereof. Therefore, CITES Authorities and Customs officers find it frequently very difficult to identify CITES-listed species in plant commodities.

The introductory chapters and the ID-sheets of the most important medicinal and aromatic plant species are designed to assist CITES Authorities and Customs officers in identifying herbal commodities in trade that originate from species covered by CITES, in case of doubt a specialist should be consulted.

## Definitions

**Drug:** in pharmacy, the term *drug(s)* is defined as dried material or substances derived mainly from plant origin but also from animals. Drugs are either used as raw material, extract or decoction in teas; or processed into phytopharmaceuticals; or used for technical purposes. The term *drug* refers also to fat and essential oils, resins, balsams or gums as well as metabolical products from micro-organisms (antibiotics). In this paper the term *drug* always refers to the **botanical drug** and applies to material derived from plants, including resins, balsams and gums (= **medicinal and aromatic plant material**). Accordingly the trade in botanical drugs is called **drug trade** and the companies involved are called **drug traders** or **drug processing companies**.

**Special cases of the term *drug*:** *drug* is a generic term. Several types of drugs are distinguished according to the use made of them. **Officinal drugs** are included in pharmacopeias and officially acknowledged as remedies. Their quality control is subject to strict provisions. **Non-officinal drugs** are not covered by pharmacopoeias and no legally-binding examination provisions exist for them. They often represent a considerable share of the drug trade. While some drugs of this kind serve solely technical purposes, most are used for tea mixtures or processed into extracts. **Spices** are diverse parts of plants which can be used as aromas and essences. Owing to their aromatic and savoury taste and odour, they can be used as a seasoning ingredient in human food or alcoholic beverages (herb liqueur, bitters, etc.). **Narcotic drugs** present another type of drugs. The terms **whole drugs**, **cut drugs** and **powdered drugs** refer to differently processed drugs.

**Herb:** the English language has several definitions for the term *herb*:

- In the kitchen, it denominates aromatic leafy parts of plants which are added to food for colouring and/or flavouring.
- In botanical science, it refers to any non-woody plant which dies down after flowering.
- In popular herbal books, it is used for plant species that have therapeutic properties, regardless of whether they are trees, shrubs, or annuals, or whether they are flowering plants, ferns, mosses, liverworts, lichens, or fungi.
- In pharmaceutical practice it is used to specify a part of a plant in use (see chapters 2 and 3).  
**The term *herb* is only used in the latter sense hereinafter.**

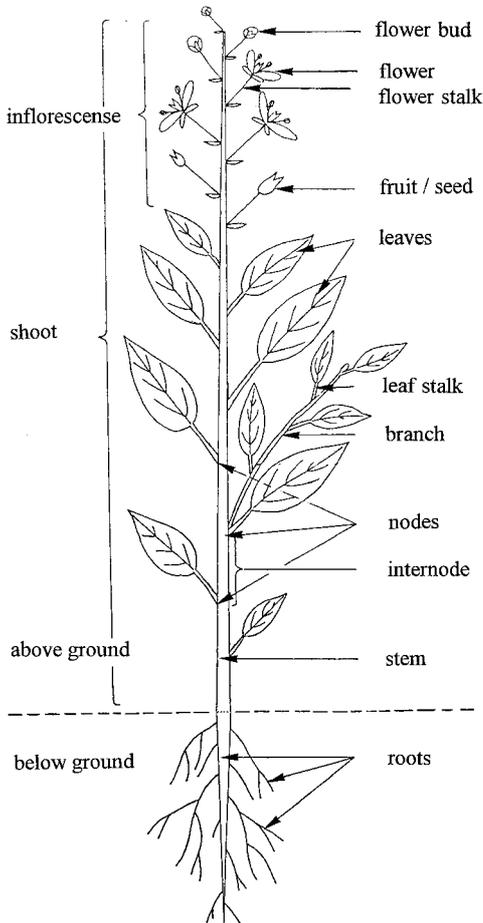
**Plant source** is a medicinal or aromatic plant species from which one or more botanical drugs originate.

**Medicinal plants** are plants of which the drug derived from it has a healing effect.

### Plant parts used

Active constituents are frequently concentrated in a certain part of a plant or may be found in one plant organ exclusively. Harvest and trade are therefore restricted in most cases to this particular part. Nevertheless, in general, all plant parts can be useful, from roots to seeds (Figure 2). When the useful ingredients are found in several organs of a plant, it is also common to use several plant parts, or even the whole plant body. In trade, the terms **flower drugs**, **leaf drugs**, **wood drugs**, **herb drugs**, **bark drugs** or **root drugs** are used.

## Overview of plant morphology with respect to medicinal and aromatic plants



Typically, a plant is composed of a **root system** below ground and of a **shoot system** above ground. In general the **shoot system** consists of the **stem, leaves and flowers** (Figure 1).

Across the plant kingdom, roots, stems, leaves and flowers show a considerable range in size, shape and structure (Figure 2), and their shapes are often unique to each species. This allows to distinguish between different species easily.

Figure 1: Plant morphology – basic terminology.

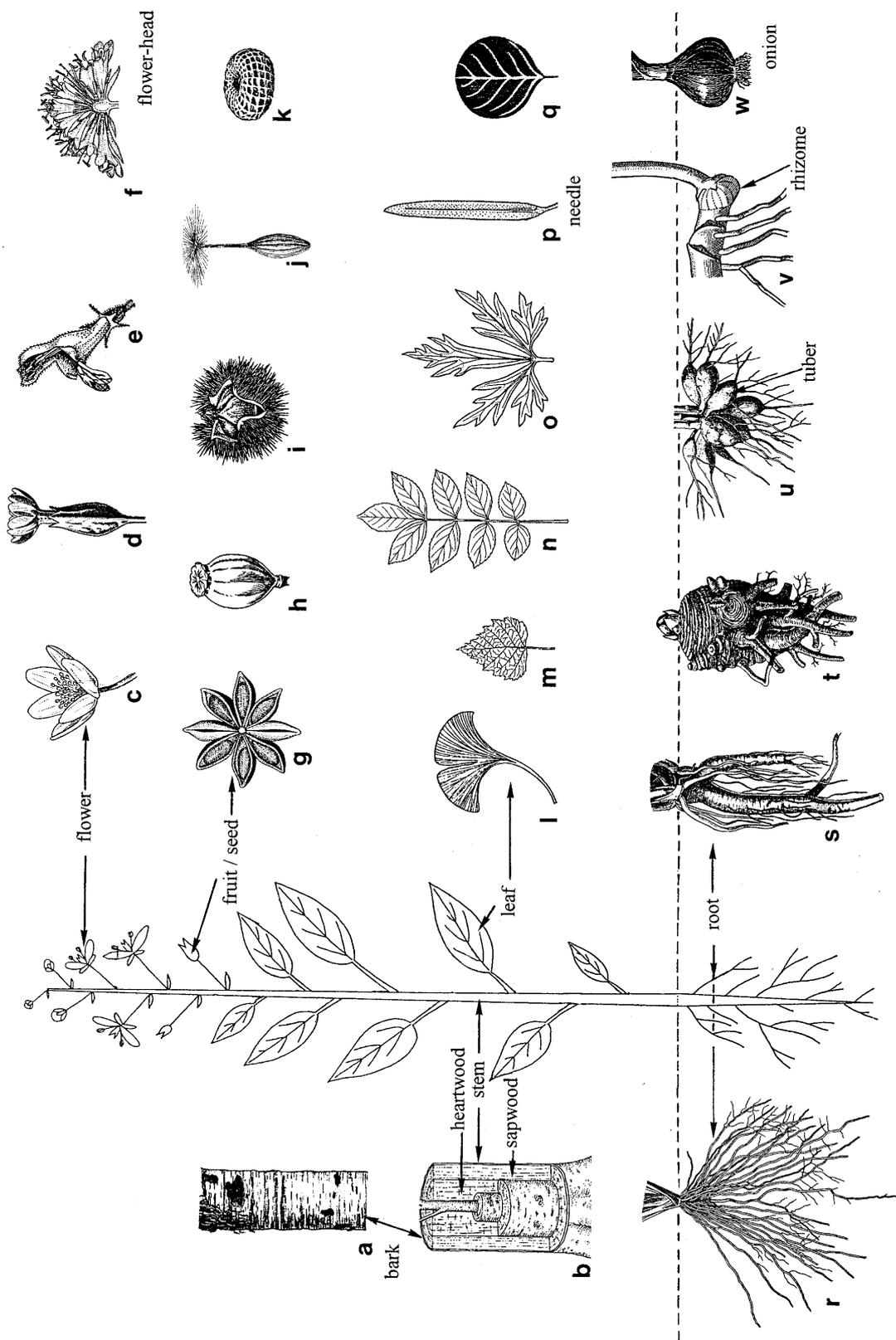


Figure 2: The range of morphology of roots, stems, leaves, flowers, fruits, and seeds.

**Plant parts below ground** are roots, tubers, bulbs and rhizomes. **Roots** show a wide range of modifications, but they are always lacking leaves. They can be branched or unbranched, fine or fibrous, thick or tough, swollen or fleshy, and may differ in structure, size and thickness. **Tubers** and **bulbs** also vary considerably in size, shape and colour. Well-known examples are potatoes for tubers and onions for bulbs. **Rhizomes** or **rootstocks** may look very similar to roots, however, in contrast to them, they bear small scaly leaves or at least the scars when these leaves have been lost. Rhizomes tend to be thick, fleshy or even woody.

**Stems** can be defined as a series of **nodes** and **internodes**. The point on the stem at which one or more leaves are attached is termed a node and the interval between two nodes is an internode. Stems show a considerable variety in shape and type of surface. They may be cylindrical or square in cross-section, flattened or swollen; their surface may be smooth, rough, prickly or spiny, hairless to densely haired, and even ribbed. Stems differ in size, thickness and in the production of wood and bark, ranging from tiny, herbaceous and green stems to brown, woody trunks. **Wood** originates from thickness growth and consists of distinct, mainly species-specific tissues. In general, wood consists of (1) the outer and softer **sapwood**, which contains the sap transport (or vascular) system, and of (2) the inner **heartwood**, which contains strengthened tissues that form the trunk, stems and branches. Concentric layers called growth rings can frequently be observed in cross-sections. Wood varies greatly in colour, texture, hardness, toughness, density, luster, polish, shrinkage and specific weight. In addition, odour and microscopic characters play an important role in the identification of wood. **Bark** refers to the outer layers of woody stems and appears variously textured. Its outer surface is characteristic for many genera or even species and may be smooth, fissured, cracked, knobby, scaly or peeling.

**Leaves** are usually composed of a **leaf stalk** and of a (mostly) flattened **leaf blade**, with in many cases different upper and lower surfaces. Structure, shape and size of the leaf blades vary from species to species (Figure 2). Leaf shapes range from small to large, from round to ovate or linear, from flat to inrolled, and from simple to divided or pinnate. Leaves may be thin or thick, and the structure soft, hard, fleshy, papery, leathery or coriaceous. There is also a wide range of characters with regard to surface and margins of the leaves. In general, leaves show species-specific patterns of colour, hairs, prickles, glands, scales, wax coats and pattern of veins (parallel-veined, net-veined, reticulate-veined). The leaf margins may be entire, toothed or differently lobed.

In general, the components of a **flower** from the outside to the centre (Figure 3) are the **calyx**, the **corolla**, the **stamens** (male organs) and the **pistil** (female organ). A number of, in most cases, green **sepals** form the calyx while variously-coloured leaves named **petals** form the corolla. The pistil consists of the ovary, the style and the stigma. However, there are many deviations from this basic pattern, and there is a great variation in size, number, arrangement, form, symmetry, colour, and degree of fusion of the various parts. Flowers may be solitary, such as in tulips, or they may be arranged in different **inflorescences**, such as spikes, panicles, umbels or catkins. A very special type of inflorescence, which is of interest in the medicinal context, is a **capitulum** (flower-head) (Figure 2). Here, many flowers sit on the flattened top of a stem and are surrounded by several, often scale-like, green leaves. The flowers are either all equally sized and in many cases small, or the outer ones differ from the inner ones by being larger and often differently coloured. In the latter case, the inflorescence may look like a single flower.

**Seeds** develop inside the ovary. They range from extremely light and small to large and heavy, they may have hairs or spines, and the surface may be smooth, ribbed or wrinkled. In addition, a vast diversity of **fruit** types are found, e.g. apples, blueberries, dandelions, dates or pumpkins.

The morphological characters outlined above can be found in all plant species belonging to the **flowering plants**, which represent the dominant group of plants. Most of the CITES-listed medicinal and aromatic plant species are flowering plants and within this group they are mainly found in the so-called

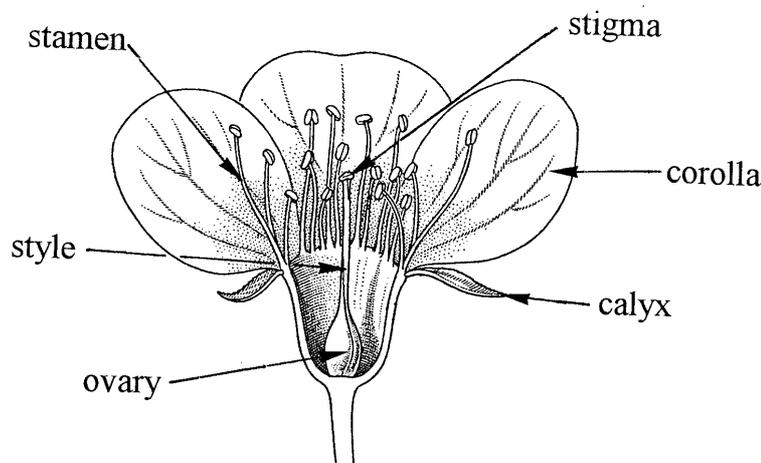
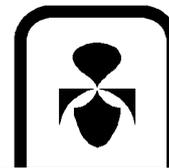


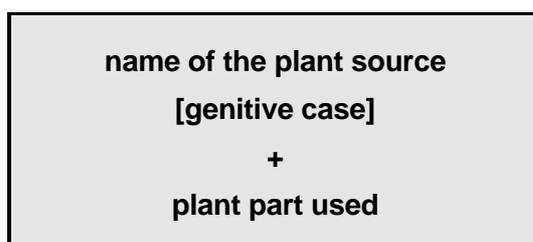
Figure 3: Structure of a simple flower. Ovary, style and stigma form the pistil.

**Angiosperms** which are characterized by often brightly coloured flowers. Only a few species of the other group, called **Gymnosperms** (conifers), are included in CITES. Conifers possess in many cases needle-like leaves and usually bear cones. Besides these some **ferns** are also represented in the CITES Appendices. The lack of coloured flowers and cones differentiate organisms of these last two groups from flowering plants. However, the morphological characters described above also apply to them in the case of roots, stems and leaves.

## Pharmaceutical names

A variety of trade names for botanical drugs are used internationally by traders, producers and in retail trade. In addition to country- or even region-specific vernacular names, scientific pharmaceutical names, often in Latin, are used to denominate botanical drugs. Similar to scientific names of plant species, the latter make identification and communication much easier than the use of common trade names. In contrast to the scientific name, the scientific pharmaceutical name does not only indicate the medicinal or aromatic plant from which a specific plant material is sourced (the plant source), but further allows the immediate recognition of the plant part used. A scientific pharmaceutical name consists of two or three words and is composed of the denominations of the plant part used and of the plant source. In contrast to a scientific plant name, the scientific pharmaceutical name is never set in italics but written in upright letters. The following explanations refer to the scientific pharmaceutical names.

**Basic formula:** the structure of a scientific pharmaceutical name may be illustrated by the following formula:

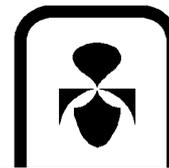


- According to the basic formula the **first part of a pharmaceutical name** identifies the **plant source**. It consists of either one or of two words. As for scientific names, the first word starts with a capital letter, the second one with a lower letter. But, in contrast to a scientific name, it is always written in plain upright letters and not in italics. This first part of a scientific pharmaceutical name may be derived from the scientific name or from a vernacular name of the plant source. In any case, the name is transferred to the genitive case (Table 1).

Table 1: Scientific plant names in their nominative and genitive cases. The endings of the different cases are printed in bold letters. The names are arranged according to different declension types.			
Nominative case	Genitive case	Nominative case	Genitive case
Ending in <b>-a</b> <i>Arnica</i> <i>Cynara</i>	<b>Arnicae</b> <b>Cynarae</b>	Ending in <b>-um</b> <i>Guaiacum</i> <i>Origanum</i>	Guaiaci Origani
Ending in <b>-is</b> <i>Digitalis</i> <i>Hydrastis</i>	<b>Digitalis</b> <b>Hydrastis</b>	Ending in <b>-on</b> <i>Rhododendron</i>	Rhododendri
Ending in <b>-is</b> <i>Hypoxis</i> <i>Berberis</i>	<b>Hypoxidis</b> <b>Berberidis</b>	Ending in <b>-ix</b> <i>Salix</i>	<b>Salicis</b>
Ending in <b>-o</b> <i>Plantago</i> <i>Senecio</i>	<b>Plantaginis</b> <b>Senecionis</b>	Others <i>Aloe</i> <i>Juglans</i> <i>Papaver</i>	Aloes Juglandis Papaveris

The **second part of a pharmaceutical name** identifies the **plant part** used. It consists mainly of only one word. The denomination of the plant part is given in Latin, is always used in the singular, and starts with a small letter (Table 2).

Table 2: Important parts of plant in use and their Latin and English denominations (singular and plural).			
Latin denomination	English denomination	Latin denomination	English denomination
bulbus, bulbi	bulb(s)	lichen	lichen(s)
calyx, calyces	calyx, calyces	lignum, ligna	wood(s)
caulis, caules	stem(s)	nux, nuces	nut(s)
cortex, cortices	bark(s)	radix, radices	root(s)
cortex radices, cortices radicum	rootbark(s)	resina, resinae	resin(s)
flos, flores	flower(s)	rhizoma, rhizomata	rhizome(s)
folium, folia	leaf, leaves	semen, semina	seed(s)
fructus, fructi	fruit(s)	stigma, stigmata	stigma(s)
gummi	gum(s)	stipes, stipites	stalk(s)
herba, herbae	herb(s)	tuber, tubera	tuber(s)



**Main variants:** Although the scientific pharmaceutical names are always equally structured, several variants can be distinguished on the derivation of the first part of the name (Table 3). It may be formed on the basis (1) of the **complete scientific name of the plant source**; (2) of a **synonym**, i.e. a scientific name of the plant source which is no longer scientifically accepted; (3) of a **part of the scientific name or of a synonym** of the plant source, or (4) of a **vernacular name**.

Table 3: Examples of scientific pharmaceutical names formed according to different principles.		
Botanical drug	Plant source	Derivation of the scientific pharmaceutical name from ...
Hydrastis canadensis rhizoma	<i>Hydrastis canadensis</i>	The complete accepted scientific name
Cardui mariae fructus	<i>Silybum marianum</i>	The complete formerly used scientific name <i>Carduus marianus</i>
Bellidis flos	<i>Bellis perennis</i>	The generic name of the accepted scientific name
Scillae bulbus	<i>Urginea maritima</i>	The generic name of the formerly used scientific name <i>Scilla maritima</i>
Kava-kava rhizoma	<i>Piper methysticum</i>	The Polynesian vernacular name Kava

**Pharmaceutical nomenclature in German-speaking countries:** An additional scientific pharmaceutical nomenclature exists in German-speaking countries. Similar to the nomenclature described above, pharmaceutical names are composed of two to three words, indicating also the plant parts used and the plant source. The main difference of both nomenclatures is the order of both parts. Here, the **first word** of the scientific pharmaceutical name identifies the **plant part used**. Furthermore, some of the plant parts are used in their plural form, such as flowers (Flores), leaves (Folia) or tubers (Tubera) (Table 4, words in bold). The denomination of the plant part is written with initial capital letters. The second part of the pharmaceutical name refers to the plant source which is formed as outlined in the previous paragraphs except that it also bears a capital letter.

Table 4: Examples for pharmaceutical names according to different pharmaceutical nomenclatures. The differences in the names of the plant parts used are printed in bold letters.			
Pharmaceutical names	Pharmaceutical names in German speaking countries	Pharmaceutical names	Pharmaceutical names in German speaking countries
Centaurii herba	Herba Centaurii	Hydrastis rhizoma	Rhizoma Hydrastis
Gentianae radix	Radix Gentianae	Liquiritiae radix	Radix Liquiritiae
Ginkgo <b>folium</b>	<b>Folia</b> Ginkgo	Myrtilli fructus	Fructus Myrtilli
Guaiaci lignum	Lignum Guaiaci	Salep <b>tuber</b>	<b>Tubera</b> Salep
Hibisci <b>flos</b>	<b>Flores</b> Hibisci	Scillae bulbus	Bulbus Scillae

**Additional information to the plant part used:** In some cases, the plant part in use is more exactly characterized using the terms **cum** (abbreviated c.) = **with** and **sine** (abbreviated s.) = **without**. In the case of the drug *Calendulae flos cum calyce* (abbreviated cal.), flowers and calyces of *Calendula officinalis* are contained in the drug. For instance in the case of *Herba Absinthii sine floribus* (abbreviated flor.), the herb parts of *Artemisia absinthium* (absinthe, wormwood) are used without the flowers.

**Homeopathic names of botanical drugs:** In homeopathy, drugs are named differently. A homeopathic name consists of one or two words which refer to the plant source only; it does not indicate the part of the plant used. Commonly, a homeopathic name is formed on the scientific name of the plant source. As for the scientific pharmaceutical nomenclature, it may be formed on the basis of the accepted scientific name or of a synonym, either using the complete scientific name or only part of it. Accordingly, the drug *Arnica* originates in *Arnica montana* and *Draba verna* is obtained from *Erophila verna*, formerly known as *Draba verna* (common whitlowgrass).

## Plant sources

Botanical drugs may be obtained (1) from **one plant source** only or (2) from **several plant sources**. This implies, that a pharmaceutical name may refer to one or to several plant species. These species do not necessarily belong to the same plant genus. The drug *Hydrastis canadensis rhizoma* originates from *Hydrastis canadensis* only; *Guaiaci lignum* may be obtained either from the wood of *Guaiaacum officinale* or from *Guaiaacum sanctum*; *Dendrobii herba* is collected from several *Dendrobium* species; and in the case of *Quassiae lignum*, the plant sources of this wood derivative are *Quassia amara* and *Picrasma excelsa*.

Cases of **adulteration** of botanical drugs may occur. In most cases, adulterations are similar-looking plant parts of other species. Either mixtures of or even pure alternative botanical drugs may be observed.

## Commodities of botanical drugs

Botanical drugs are traded in different forms depending on their use. They may be traded whole or after having been processed mechanically, for example cut, powdered, squeezed, rasped, rubbed or peeled. Table 5 lists common forms of processing and their abbreviations used in trade. Botanical drugs may also be processed into fruit pulps, pulped juices, aqueous extracts, alcoholic extracts (tinctures), essential oils, medicinal oils or extracts.

Regarding trade in botanical drugs, some general observations can be made:

- In international trade, botanical drugs are frequently traded in their whole form or, at the most, coarsely chopped. However, trade in cut commodities is increasing.
- The share of dried plant parts amounts to about 95% of trade. The remaining 5% are plant parts preserved in alcohol (mostly for use in homeopathy), or fresh plant material (for processing into either homeopathic remedies or phytopharmaceutical products).
- Botanical drugs used in traditional Chinese or East Asian medicine (TCM, TEAM) always consist of dried material.



Table 5: Processing forms of botanical drugs in trade. The most commonly used denominations are printed in bold.		
Abbreviation	Latin denomination	English denomination
conc.	concisus	cut
conc. gross.	concisus grossus	coarsely cut
cont.	contusus	shredded, broken
crud.	crudus	crude
dep.	depuratus	cleaned
elect.	electus	selected
germ.	germinatus	germinated
min. conc.	minutim concisus	fine cut
mund.	mundatus	peeled
nat.	naturalis	natural
pulv.	pulvis	moderately fine powder
pulv. gross.	pulvis grossus	coarse powder
pulv. subt.	pulvis subtilis	fine powder
rasp.	raspatus	rasped
rec.	recens, recenter	fresh
sicc.	siccatus	dried
tost.	tostus	roasted
tot.	totus	whole

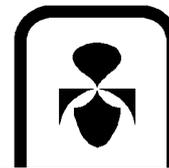
## CITES and medicinal and aromatic plants

About 21,000 plant species are subject to CITES controls. Only 17 of them have been explicitly included in one of the CITES Appendices due to their over-exploitation for the international trade in botanical drugs. Other medicinal and aromatic plant species entered Appendix II when whole families like orchids and cacti were included owing to their horticultural trade potential. In all, more than 240 medicinal and aromatic plant species have been identified in the CITES Appendices most of these being orchids (Schippmann 2001). However, few of them are traded internationally in large quantities. Table 6 lists medicinal and aromatic plants subject to CITES controls.

In general, live plants and whole, dead specimens are subject to CITES. In respect to plant species listed in Appendix I, the provisions apply also to any readily recognizable parts or derivatives thereof. For taxa included in Appendices II and III, annotations specify the parts and derivatives of the relevant species which are subject to the provisions.

Table 6: Medicinal and aromatic plants included explicitly in the CITES Appendices owing to their over-exploitation for the international trade in botanical drugs (marked with \*), or belonging to genera and families included in the Appendices as higher taxa listing (Schippmann 2001). The fifth column indicates the species describes in the data sheets CITES status as of 19.7.2000.

Family	Taxa (Family/genus/ species) included in CITES	Number of medicinal and aromatic plant species	CITES Appendix	Data sheets prepared
Amaryllidaceae	<i>Galanthus</i> spp.	2	II	-
	<i>Sternbergia</i> spp.	1	II	-
Apocynaceae	<i>Rauvolfia serpentina</i> *	1	II	<i>Rauvolfia serpentina</i>
Araliaceae	<i>Panax ginseng</i> *	1	II	-
	<i>Panax quinquefolius</i> *	1	II	<i>Panax quinquefolius</i>
Berberidaceae	<i>Podophyllum hexandrum</i> *	1	II	-
Cactaceae	Cactaceae spp.	10	II	-
Compositae	<i>Saussurea costus</i> *	1	I	<i>Saussurea costus</i>
Cyatheaceae	<i>Cyathea</i> spp.	1	II	-
Cycadaceae	Cycadaceae spp.	1	II	-
Dicksoniaceae	<i>Cibotium barometz</i>	1	II	<i>Cibotium barometz</i>
Dioscoreaceae	<i>Dioscorea deltoidea</i> *	1	II	-
Droseraceae	<i>Dionaea muscipula</i>	1	II	-
Euphorbiaceae	<i>Euphorbia</i> spp. (succulent species only)	8	II	-
Gnetaceae	<i>Gnetum montanum</i>	1	III	-
Leguminosae	<i>Pterocarpus santalinus</i> *	1	II	<i>Pterocarpus santalinus</i>
Liliaceae (Aloeaceae)	<i>Aloe</i> spp.	13	II	<i>Aloe ferox</i>
Nepenthaceae	<i>Nepenthes khasiana</i>	1	I	-
	<i>Nepenthes</i> spp.	1	II	-
Orchidaceae	Orchidaceae spp.	173	II	<i>Bletilla striata</i> <i>Dendrobium</i> spp. <i>Gastrodia elata</i> Orchidaceae spp. (Salep)
Orobanchaceae	<i>Cistanche deserticola</i> *	1	II	<i>Cistanche deserticola</i>
Podocarpaceae	<i>Podocarpus nereifolia</i>	1	III	-
Primulaceae	<i>Cyclamen</i> spp.	2	II	-
Ranunculaceae	<i>Adonis vernalis</i> *	1	II	<i>Adonis vernalis</i>
	<i>Hydrastis canadensis</i> *	1	II	<i>Hydrastis canadensis</i>
Rosaceae	<i>Prunus africana</i> *	1	II	<i>Prunus africana</i>
Sarraceniaceae	<i>Sarracenia</i> spp.	2	II	-
Scrophulariaceae	<i>Picrorhiza kurrooa</i> *	1	II	<i>Picrorhiza kurrooa</i>
Taxaceae	<i>Taxus wallichiana</i> *	1	II	<i>Taxus wallichiana</i>
Thymelaeaceae	<i>Aquilaria malaccensis</i> *	1	II	<i>Aquilaria malaccensis</i>
Valerianaceae	<i>Nardostachys grandiflora</i> *	1	II	<i>Nardostachys grandiflora</i>
Zygophyllaceae	<i>Guaiacum officinale</i> *	1	II	<i>Guaiacum officinale</i>
	<i>Guaiacum sanctum</i> *	1	II	<i>Guaiacum sanctum</i>
	<b>Total</b>	<b>236</b>		



## Abbreviations

CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora

hom. Homeopathy

TCM Traditional Chinese medicine

TEAM Traditional East Asian medicine

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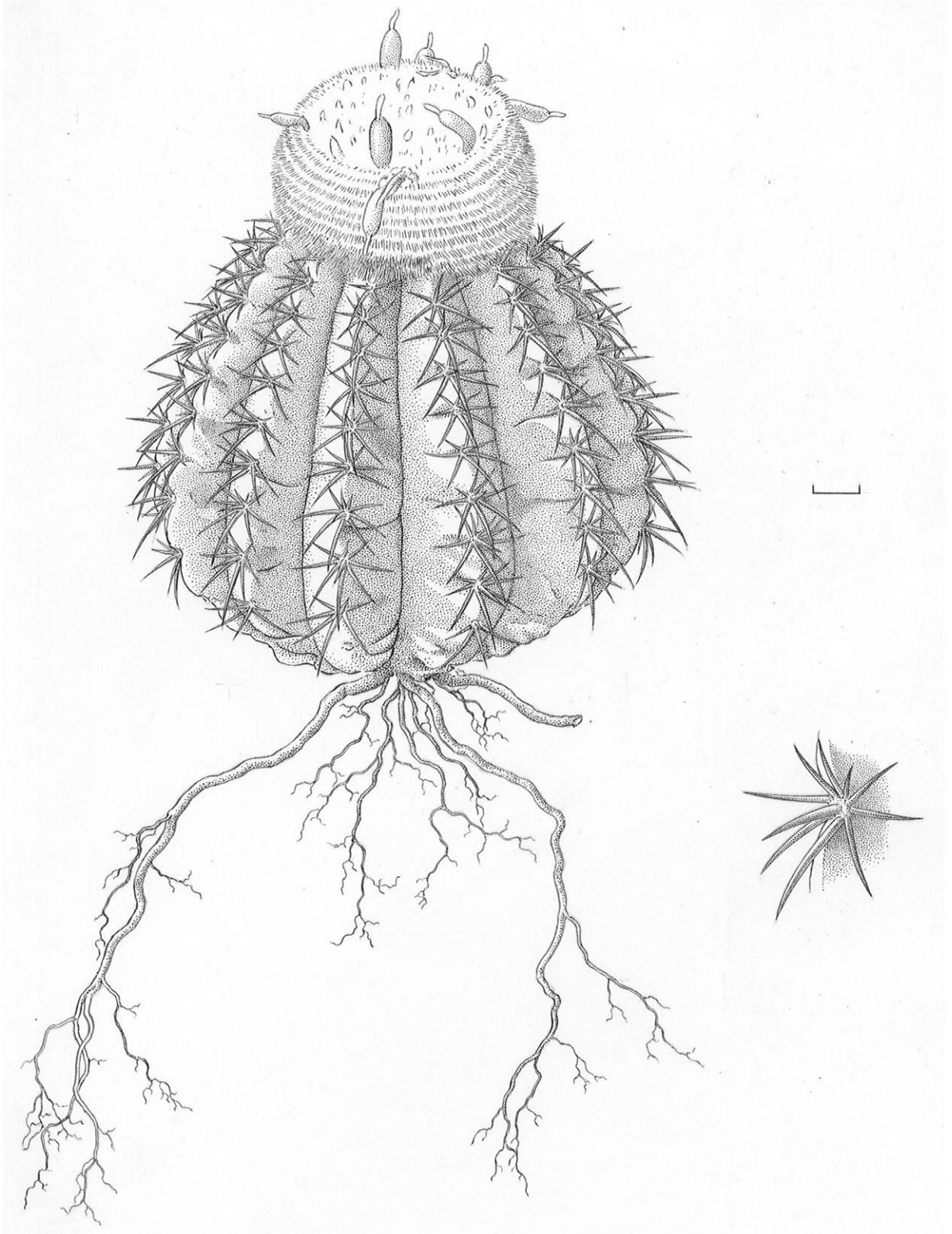
# Melocactus conoideus

Buining & Brederoo 1973

**Common names:** bras.: coroa de frade, cabeça de frade (coroa do diabo, roseta do diabo)

**Scientific synonyms:** None

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

- Characteristics:** Middle-sized, distinctly ribbed, depressed globose to slightly conical (hence the scientific name) cactus, broader than high above substrate, with rather short, but strong, protruding spines, not obscuring the stem. Adult specimens with a white, rather flat, semi-globose to short cylindrical, densely woolly and bristly cephalic zone on the stem apex.
- Roots:** Fibrous, long, ramified, from the centre of the stem base.
- Stem:** Strongly depressed-globose to hemispheric, up to 10 cm high, 17 cm Ø, embedded in quartz gravel.
- Ribs:** 11-14, vertical, very low and rounded, to 25 mm high, 40 mm broad.
- Areoles:** 6.5-7.5 mm long, 6.5 mm wide, ca. 15 mm apart on the ribs.
- Spines:** Strong, hard, dark brown overlaid with grey.
- Radial spines:** 8-11, straight to slightly recurved near tip, radiating and slightly protruding, lowest in the areole longest, 20-35 mm long, 1.5-1.7 mm Ø at base.
- Central spines:** 1, straight to slightly curved, porrect, 20-22 mm long, 1.5 mm Ø at base.
- Cephalium:** Up to 4 cm high, 7.5 cm Ø, with numerous dark reddish bristles and abundant white wool, aspect rather white.
- Flowers:** Appearing on top of the cephalium, in rings, pinkish-magenta, ca. 22 mm long, 10 mm Ø, immersed in the cephalic wool.
- Fruits:** Lilac-magenta, 18 mm long, 5-6 mm Ø.
- Seeds:** 1.05-1.25 mm long, 0.9-1.05 mm Ø.
- Juvenile plants:** Lacking a cephalium, spines sometimes strongly curved to hooked.

**Distribution:** State of Bahia, Brazil.



**Trade:** *M. conoideus* is still common, and well reproducing in habitat (Bohle 2000 in lit.). However, it is a local endemic, reported from a single mountain, Morro do Cruzeiro, Serra do Periperi, where its type locality is highly threatened by extraction of the quartz gravel, to which it is restricted (Bohle 2000, Machado 2000 in lit., Taylor 1991) and through commercial collection for the European horticultural market (Taylor 1991). Further localities in the same mountain range have recently been found, where the species occurs in larger numbers (Machado 1999 in lit.). 1984-1989, prior to App. I-listing, 706 specimens (7 shipments) were reportedly exported from Brazil to the USA, Germany and the Netherlands. Probably they were at least partly wild-collected. Recently part of the habitat has been included in a new natural reserve, but implementation is not yet effective (Machado 1999 in lit.). Generally, *Melocactus* spp. for their need of elevated temperatures in winter, are not as popular and well distributed in horticulture as other, more hardy cacti, the dwarf *M. matanzanus* and several bluish species being the most popular and most frequently found in trade. There are some collectors focusing on "cephalic" cacti or Brazilian cacti, who create a certain demand. *M. conoideus* is artificially propagated to some extent today. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001.

**Similar species:** The genus *Melocactus* is morphologically rather uniform. Obvious specific differences are encountered in stem size, shape and colour, number of ribs, spine number, size and colour and cephalium colour and maximum size. Identification is difficult for the non-expert, and in immature specimens, still lacking a cephalium, it is virtually impossible. *M. conoideus* most closely resembles *M. bahiensis* and, to a lesser extent, *M. oreas*, but differs from both in its more strongly depressed habit, with very low ribs (Taylor 1991).

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
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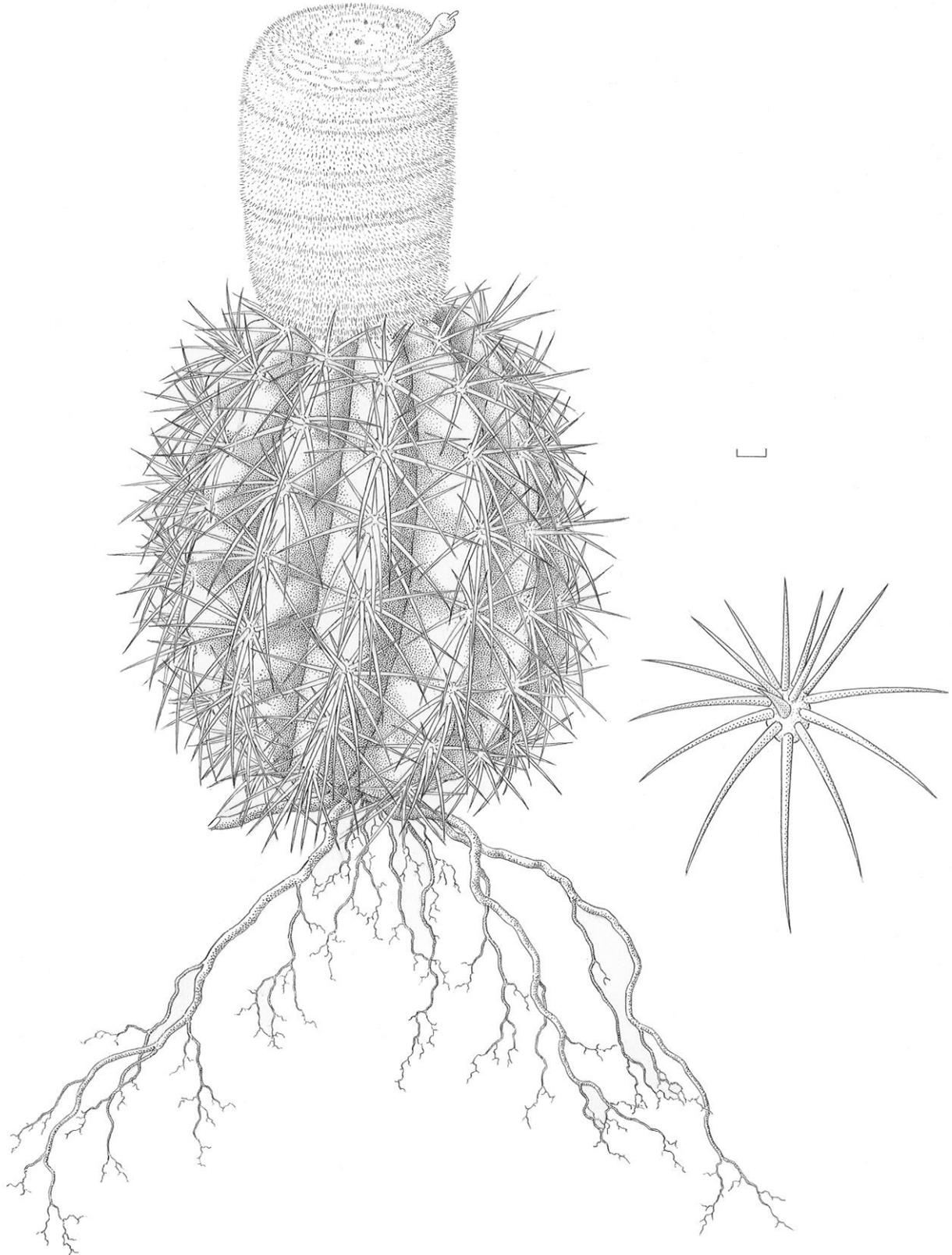
# Melocactus deinacanthus

Buining & Brederoo 1973

**Common names:** bras.: coroa de frade, cabeça de frade (coroa do diabo, roseta do diabo)

**Scientific synonyms:** none

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Excluded taxa:** *Melocactus deinacanthus* fa. *mulequensis* (Buining & Brederoo) P. J. Braun 1988  
= *Melocactus mulequensis* Buining & Brederoo 1976  
*Melocactus deinacanthus* ssp. *florschuetzianus* (Buining & Brederoo) P. J. Braun 1988  
= *Melocactus florschuetzianus* Buining & Brederoo 1975  
*Melocactus deinacanthus* ssp. *longicarpus* (Buining & Brederoo) P. J. Braun 1988  
= *Melocactus longicarpus* Buining & Brederoo 1975

**Characteristics:** Middle-sized to relatively big cactus, extremely heavily and very dark spined, with numerous, very long central and radial spines (hence the scientific name, which means: with giant spines), stem coarsely ribbed, barrel-shaped. Adult specimens with a rather dark, cylindrical, densely woolly and bristly cephalic zone on the stem apex, which can get quite elongated in old specimens.

Roots: Fibrous, long, ramified, from the centre of the stem base.  
Stem: Globose to elongate, often rather large, up to 35 cm high, 12-25 cm Ø.  
Ribs: 10-12, acute, vertical, to 4 cm high, 6 cm broad near stem base.  
Areoles: 15 mm long, 10 mm wide, to 33 mm apart on the ribs.  
Spines: 15-21, reddish-brown.  
    Radial spines: 11-14, extremely long and strong, lowest 8 cm long, 2.5 mm Ø, somewhat recurved.  
    Central spines: 4-7, shorter than the longest centrals, lower to 5.3 cm long, 3 mm Ø.  
Cephalium: Up to 25 cm high, 9 cm Ø, with exposed bristles at the apex, strongly obscured by numerous dark bristles, aspect rather dark.  
Flowers: Appearing on top of the cephalium, in rings, pinkish-magenta, to 26 mm long, 11 mm Ø, immersed in the cephalic wool.  
Fruits: Entirely white, shortly clavate, 12-22 mm long, 6-12 mm Ø.  
Seeds: 1.15-1.35 mm long, 1.05-1.25 mm broad.

**Distribution:** State of Bahia, Brazil.



**Trade:** Local endemic with a single known, very limited site (Mun. Riacho de Santana), restricted to exposed granite/gneiss outcrops. Population estimated at several hundred individuals only and rather decreasing between 1994-1998 (Bohle 2000 in lit.). The habitat is relatively safe, land use is restricted to grazing by goats due to the rocky nature of the habitat. 1984-1989, prior to App. I-listing, 68 specimens (5 shipments) were reportedly exported from Brazil to the USA, Germany and the Netherlands. Probably they were at least partly wild-collected. The species is classified as critically endangered (Taylor & Zappi 2001) because of its single roadside site. Generally *Melocactus* spp. for their need of elevated temperatures in winter, are not as popular and well distributed in horticulture as other, more hardy cacti, the dwarf *M. matanzanus* and several bluish species being the most popular and most frequently found in trade. There are some collectors focusing on "cephalic" cacti or Brazilian cacti, who create a certain demand. Today extremely little international trade in this species is reported, it is only in seeds. The species is not frequently found in cultivation and hardly available. Nurseries registered for artificial propagation: None.

**Similar species:** The genus *Melocactus* is morphologically rather uniform. Obvious specific differences are encountered in stem size, shape and colour, number of ribs, spine number, size and colour and cephalium colour and maximum size. Identification is difficult for the non-expert, and in immature specimens, still lacking a cephalium, it is virtually impossible. For the taxonomist, *M. deinacanthus* is readily distinguished from all members of the genus by the combination of shortly clavate, pure white fruits and uniquely shaped seeds. The spination with numerous central and radial spines is superficially similar to that of *M. ernestii* ssp. *longicarpus* (Taylor 1991). Mature specimens of *M. deinacanthus* are quite impressive and outstanding for their numerous and very long spines, the centrals being shorter than the longest radials.

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Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
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# Melocactus deinacanthus

Buining & Brederoo 1973

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Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.



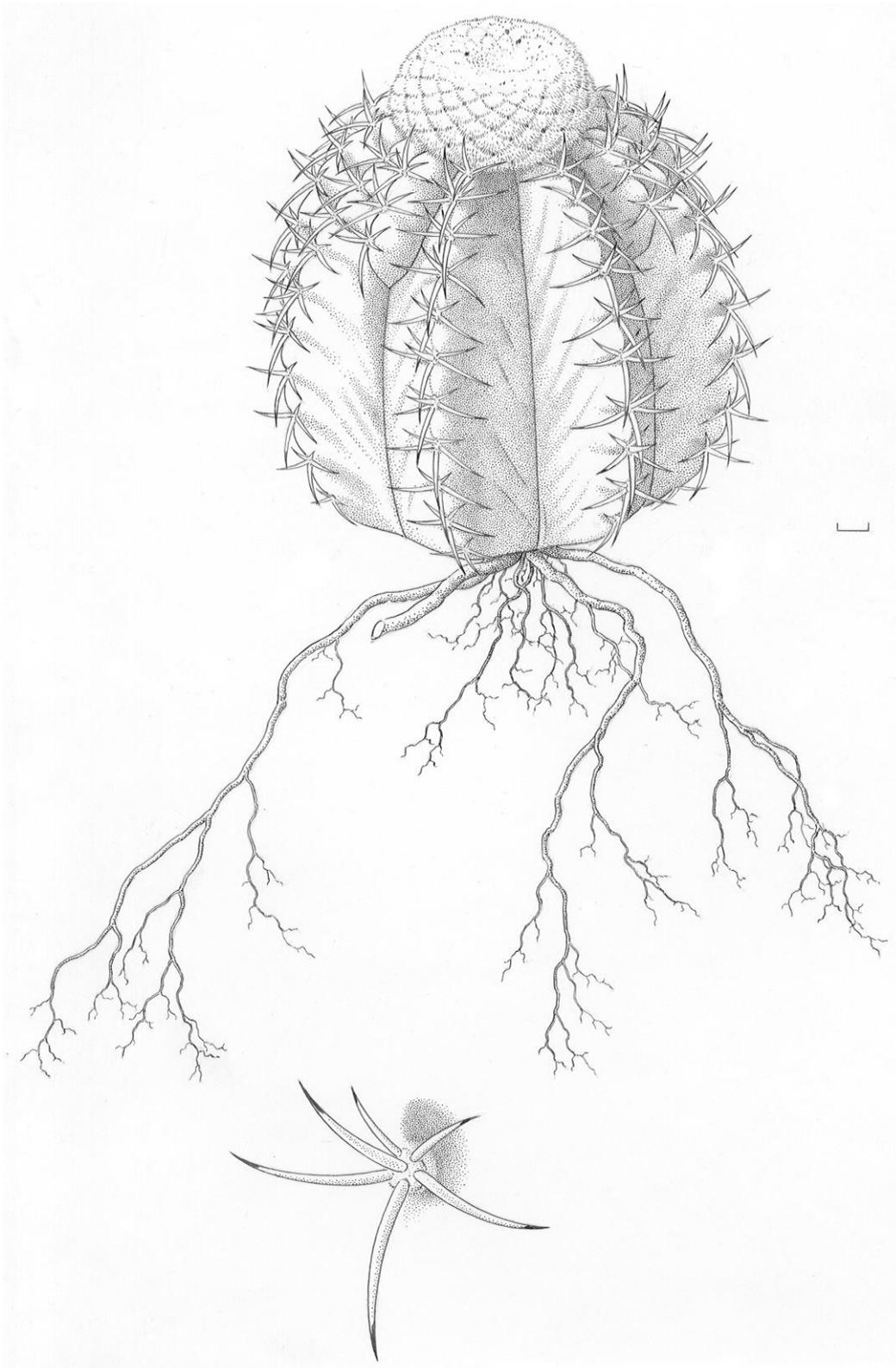
# Melocactus glaucescens

Buining & Brederoo 1972

**Common names:** bras.: coroa de frade, cabeça de frade (coroa do diabo, roseta do diabo)

**Scientific synonyms:** none

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Characteristics:** Middle-sized, distinctly bluish to greyish (hence the scientific name), globular, vertically ribbed cactus with rather few and short but strong spines, not obscuring the stem. Adult specimens with a striking white, rather flat, semi-globose to cylindrical, densely woolly cephalic zone (with hidden bristles) on the stem apex.

**Roots:** Fibrous, long, ramified, from the centre of the stem base.

**Stem:** Depressed-globose to pyramidal, intensely light blue-glaucous at first, grey-green in age, 13-18 cm high, 14-24 cm Ø, highly mucilaginous.

**Ribs:** 8-15, vertical, to 4 cm high, 6 cm broad near stem base.

**Areoles:** Up to 8 mm long, 5 mm wide, 10-20 mm apart on the ribs.

**Spines:** 6-10, brown, thickly overlaid with grey, dark brown to black at tip.

**Radial spines:** 5-8, not or scarcely overlapping with those from areoles on adjacent ribs, nearly straight to somewhat recurved, lower 3 11-25 mm long, 1-1.8 mm Ø.

**Central spines:** (0-) 1-2, lower 11-20 mm long, 0.8-1.7 mm Ø, ascending and upcurved.

**Cephalium:** Striking white, up to 10 cm high, 6-7.5 cm Ø, bristles hidden beneath dense wool.

**Flowers:** Lilac-magenta, ca. 25 mm long, 15.5 mm Ø.

**Fruits:** Entirely deep red, 9.5-16 mm long, 5-7 mm Ø, terete or somewhat flattened.

**Seeds:** 1.1-1.35 mm x 0.9-1.15 mm.

**Distribution:** State of Bahia, Brazil.



**Trade:** Extremely restricted in distribution, known from only a few localities west of the city of Morro de Chapéu (2 according to Taylor 1991 or more acc. to Machado 1999 in lit. and Braun 2001 in lit.) with a low number of individuals (Machado 1999 in lit.). The habitats are not likely to suffer much modification and collecting is the main potential threat (Machado 1999 in lit.). 1984-1989, prior to App. I-listing, 57 specimens (3 shipments) were reportedly exported from Brazil to Germany and the Netherlands. Probably they were at least partly wild-collected. Taylor & Zappi (2001) classify the species as critically endangered in view of its rarity and potential threats from commercial collecting. A local reserve to protect this and other rare species has been proposed (Machado 2000 in lit., Taylor & Zappi 2001). Generally *Melocactus* spp. for their need of elevated temperatures in winter are not as popular and well distributed in horticulture as other more hardy cacti, the dwarf *M. matanzanus* and several bluish species being the most popular and most frequently found in trade. There are some collectors focusing on “cephalic” cacti or Brazilian cacti, who create a certain demand. Today, rather little international trade in artificially propagated plants and some trade in seeds of this species is reported, it is not generally available. Nurseries registered for artificial propagation: Germany P-DE-1001.

**Similar species:** The genus *Melocactus* is morphologically rather uniform. Obvious specific differences are encountered in stem size, shape and colour, number of ribs, spine number, size and colour and cephalium colour and maximum size. Identification is difficult for the non-expert, and in immature specimens, still lacking a cephalium, it is virtually impossible. *M. glaucescens* is reported to hybridize in nature with *M. concinnus*, with which it is specifically compared for its glaucous to grey-green, depressed-globose stem and with *M. ernestii* (= x *M. albicephalus* Buining & Brederoo). The striking white-woolly cephalium, lilac-magenta flowers and small, deep red fruits set it apart from other species of the *M. violaceus* Group, to which it belongs (Taylor 1991).

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
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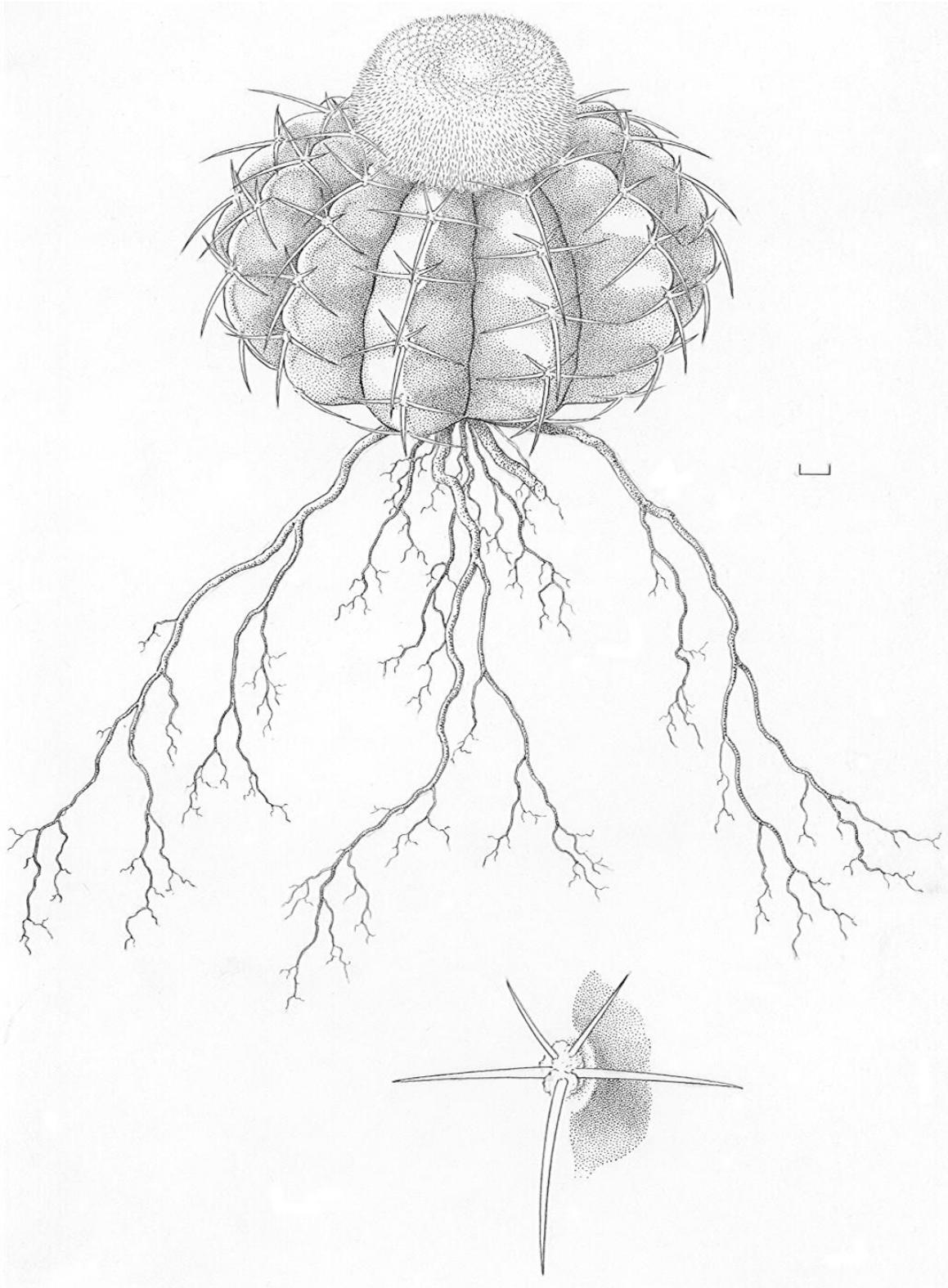
# Melocactus paucispinus

G. Heimen & R. Paul 1983

**Common names:** bras.: coroa de frade, cabeça de frade (coroa do diabo, roseta do diabo)

**Scientific synonyms:** none

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Characteristics:** Middle-sized, distinctly ribbed, strongly depressed-globose, few-spined (hence the scientific name) cactus, notably broader than high above substrate, with rather short, but strong spines, not obscuring the stem. Adult specimens with a white, rather flat, semi-globose to short cylindrical, densely woolly and bristly cephalic zone on the stem apex.

**Roots:** Fibrous, long, ramified, from the centre of the stem base.

**Stem:** Hemispheric or disc-shaped, usually partly buried in the sand, light grey-green, never glaucous even when young, 7-11.5 cm high, 15-19 cm Ø, highly mucilaginous.

**Ribs:** 9-10, up to 2.5-4 cm high, 3.7-5 cm broad near stem base.

**Areoles:** Ca. 3.5-7 mm long, 2.5-5.5 mm wide, to 25 mm apart on the ribs.

**Spines:** Strong, hard, pale grey with dark brown tips.

**Radial spines:** 4-6, recurved, lowest largest, 2-3.2 cm long, 1.2-2 mm Ø, uppermost 1-3 much smaller, to 1 cm long, 1 mm Ø.

**Central spines:** none

**Cephalium:** Up to 3-6 cm high, 7-8 cm Ø, composed of dense, fine, pinkish-red bristles and creamy-white wool.

**Flowers:** Deep pink, about 25 mm long, 14 mm Ø.

**Fruits:** Pale lilac-pink, 14-19 mm long, 5.5-7.5 mm Ø.

**Seeds:** 1.3-1.6 mm x 1.2-1.5 mm.

**Distribution:** States of Bahia and (N) Minas Gerais, Brazil.



**Trade:** Known from a few sites, apart of the type locality: Pico das Almas 120 km north of it (Taylor 1991), and Morro do Chapeu 140 km north of it (Machado 2000 in lit., Bohle 2000 in lit.). Further reported from northern Minas Gerais, without detailed information (Braun 2001 in lit.). The plants are widely scattered in their habitats (Bohle 2000, loc. cit.), the populations small, possible habitat modification being the main threat (Machado 2000 in lit.). Taylor & Zappi (2001) report five known localities, not including the one from Morro do Chapeu, two of them holding less than 50 individuals. Habitat modification is the main potential threat, although habitats are not suitable for agriculture other than for goat grazing; some sites are within the Pico das Almas Park and thus protected. No systematic collecting has been observed (Machado 1999 in lit.). 1984-1989, prior to App. I-listing, only 2 wild-collected specimens were reportedly exported from Brazil to England for scientific purposes. But the species has been observed amongst wild-collected cacti confiscated by Dutch Customs, giving evidence for illegal trade (supporting statement for App. I-listing, 1992). Taylor & Zappi (2001) classify the species as endangered in view of a restricted distribution, rarity and desirability to collectors. Generally *Melocactus* spp. for their need of elevated temperatures in winter, are not as popular and well distributed in horticulture as other, more hardy cacti, the dwarf *M. matanzanus* and several bluish species being the most popular and most frequently found in trade. There are some collectors focusing on "cephalic" cacti or Brazilian cacti, who create a certain demand. Extremely little international trade in *M. paucispinus* has ever been reported, virtually no contemporary trade is reported, the species is largely absent from horticulture. Nurseries registered for artificial propagation: None.

**Similar species:** The depressed, partially buried, cephalium-bearing and ribbed stem is strongly reminiscent of *Discocactus pseudoinsignis* and *D. placentiformis*. These species however have distinctively fewer and longer bristles in their cephalium. Juvenile plants of *M. paucispinus* are readily confounded with *Discocactus* spp. (Taylor 1991). Within the genus *Melocactus*, *M. paucispinus* seems most similar to *M. macrodiscus* and other, similar forms with hemispheric, non-glaucous stems and lacking central spines, which are all included in *M. zehntneri*. Further, *M. violaceus* ssp. *ritteri* in some respects looks like a dwarf version of *M. paucispinus* (Taylor 1991).

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Lüthy, J. M. (2001): Review of the CITES Appendices on behalf of the Plants Committee: Appendix I-Cactaceae. Final Report (44 pp.).  
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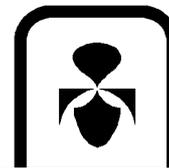
# Melocactus paucispinus

G. Heimen & R. Paul 1983

9: 1-80.  
Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

# Nardostachys grandiflora

DC.



**Family** Valerianaceae

**Synonyms** *Nardostachys jatamansi* (D.Don) DC.  
*Nardostachys chinensis* Batalin  
*Nardostachys gracilis* Kitamura  
*Fedia grandiflora* Wall.  
*Patrinia jatamansi* D.Don

**Vernacular names:**

english:	Himalayan spikenard, Indian nard, Indian spikenard, Indian valerian, true spikenard
french:	Nard india, spicanard, valériane d'Inde
spanish:	Espica-nardo
german:	Indische Narde, Nardenähre
hindi/sanskrit:	Jatamansi
italian:	Nardo indiano, spigo nardo

**Geographical range:** Himalayas; in the west from Uttar Pradesh in northwest India eastwards through Nepal, Bhutan to the northeast of Myanmar and to China in the provinces Yunnan, Sichuan and Kansu as well as northwards into Tibet.

**Distribution by country:** Bhutan, China, India, Myanmar, Nepal.

**Protection:** CITES Appendix II (#3), since 18.09.1997.

**Use:** Medicinal and aromatic plant (also used in TEAM).

## Botanical drugs in trade

**Plant parts used:** Rootstock.

**Pharmaceutical names**

latin:	Nardostachys jatamansi rhizoma, Rhizoma Nardostachyos, Nardostachys jatamansi radix, Radix Nardostachys, Radix Nardostachyos, Jatamansi, Nardostachys, Nardus indica, Spica nardi
english:	Jatamansi root, Indian nard, nardostachys rhizome, nardus root, spikenard, musk root
french:	Nard indien, spicanard
spanish:	Espica-nardo, nardo indico
chinese:	Gan Song (Gansong)
german:	Jatamansiwurzel, Nardenwurzel, Nardostachys-jatamansi-Rhizom
hindi/sanskrit	Jatamansi
italian	Rizoma di nardo indiano, rizoma di spigo nardo

**Countries of export:** Nepal, India, China.

**Source:** Mainly wild collection; in addition cultivation in range of national distribution.

**Commodities in trade:** Dried, mainly whole rootstocks and roots (crude drug); in addition the powdered rootstock and the essential oil (powder and oil are not subject to CITES).

**Characteristics:**

**Crude drug:** (Fig. 1-3) Rootstocks oblong, branched or unbranched, straight or slightly bent, 1-15 cm long, about as thick as a finger, ca. 0.5-2 cm in diameter, covered with a dense layer of fine, dark grey to grey-brown, ± reticulately interwoven fibres, derived from the dead, felt-like leaf remains (fibres may be lacking in drugs of chinese origin); rootstock at the tip sometimes with leaf remains; inside reddish brown; rootstocks mainly whole or only little broken, but fibres partly fallen off, forming a dense sediment in the commodity;

**Odour:** Aromatic;

**Taste:** Bitter;

**Essential oil:** Traded as Spikenard oil (French: Essence de nard; German: Spikenardenöl or Nardenöl);

**Similar drugs/  
adulterations:**

Owing to the similarity of the plant names, adulterations with *Valeriana jatamansi* Jones (Syn. *V. wallichii* DC.) can be observed. This species is growing in the Himalayas and supplies the drug *Valerianae indicae* rhizoma. This drug is made up of yellow- to dark-brown, globose to slightly flattened, tuber-like, 4-8 cm long and 5-12 mm thick rootstock pieces, partly jointed by short, thick stoloniform parts; surface very rough, wrinkled and strongly nodose due to many prominent root and stem scars, on the lower surface with a few roots attached; never covered with a layer of fine, brown fibres.

**References:** Mulliken, T.A. (2000): Implementing CITES for Himalayan medicinal plants *Nardostachys grandiflora* and *Picrorhiza kurrooa*. – TRAFFIC Bulletin 18(2): 63-72; Cambridge.

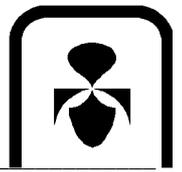


Figure 1. Crude drug, *Nardostachys jatamansi* radix; species: *Nardostachys grandiflora*, (copyright BfN).



Figure 2. Crude drug, *Nardostachys rhizoma*; species: *Nardostachys grandiflora*, (copyright BfN).



Figure 3. Crude drug, *Nardostachys rhizoma*; species: *Nardostachys grandiflora*, (copyright BfN).

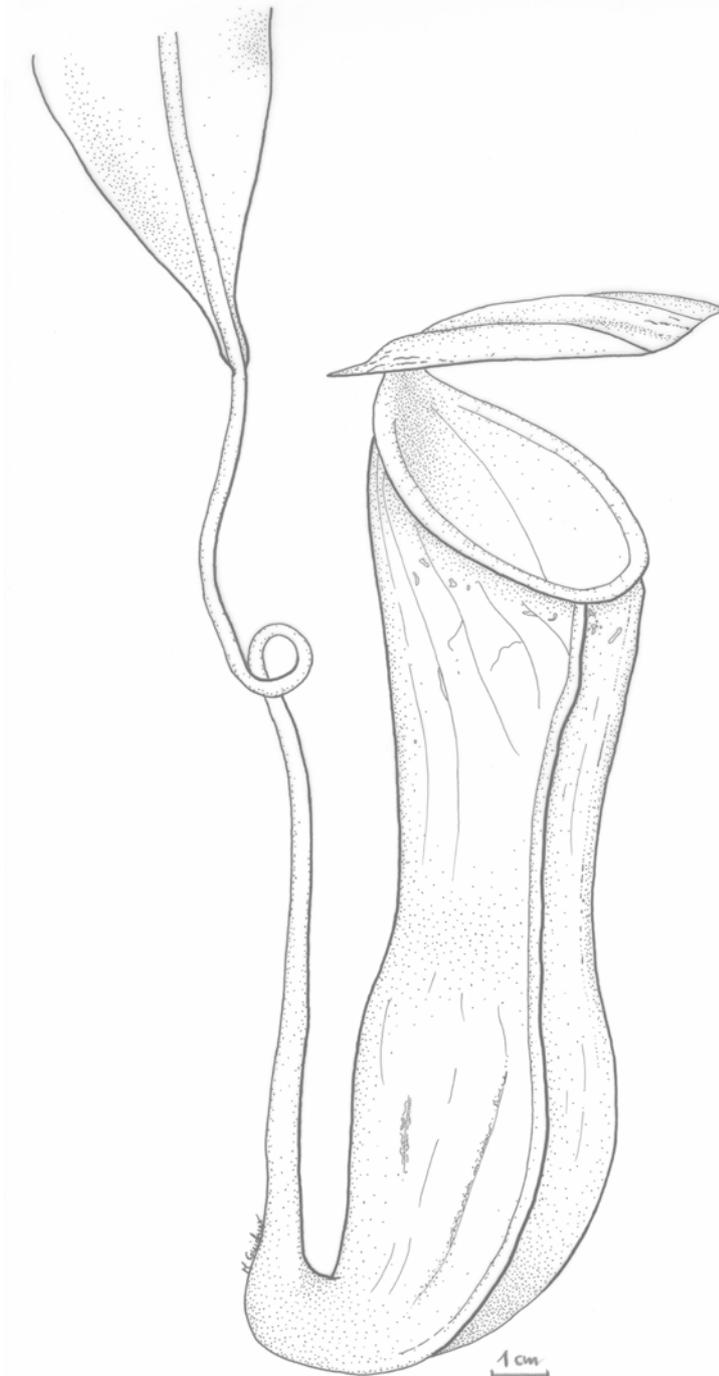
# Nepenthes kashiana

Hook f.



**Common names:** engl.: -  
esp.: -  
fr.: -

**Scientific synonyms:** None



**Characteristics:** See intraspecific variation and sheet on genus *Nepenthes*.

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**Distribution:**

India: Assam, southern Meghalaya (Mt Khasi, Mt Garo, Mt Jaintia). Endemic and the only plant of the *Nepenthes* genus in India.



**Habitat:**

Mixture of light forests and clearings, sometimes in marshes, between 500-2000 metres. A helophyte, it is rarely found in shaded environments. It can grow as a vine up to 8 metres long in an environment with trees and shrubs, but can also remain as a shrub on the ground where it is often burned by fires. It regenerates from roots.

This is the species that lives in the coolest climate.

**Threats:**

Deforestation, transformation of habitat and pasturing.

**Protection:**

There are two "sanctuaries" for *N. kashiana* (Mt. Jaintia and Mt. Garo) where it is, nonetheless, threatened.

**Intraspecific variation:**

See also the sheet on *Nepenthes rajah*.

This species is characterized by:

Traps: 15-20 x 4-7 cm, sub-cylindrical, smooth, yellow-green.

Operculum: sub-orbiculate, scattered with glands, slightly undulated along the edge, greenish-brown.

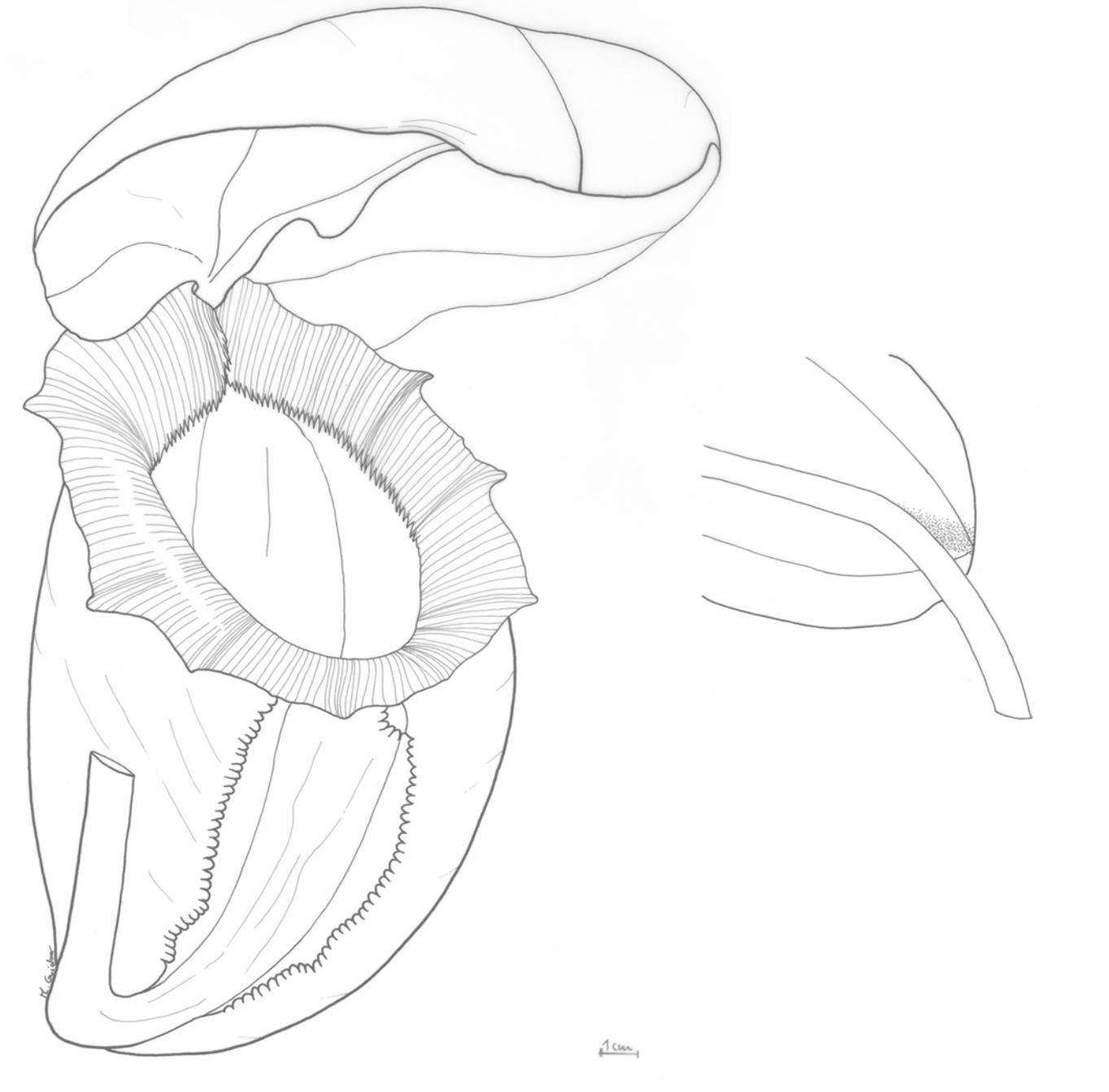
# Nepenthes rajah

Hook f.



**Common names:**      engl.: -  
                              esp.: -  
                              fr.: -

**Scientific synonyms:**      None



**Characteristics:**      See intraspecific variation and sheet on genus *Nepenthes*.

---

**Distribution:** Malaysia; Sarawak (only Mt. Kinabalu).



**Habitat:** Humid forests, higher altitudes between 1650 and 2650 metres, at sunny and moist sites (marshes and waterfalls).

**Threats:** Destruction of habitat, illegal collection.

**Protection:** All populations found inside the Mt. Kinabalu National Park are protected except when duly authorized by the government.

**Intraspecific variation:** See also the sheet on *Nepenthes kashiana*.

This species is characterized by:

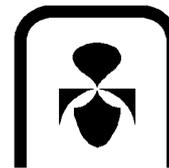
The large size of the trap (15-35 cm long and 10-18 cm wide) with a highly rounded cover, always larger than the trap's opening.

*N. merilliana* (the Philippines, Celebes, tropical, low-lying regions) also develops large traps.

The tip of the peltate leaf. The central vein separates from the leaf about 2-4 centimetres before the apex or  $\frac{3}{4}$  of the distance from the extremity of the leaf under the limb.

This characteristic is also found in *N. clipeata* (Borneo, but not Kinabalu, higher altitudes) and to a lesser extent in *N. carunculata* (Sumatra, higher regions), especially *N. carunculata* var. *robusta*, and some closely related species (*N. fusca*, *N. maxima*, *N. ovata*). But in these species, this characteristic is far less clearly developed as in *N. clipeata* and *N. rajah*.

This is also found in hybrids derived from *N. rajah* (*N. x kinabaluensis*; *N. rajah x N. villosa*).

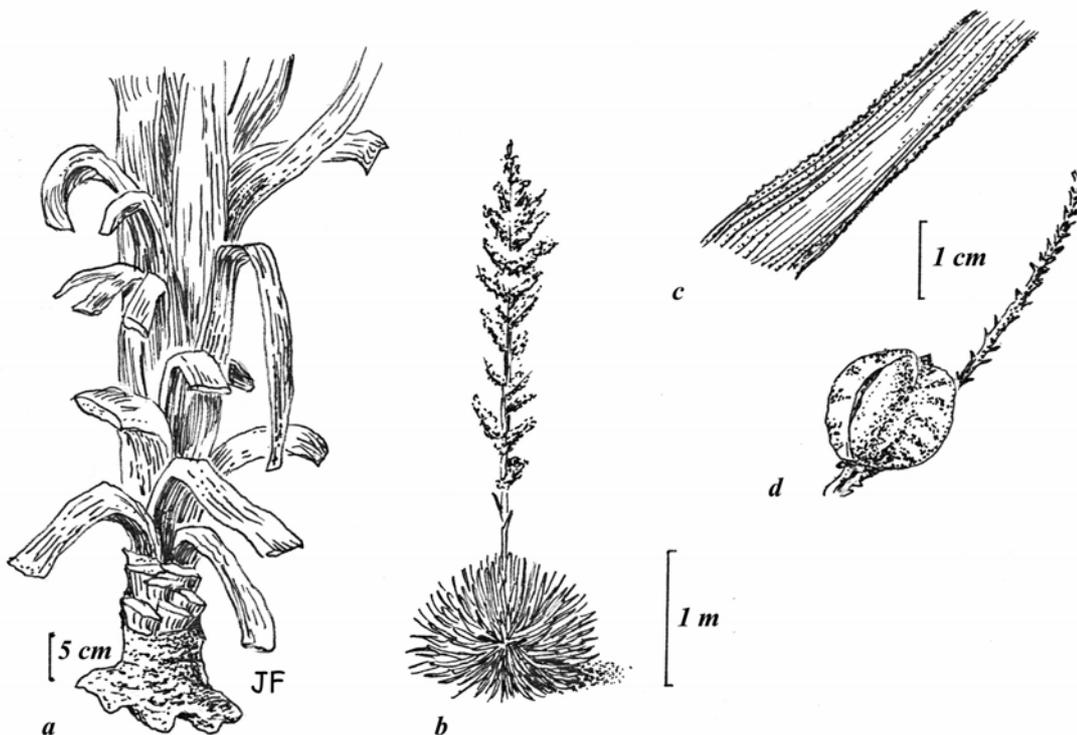


# Nolina interrata

Gentry

**Common name:** engl.: Dehesa bear-grass.  
 esp.:  
 fr.:

**Scientific synonyms:** None



**Illustration:** a. *Nolina interrata* base of rosette showing old persistent leaf bases and reticulate bark.  
 b. habit of plant.  
 c. section. of leaf  
 d. fruit

## Characteristics:

**Vegetative:** Subterranean caudiciform swollen root and aerial rosettes bearing flower stalks, the bark coarsely reticulated into pyramidal pentagons, 1 cm or more broad and about 5 mm thick. Rosettes sub-sessile, 10 to 45 leaved, the bases of desiccated leaves persisting as brownish vestiges with recurved ends. Leaves glaucous, 70-90 cm long, 8-15 mm wide, wider toward base and with tapering to slender, non-filiferous tips, margins minutely serrate.

**Inflorescence:** Stalks 0.5-1.6 m tall, axis 5-16 mm in diameter at base. Bracts inconspicuous but persistent, flowers whitish. Fruits large, broader than long, 12-15 cm wide, seeds yellowish or reddish brown, wrinkled, 5 mm x 4mm.

**Similar species:** *Nolina parryi* S. Watson, which has more leaves per rosette (45-200), inflorescence 1.6-4 m tall, with larger papery bracts.

**Distribution:** Interior foothills of San Diego County, California, USA and north western Baja California, Mexico in chaparral plant communities.



**Threats:** Urbanization and potential for illegal collection for nursery trade.

**References:** Dice, J.C. 1993, in The Jepson Manual: Higher Plants of California, Ed. J.C. Hickman, Berkeley and Los Angeles Univ. of California Press.

Gentry, H.S., 1946, A new *Nolina* from Southern California, Madrono, 8: 179-184.

US Fish & Wildlife Service, International Affairs, Internet web site.



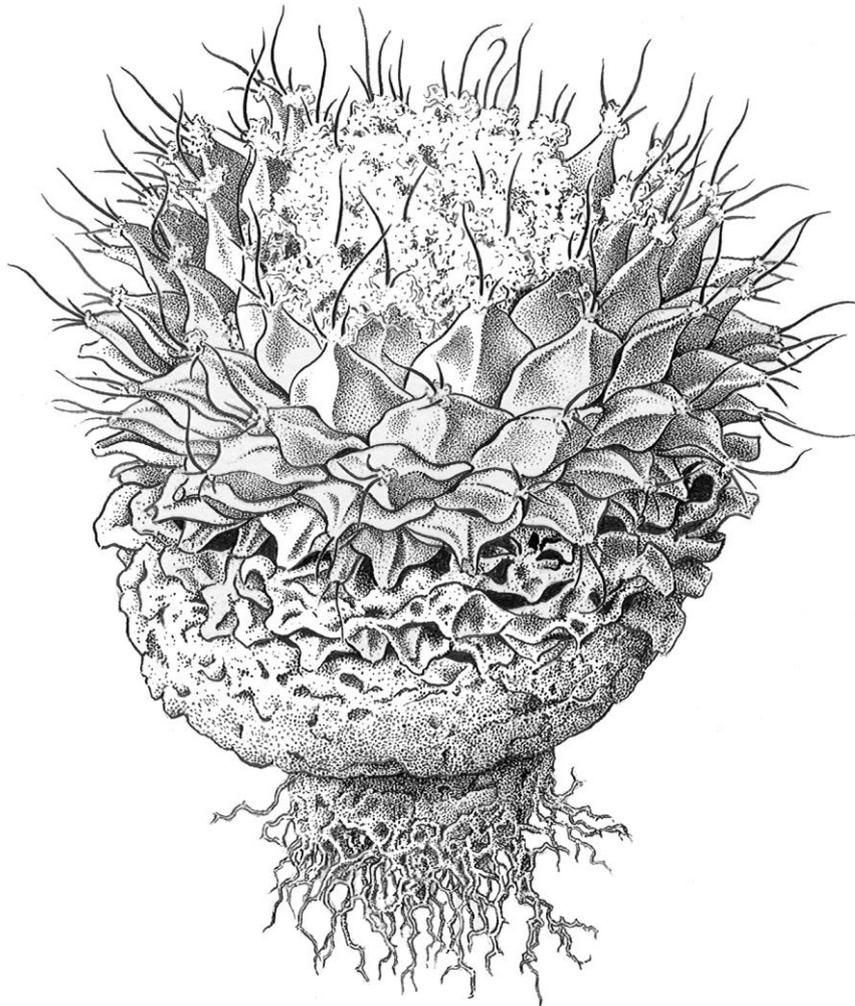
# Obregonia denegrii

Frič 1925

**Common names:** engl.: Artichoke cactus, peyote  
esp.: Peyote

**Scientific synonyms:** = *Ariocarpus denegrii* (Frič) W. T. Marshall 1946  
= *Strombocactus denegrii* (Frič) Rowley 1974

**CITES category:** Appendix II since 01.07.1975, Appendix I since 06.06.1981 (Prop. USA).



**Characteristics:** Medium sized, usually olive green cactus with rosette-like appearance. Sharp edged, scale-like, ascending tubercles, arranged geometrically in spirals (hence the vernacular name “artichoke cactus”). Hard consistence. Napiform taproot (often cut in wild-collected specimens and replaced by smaller secondary roots, as illustrated here).

**Roots:** Branched taproot from deep-seated, subterranean stem-base.

**Stem:** Solitary, depressed-globose to nearly flattened in habitat, up to 20 cm Ø, but usually much smaller, ca. 6-10 cm Ø, greyish green to dark brownish green, often bronzed in intense sunlight (olive green in cultivation). Apex with abundant white wool in cultivated specimens, almost naked

- 
- in habitat.
- Tubercles:** Broadly triangular, S-shaped in longitudinal section (ascending/appressed with tip curved outwards), 5-15 mm long, 7-15 mm wide at base, distinctly keeled on the lower/outer (abaxial) side, less on the upper (adaxial) side, with sharp lateral edges, base  $\pm$  prismatic, with an apical areole. Tubercles drying and withering at the base of the stem.
- Areoles:** At tip of tubercle, small, with deciduous white wool and deciduous spines (wool and spines much more persistent in cultivated specimens).
- Spines:** 3-4, only on the youngest tubercles, soon shed (in habitat), 5-15 mm long, irregularly twisted and curved, somewhat flexible, whitish tinged brown to dark grey.
- Flowers:** From the centre of the stem apex, white, rather small, 2-2.5 cm long, 1-2.5 cm  $\varnothing$ .
- Fruits:** Naked, claviform, fleshy, white, 1-2 cm long, drying at maturity and generally disintegrating within the apical wool.
- Seeds:** Pyriform, 1-1.4 mm long, with black, tuberculate seed coat.

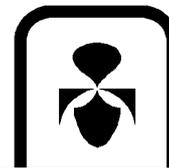
**Distribution:** State of Tamaulipas, Mexico



**Trade:** Local endemic of the valley of Jaumave, Tamaulipas, classified as safe (Anderson & al. 1994). The rocky habitats are not suitable for agriculture and thus relatively safe. There is great demand for this popular species, which grows well but extremely slowly from seed. Large plants in nurseries and collections may be wild collected. However, they may be pre Convention specimens. Thousands of wild collected specimens have been exported from Mexico to the USA prior to App. I-listing (U. S. Fish and Wildlife Service 1981). USA recorded importation from Mexico of 3'515 specimens in 1980 and 1'206 specimens in 1981. Such commercial large-scale exploitation has stopped. Recently, artificially propagated plants in flowering size (ca. 4 cm  $\varnothing$ ) are observed in international trade. Propagation from seeds is relatively easy. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Czech Republic P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Might possibly be confounded with *Ariocarpus retusus*, from which it differs most noticeably by the presence of spines and the size of the tubercles. Old specimens of *Turbinicarpus alonsoi* are looking quite similar, but have no sharp keels or edges on the tubercles, which are distinctively dull greyish, rather straight than S-shaped in longitudinal section and rather spreading than ascending, forming a more open, much smaller rosette.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): Las Cactáceas de México, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
Glass, C. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.



# Orchidaceae spp. (Salep)

**Family:** Orchidaceae

**Preliminary remarks:** Besides its main plant source *Orchis morio* L., a wide range of tuberous, terrestrial orchids of Europe and Asia can be sources of salep (see table 9). Today, salep is mainly produced in southeast Europe and the Near East. In Turkey a minimum of 38 orchid species have been identified which are utilized for salep production and another 78 species which could be potentially used. A species specific identification of the tubers in trade is difficult and not necessary since all orchid species are covered by CITES. The following details refer to the salep commodity in general.

## List of the main Salep producing orchid species and genera

Scientific name	English	French	Spanish	German	Italian
<i>Aceras anthropophorum</i>	Man orchid	(Acéras) homme-pendu	Flor del hombre ahorcado	Ohnsporn Puppenorchis	Ballerino
<i>Anacamptis pyramidalis</i>	Pyramidal orchid	Orchis	Orquídea piramidál	Pyramiden-Orchis	Giglione, cipressino, cipolla cipressina, castagnola
<i>Barlia robertiana</i>	Giant orchid	Orchis géant	Orquídea gigante	Mastorchis, Roberts Knabenkraut	–
<i>Dactylorhiza</i> spp.	(Marsh) orchid	Orchis (palmé)	Orchis, orquis	Knabenkraut	Orchidea
<i>Himantoglossum</i> spp.	Lizard flower, lizard orchid	Loroglosse, orchis bouc	–	Riemenzunge	Barbone, sati rione, salep, salop, testicolo di volpe, testicolo di cane, fior cappuccio, piccanaso
<i>Neotinea maculata</i>	Dense-flowered orchid	Habénaria à fleurs denses, néotinéa tachetée	–	Gefleckte Waldwurz, Keuschorchis	–
<i>Orchis</i> spp.	Cuckoo-flower, orchid, orchis	Orchis	Orchis, orquis	Knabenkraut	Giglione, giglio basilico, militare etc., orchidea
<i>Ophrys</i> spp.	(Bee/Spider) orchid, ophrys	Ophrys	Ofris, orquídea	Ragwurz	Fior-ragno, fior mosca, fior bombo, fior d'ape, vesparia
<i>Platanthera bifolia</i>	(Lesser) butterfly orchid	Orchis à deux feuilles, orchis blanc, double- feuille, platanthère à deux feuilles	Dobla fuèlha	Zweiblättrige, Kuckucksblume/ Waldhyazinthe	Bisorchis, cipolla da due foglie, foglie d'uovo, platantera comune
<i>Serapias</i> spp.	Tongue orchid, serapias	Helléborine, serápias	Gallos	Zungenstendel	Satirio, limodoro, galletto giano, unghie di gatto

**Geographical range:** Salep producing orchids are distributed in Europe, North Africa and in temperate Asia; the distribution centre is in the Mediterranean region and in the Middle East.

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**Protection:** CITES Appendix II (#7), since 01.07.1975.  
All species of the family Orchidaceae are subject to CITES.

**Use:** Medicinal and aromatic plant, horticultural plant, food.

## Botanical drugs in trade

**Plant parts used:** Root tubers.

**Pharmaceutical names:**

latin:	Salep tuber, Tubera (Tuber) Salep, Radix palmae Christi, Radix Salep, Salep
english:	Salep, salep bulbs, salep rhizome, salep root
french:	Salep, tubercules de salep
spanish:	Orquídea silvestre, satirion, testículo de perro
arabian:	Sahleb
german:	Johannishände, Knabenkrautknollen, Orchis-Arten-Knollen, Orchisknollen, Salep, Salepknollen, Salepwurzel
greek:	Salépi
italian:	Salep
turkish:	Salep

**Countries of export:** Albania, China, India, Iran, Turkey.

**Source:** Mainly wild-collection; unknown whether cultivated. Most of the Salep traded nowadays is synthetically produced.

**Commodities in trade:** Dried, whole root tubers of different origin (Levante salep, Oriental salep, maras-salep, etc.), individual tubers or threaded on white or coloured strings (crude drug) or the same cut (cut drug); in addition also powdered root tubers and finished products are in trade (partly containing other starch products as substitutes).

### Characteristics:

**Crude drug:** (Fig. 1-3) Root tubers variably shaped and sized, often even within one sample, globose to flattened, circular to ovoid, oblong or spindle-shaped, rounded at bottom, acute or irregularly palmately lobed, (5-) 10-40 mm long and wide, (3-) 5-15 mm thick; tubers horny, hard, smooth to longitudinally wrinkled, dull or glassy, translucent, colour varying from white, grey, yellowish, yellow-brown, reddish-brown to dark brown, with distinct, ± circular stem scar at top, clearly visible as a rough dent; weight 0.2-1.7g; internally the tubers are unstructured; samples which are not threaded often with remains of strings;

**Cut drug:** (Fig. 4) Tubers cut into 7-10 mm long and wide pieces; fragments unstructured; characters see "Crude drug";

**Odour:** Musty, unpleasantly to evil-smelling;

**Taste:** Fade and mucilaginous.

**References:** Kasperek, M. & Grimm, U. (1999): European trade in Turkish salep with special reference to Germany. - *Economic Botany* 53(4): 396-406; New York.



Figure 1. Crude drug, Salep tuber; Orchis or Ophrys species, (copyright BfN).



Figure 2. Crude drug, Salep tuber; Gymnadenia and Dactylorhiza species, (copyright BfN).



Figure 3. Crude drug, Salep tuber, (copyright BfN).



Figure 4. Cut drug, Salep tuber, (copyright BfN).



## The difference between artificially propagated and wild-collected orchids



## Foreword

The purpose of this manual is to assist inspectors in their implementation of CITES provisions regarding orchids. It may sometimes be difficult to distinguish orchids (particularly terrestrial orchids) from other plants when they are not in flower, but it is frequently impossible to distinguish one species or even one genus of orchids from another without flowers or a label. The names on the labels themselves may be internally or accidentally inaccurate. Complicating these problems is the vast number of bigeneric and multigeneric orchid hybrids now available and commonly traded as artificially propagated specimens. Although the identification of sterile orchid specimens is beyond the scope of this guide, some of the general growth habits of orchid genera or groups of genera that are traded in large quantities will be explained and illustrated. The main purpose of this chapter is to provide information on how to differentiate between specimens that are artificially propagated as defined by CITES and those that are not. For the sake of reference, specimens that are not artificially propagated are referred to as wild or wild-collected specimens and are given the source code 'W' that should be included in permits and certificates. It should be noted that these specimens are not always taken directly from the wild, but may also be grown under semi-natural (not controlled) conditions and, therefore, do not qualify for the CITES definition of artificially propagated.

## Acknowledgements

I wish to thank Ms Sandra Bell, Curator of the Living Orchid Collection, Dr. Phillip Cribb, Assistant Keeper of the Herbarium, Royal Botanic Gardens, Kew, and Messrs. Ger van Vliet and Charles Akin, CITES Secretariat, for their helpful comments on the manuscript. Drawings were prepared by Eleanor Catherine and Judi Stone.



## 1. Introduction

### 1.1 General morphology and growth habits

The orchid family (Orchidaceae) is one of the largest and most widely traded of all plant families. Representatives can be found all over the world, except in the Arctic and Antarctic. Conservative estimates place the number of taxa at about 20,000 species in 750 genera. Habitats include rain forests, cloud forests, elfin forests, swamps, sand dunes, semi-desert scrub, grasslands, dry mountain plains of varying altitudes, alpine meadows and alpine bogs. The majority of species are found in the tropics where diversity is highest between 1,000 and 2,000 metres above sea level. Some taxa, such as *Vanilla*, are pantropical, whereas others are restricted to localized sites. The vast diversity of growth forms has allowed orchids to adapt to virtually every habitat type, including very stressed environments. Because of this capacity to adapt to all sorts of environments, many orchids are relatively easy to cultivate. This adaptability and a great and interesting variety of flower structure and colour have made them appealing to horticulturists over many centuries. The popularity of some species and their trade among collectors have been the source of threats to their survival. As a result, several popular taxa, particularly the slipper orchids in the genera *Paphiopedilum* and *Phragmipedium*, have been included in Appendix I. Other orchid taxa currently included in Appendix I are *Cattleya trianaei*, *Dendrobium cruentum*, *Laelia jongheana*, *Laelia lobata*, *Peristeria elata*, *Renanthera imschootiana* and *Vanda coerulea*.

What are the diagnostic features of orchids? In other words, what makes an orchid an orchid?

Flower parts are arranged in threes – three sepals (outermost floral parts) and three petals positioned inside the whorl of sepals. The median petal, termed the labellum or lip, is, however, often modified, showy and invested with calluses, ridges, glands and hairs for attracting pollinators (Fig. 1).

Flowers of some orchids such as *Angraecum*, *Calanthe* and *Disa*, have a tubular extension to the labellum called a spur which often contains nectar (Colour plate 1; Fig. 7). The length of the spur may vary from a few millimetres up to 45 centimetres.

The stigmas, styles, and anthers are fused to varying degrees into one single structure, termed the column that is positioned opposite the lip (Fig. 2).

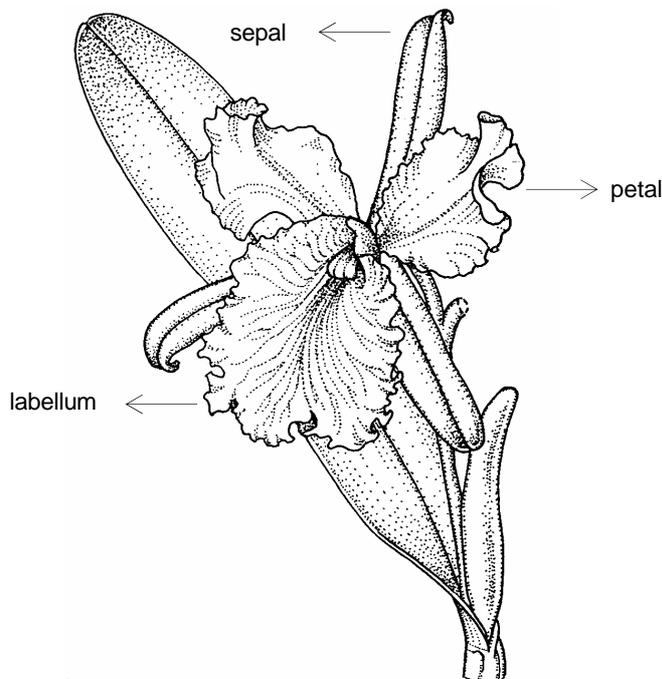


Figure 1

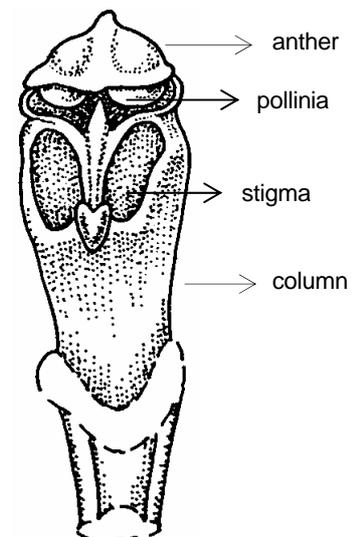


Figure 2

Three separate anthers are found only in *Apostasia* and *Neuwiedia* (both generally regarded as among the most primitive of orchids, but not in cultivation outside botanic gardens).

- ii) Two anthers (Colour plate 2) are found in the slipper orchids (*Cypripedium*, *Paphiopedilum*, *Phragmipedium*, *Mexipedium* and *Selenipedium*). All other genera have only one anther.
- iii) Those with a single anther, covered by an anther cap positioned at the top of the column, have two to eight clumps of pollen called pollinia (Fig. 2). In many orchids, the pollinia are attached to a stalk (called a stipe) with a sticky pad (called a viscidium). The entire structure-composed of pollinium, stipe, and viscidium-is transferred from one flower to another by pollinators (Colour plate 3). Below the anther are the stigma lobes (Fig. 2).

Flowers are typically stalked and borne on an unbranched inflorescence called a raceme (Fig. 3-7). A few genera (e.g. *Bulbophyllum* sect. *Cirrhopetalum*) produce inflorescences called umbels, in which flowers originate from the same point at the tip of the inflorescence stalk. In some species of *Oncidium*, flowers are arranged in branched inflorescences called panicles. Some genera produce only one-flowered inflorescences (e.g. most *Paphiopedilum* species [Fig.8], *Pescatorea*, *Masdevallia* [Fig. 9] and *Maxillaria*). Other inflorescence types-capitulum, corymbs, and cymes (see Glossary)-occur only rarely in the orchid family.

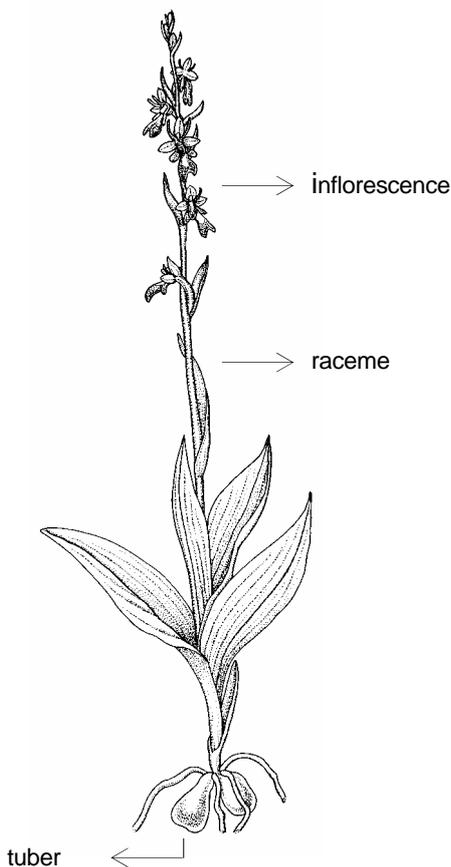


Figure 3



Figures 4 and 5

After pollination, the ovary swells and develops into a fruit known as a capsule or "pod." The capsule usually opens along three suture lines to release thousands or even millions of tiny, dust-like seeds lacking endosperm. Without stored food reserves, the seeds can only grow into viable seedlings when they associate with mycorrhizal fungi that provide the seedlings with the necessary carbohydrates and mineral nutrition.



There are two basic growth forms of orchids.

- i) The first is the monopodial habit (Fig. 4, 7, 10) in which the same apical growing point (meristem) produces new leaves continuously. The leaves are often arranged in two opposite rows. Flowers and new aerial roots arise from the axils of the leaves. Taxa with this growth form are the genera *Angraecum*, *Aerangis*, *Phalaenopsis*, *Renanthera*, *Rhynchostylis*, *Vanda* and the vast array of artificially produced bigeneric and multigeneric hybrids such as *Ascocenda*, *Doritaenopsis*, *Mokara* and *Neofinetia*.
- ii) The other major growth form is sympodial (Colour plates 3-7; fig. 5, 6, 8, 9, 11), represented, for example, by the genera *Cattleya*, *Dendrobium*, *Masdevallia* and *Paphiopedilum*. New leaves, stems, pseudobulbs, and roots grow from buds at the nodes (growing points) on the rhizome. Most sympodial orchids produce pseudobulbs (see also paragraph B below). Pseudobulbs are modified, thickened stems that function as storage organs for water and nutrients. Pseudobulbs may be only a few millimetres or up to a meter long, depending on the species. They may be simply a single bulb with one or several leaves on top (Colour plates 4, 6; Fig. 12 ) or may be compound with many joints or nodes (Colour plates 5, 7-10; Fig. 5, 11). In a few taxa, such as *Cymbidium*, these nodes are hidden by the leaf sheaths. The general shape of the pseudobulb can be round, ovoid (pseudobulbs of only one joint or node), conical, club-shaped or spindle-shaped (pseudobulbs with several nodes). The internodes of the rhizome, the parts between two successive nodes, may be relatively long (some species of *Bulbophyllum*, *Coelogyne*, and *Dendrobium*) (Colour plates 4-7; Fig. 5, 12) or short (most species of *Paphiopedilum*, *Masdevallia* and *Pleurothallis*) (Fig. 8, 9). *Vanilla* is unusual in this respect. It is a sympodial orchid lacking pseudobulbs, but its stems are climbing and vine-like and be several metres long. In all sympodial orchids, flowers are produced at the apex of the stem, at the apex or base of the pseudobulb (see below), or directly from the rhizome.

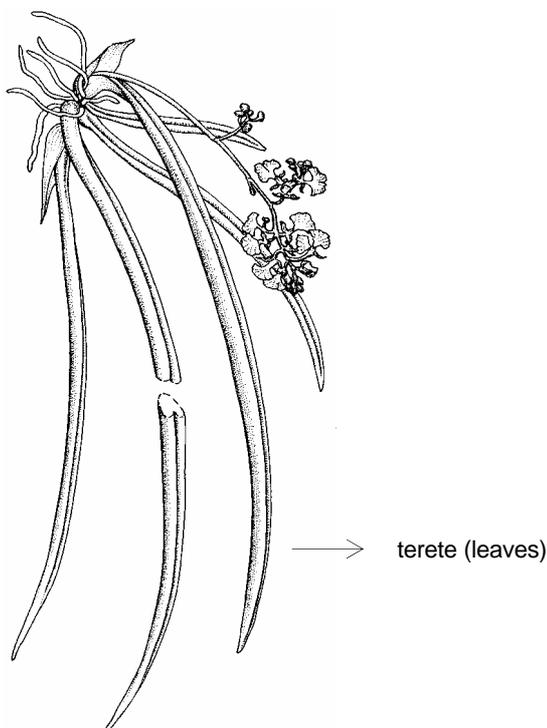


Figure 6

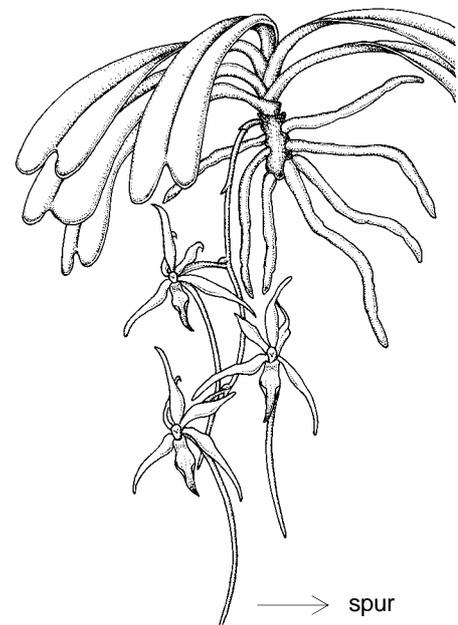


Figure 7

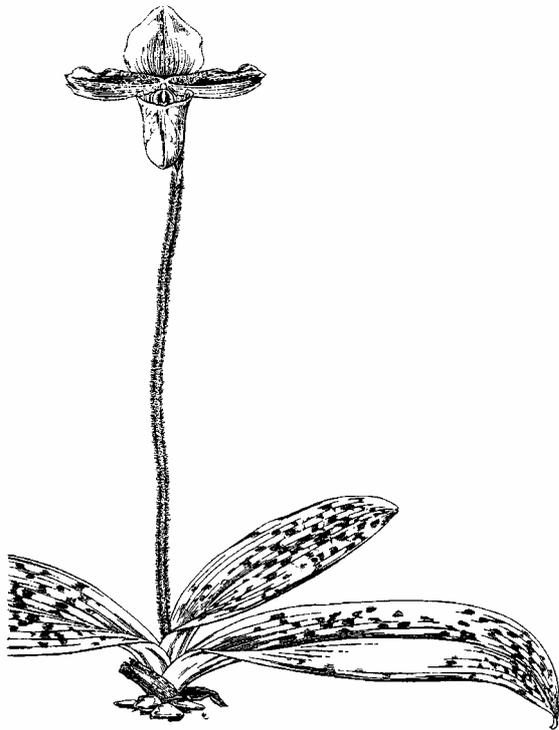


Figure 8



Figure 9

Orchid roots are remarkably diverse themselves, reflecting the different types of habitats and ecological microclimates to which orchids have adapted.

- i) Some may be strictly aerial and never seem to penetrate or adhere to a substrate. This phenomenon is common among the monopodial orchids such as *Phalaenopsis* and *Vanda*. Aerial roots in some genera such as *Ansellia* grow upward to form "nests" or "baskets" where debris accumulates. Nutrients released from the decaying debris nourish the plant.
- ii) Most roots, however, contact a substrate soon after initiation, thus firmly attaching the plant to the tree or rock it is growing on. Roots of many terrestrial genera (e.g. *Caladenia*, *Disa*, *Orchis*) form storage tubers.
- iii) Finally, plants of some orchid species (for example, *Chiloschista*) are essentially devoid of shoots and leaves. The bulk of the plant consists of flattened, photosynthetic roots that also fulfil the function of leaves.
- iv) Roots of many terrestrial and virtually all epiphytic orchids are surrounded by a specialized epidermis or velamen. The velamen consist of one, two or several layers of cells that are dead at maturity, giving the root a silvery appearance. Only at the tip of the root are the velamen cells still alive, having a green to whitish colour. In nature, the velamen probably has several functions. One of these is to absorb and retain moisture and dissolved nutrients long enough for them to be transferred to the living portions of the root.

Among terrestrial orchids, genera such as *Bletia* and *Spathoglottis* have compact, top-shaped stems with several internodes (called corms). These are positioned at or just beneath the soil surface, as in the genus *Gladiolus*. Many sympodial terrestrials, such as *Cypripedium*, have a creeping rhizome similar to that of a lily-of-the-valley (*Convallaria*).



Leaves of orchids are usually dorsiventrally flattened, although some species of *Dendrobium*, *Oncidium*, and *Lockhartia* have laterally flattened or "equitant" leaves. Still others, as in other species of *Oncidium* and *Brassavola*, are cylindrical or pencil-like terete (Fig. 6). Leaf veins are parallel to one another, although some terrestrial orchids have reticulate venation. At maturity, leaves may be folded lengthwise only in the middle along the prominent midrib (conduplicate) or may have several folds (pleated). Pleated leaves are relatively thin and characterize the *Cypripedium*, *Sobralia*, *Phaius*, and *Catasetum* genera (Fig. 14). Conduplicate leaves (Fig. 1, 4-12) may vary from thin to thick and be leathery. The vast majority of epiphytic orchids, including the most commonly grown genera (*Cattleya*, *Cymbidium*, *Paphiopedilum*, *Phalaenopsis*) have conduplicate, leathery leaves.

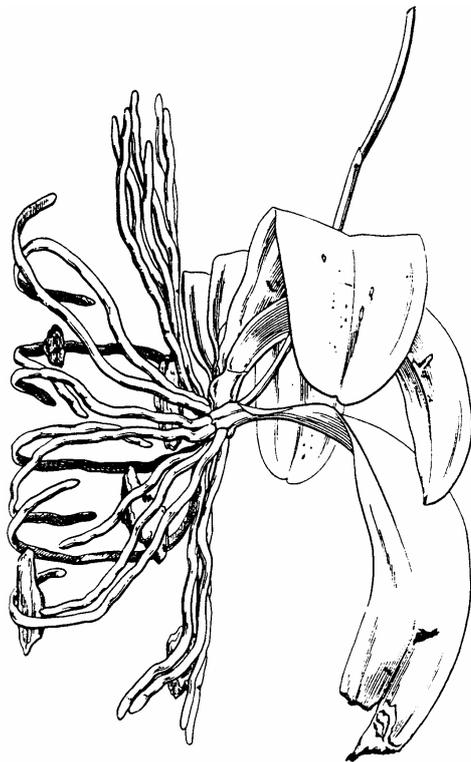


Figure 10

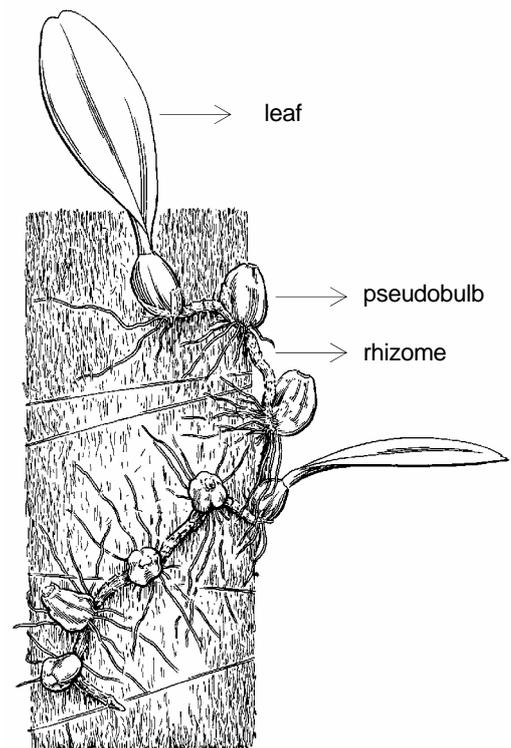


Figure 11

## 1.2 Diversity in growth forms

Sometimes it is possible to recognize specific taxa within the two broad groups of monopodial and sympodial orchids. Monopodial orchids generally originate from Asia (subtribe Aeridinae from tropical Asia that includes *Phalaenopsis*, *Vanda* and their relatives) or in Africa (subtribe Angraecinae, including *Aerangis*, *Angraecum* and their relatives), but leaves of the Angraecinae differ by having leaves with unequal, bilobed tips (Fig. 7). Plants of *Phalaenopsis* (Fig. 10) can be distinguished from those of *Vanda* when not in flower. Leaves of *Vanda* are either terete, strongly folded or keeled on the lower surface throughout the length of the leaf, whereas those of *Phalaenopsis* are folded only at the base and are broadest toward the apex.

Within the sympodial orchids, there is a group without pseudobulbs and a much larger group with pseudobulbs. In the first group are the European terrestrial orchids bearing tubers such as *Ophrys* and *Orchids* (Fig. 3). There are also tropical and subtropical taxa like *Paphiopedilum*, *Phragmipedium* (both with leaves arranged in opposite rows), *Cypripedium* (leaves spirally arranged) and the group of *Dracula*, *Masdevallia*, *Pleurothallis*, and their allies (all from Central and South America). The group of orchids with pseudobulbs can be divided roughly into those with a simple pseudobulb of one joint or node

(*Bulbophyllum*, *Coelogyne*, *Odontoglossum*, *Oncidium*, *Pleione*) and one group with pseudobulbs of many joints or nodes (*Cattleya*, *Cymbidium*, *Dendrobium* and *Laelia*) with leaf sheaths at the base or enclosing the pseudobulb.

Pseudobulbs vary greatly in size and shape. Those of some species may be only a few millimetres long and weigh a fraction of a gram, whereas others may be several meters long and weigh several kilograms. Depending on the species, some are globose, cylindrical (Fig. 11), ovoid (Colour plate 4), spindle-shaped (Colour plate 7; Fig. 5), swollen at the internodes to resemble a chain (Colour plate 8) or cane-like (Colour plates 9 and 10).

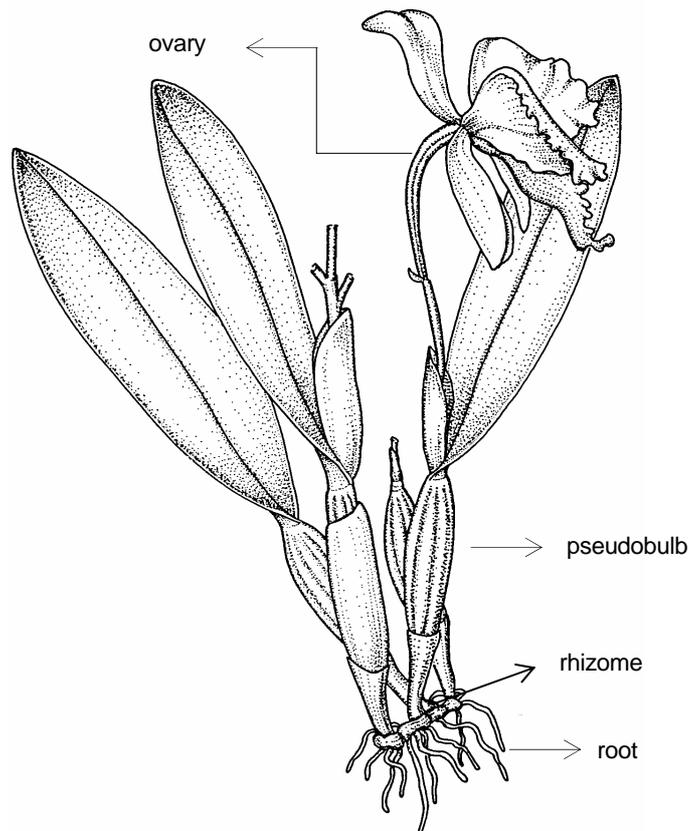


Figure 12

## 2. Identification of Orchids

Although the number of orchids collected from the wild have declined in the last century, significant trade in wild plants of several genera still exists. The vast majority of trade (almost 80 per cent) is in artificially propagated specimens. The most commonly traded orchids belong to the following genera: *Cattleya*, *Cochlioda*, *Cymbidium*, *Cypripedium*, *Dendrobium*, *Encyclia*, *Epidendrum*, *Laelia*, *Masdevallia*, *Miltonia*/*Milioniopsis*, *Odontoglossum*, *Oncidium*, *Paphiopedilum*, *Phalaenopsis*, *Pleione*, and *Vanda*. Of these, the majority, (*Cochlioda*, *Cypripedium*, *Encyclia*, *Epidendrum*, *Laelia*, *Paphiopedilum* and *Pleione*), are traded as named species. The majority of plants traded in other genera, are either hybrids or unnamed species.

Orchids are generally shipped as sterile plant specimens with only a list of orchid names and the quantities included in the shipment. Quite often, the plants themselves are not labelled, so there is no way to cross-reference names and plants. Even orchid experts may find it difficult to identify genera and



especially specific names of sterile plants. The collectors and nurseries in the countries of origin generally have a good idea of the identity of the plants they are exporting. On the rare occasion when flowering plants are present in a shipment, the flowers are frequently so badly damaged and desiccated that identification is difficult or impossible without an excellent library, microscopes and unlimited time.

Further complicating the identification of orchids is the fact that orchids interbreed very easily in cultivation. This has substantially increased the number of new orchid hybrids. There are primary hybrids (between species of the same genus); bigeneric hybrids (between species or hybrids from different genera) such as *Cattleytonia* (*Cattleya* x *Broughtonia*), *Laeliocattleya* (*Laelia* x *Cattleya*) and *Ascocenda* (*Ascocentrum* x *Vanda*); and multigeneric hybrids (between species or hybrids from more than two genera) such as *Brassolaeliocattleya* (*Brassavola* x *Laelia* x *Cattleya*), *Sophrolaeliocattleya* (*Sophronitis* x *Laelia* x *Cattleya*), *Vuykstekeara* (*Cochlioda* x *Miltonia* x *Odontoglossum*) and *Potinara* (*Brassavola* x *Cattleya* x *Laelia* x *Sophronitis*). As many as seven compatible genera have been hybridized to form one hybrid taxon. Though hybrids are not the main focus here, the generic name is sometimes an easy way to determine whether the plant is a species or hybrid. Even when the hybrid is primary and the generic name does not change, the hybrid name (grex name) is upper case rather than lower case like a species name, e.g. *Paphiopedilum* 'Maudiae' (*P. lawrenceanum* x *P. callosum*). A complete list of hybrid genera and their generic components is provided in the 4th edition of The Handbook of Orchid Nomenclature and Registration.

Quite often there are several synonyms for the same plant taxon. (Taxon is a term used for various levels in the classification of plants and animals. A taxon can be a genus, species, subspecies, etc.) Experts do not always agree about the name that should be applied to a certain taxon. One author may regard a particular taxon as a species, naming it, for example, *Phalaenopsis bellina*. Other authors may regard it as only a variety, in this case it would be *Phalaenopsis violacea* var. *bellina*. Both names refer to the same taxon.

New research may indicate that earlier ideas about a taxon were incorrect, possibly resulting in a regrouping of the species into another genus. For example, *Phragmipedium xerophyticum* was included in Appendix I under that name in 1990. A different opinion about the species based on scientific evidence led to the species being placed in a new genus *Mexipedium*, which is a genus not included in Appendix I. In the CITES Orchid Checklists, however, it is still regarded as a species of *Phragmipedium*.

Even if there is agreement on the names that should currently be used, synonyms are still applied by nurseries and enthusiasts because they refuse to adopt the new names or do not know them. In the nursery trade, there is great reluctance to accept new names since the older names are well established. For the most important groups of orchids in trade, there are checklists of names generally accepted by experts and approved by the Conference of the Parties and included in the CITES Orchid Checklists. Where possible, check the names of wild-collected plant specimens using the CITES Orchid Checklists published by the Royal Botanic Gardens, Kew. Each checklist is organized into three parts: 1) an alphabetical list of all accepted names and synonyms; 2) a separate list for each genus, alphabetized by accepted name with full synonymy and geographic distribution; and 3) an alphabetical list of accepted names arranged for the country in which they are found.

Other difficulties in the identification of orchids are: 1) the frequency with which names change as taxonomists revise their taxonomic position in light of new evidence; 2) the use of incorrectly spelled names; and 3) the use of falsified names.

Other sources of information about orchid identification include the following:

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### General books readily available from bookstores

- Bechtel, H., P. J. Cribb, and E. Launert. 1992. The manual of cultivated orchid species. 3rd ed. Blandford, Poole, UK.
- Cribb, P. J. 1987. The genus *Paphiopedilum*. Royal Botanic Gardens, Kew, in association with Collingridge, UK.
- \_\_\_\_\_ and I. Butterfield. 1988. The genus *Pleione*. Royal Botanic Gardens, Kew, in association with Christopher Helm, UK.
- DuPuy, D. and P. J. Cribb. 1987. The genus *Cymbidium*. Christopher Helm, London.
- Hawkes, A. D. 1965. Encyclopaedia of cultivated orchids. Faber, London.
- International Orchid Commission. 1993. Handbook on orchid nomenclature and registration. 4th ed. Royal Horticultural Society, London.
- Jones, D. L. 1988. Native orchids of Australia. Reed Books, French Forest, New South Wales, Australia.
- Pridgeon, A. M., (ed.). 1992. The illustrated encyclopedia of orchids. Weldon, Sydney.
- Seidenfaden, G. and J. J. Wood. 1992. The orchids of Peninsula Malaysia and Singapore. Olsen & Olsen, Fredensborg, Denmark.
- Vermeulen, J. J. 1991. Orchids of Borneo. 2. Bulbophyllum. Royal Botanic Gardens, Kew and Sabah Society, UK.
- Withner, C. L. 1988 (Vol. 1); 1990 (Vol. 2); 1993 (Vol. 3). The cattleyas and their relatives. Timber Press, Portland, Oregon.

### Books usually limited to botanical libraries

- Banerji, M. C. and P. Pradhan. 1984. The orchids of Nepal Himalaya. J. Cramer, Verduz.
- Dunsterville, G. C. K. and L. A. Garay. 1979. Orchids of Venezuela: an illustrated field guide. Harvard University Press, Cambridge, Massachusetts.
- Luer, C. A. 1972. The native orchids of Florida. New York Botanic Garden, New York.
- Luer, C. A. 1975. The native orchids of the United States and Canada excluding Florida. New York Botanic Garden, New York.
- Pabst, G. and F. Dungs. 1977. Orchidaceae Brasilienses. Band 1 and 2. Kurt Schmiersow, Hildesheim, Germany.
- Pradhan, U. C. 1976 (Vol. 1); 1979 (Vol. 2). Indian orchids: guide to identification and culture. U. C. Pradhan, Kalimpong, India.
- Seidenfaden, G. and T. Smitinand. 1959-1964. The orchids of Thailand: a preliminary list. Parts 1-7. The Siam Society.
- Sweet, H. R. 1980. The genus *Phalaenopsis*. Orchid Digest Inc. Pomona, California.
- Valmayor, H. L. 1984. Orchidiana Philippiniana. Eugenio Lopez Foundation, Manila.



### 3. Characteristics of Artificially Propagated and Wild-collected Orchids

Important:

When checking a shipment of orchids accompanied by a CITES permit or certificate issued for specimens that were artificially propagated, it is important to first determine whether the specimens were artificially propagated in accordance with the CITES definition. This definition includes the requirement of propagation under controlled conditions.

In some parts of the world, orchids are grown out of doors, under non-controlled conditions, (e.g. on trees in coffee plantations, large gardens or without any protection against the natural environment). Specimens grown under such semi-natural conditions cannot be traded as "A" because they do not conform to the requirement of "controlled conditions." On the permit, the source indicated should be "W", although the specimens may not necessarily originate in their natural, wild environment.

Though it may be difficult to distinguish wild-collected orchids from those cultivated outdoors under semi-natural conditions, there are several features of roots, leaves and stems which make it rather easy to differentiate these plants from those that are artificially propagated. Please refer to the corresponding illustrations to clarify and supplement textual descriptions. It is also important to look for a combination of characteristics mentioned under paragraphs A through E below. The detection of one characteristic at first sight should be reason for a more thorough inspection of the entire shipment. In the event of doubt, always consult a specialist. The following chapters describes some symptoms of diseases that may occur in cultivation under controlled conditions. Normally, these are incidental, occurring on only a few plants and concern primarily leaves, roots or flowers.

#### 3.1 Roots

Roots of wild-collected plants are often dead (Fig. 13-15) as can be seen from the breakdown and decay of the velamen, leaving only string-like strand of vascular tissue. This damage may also result when an epiphyte is torn from its substrate such as the bark of a tree. The remaining roots are often torn longitudinally or snapped off altogether. New roots may be growing from old damaged roots. Collectors often cut all the roots back to the base of the stem (Colour plate 11; Fig. 16) to prevent water loss and rot in transit or to try to disguise the wild origin of the plant.

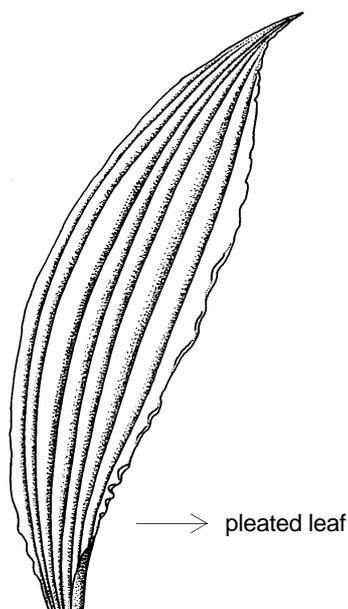


Figure 13



Figure 14

Artificially propagated orchids usually have a number of undamaged, long, healthy roots. These may be firm with root hairs (e.g. *Paphiopedilum*) or have a silvery white velamen. New roots will have a white to green growing tip. Very often, the mass of roots will be cylindrical as a result of their having been inside a pot (Fig.13). Roots longer than 15 cm and growing perpendicular to the shoot (Fig. 14) most likely belong to a wild plant.

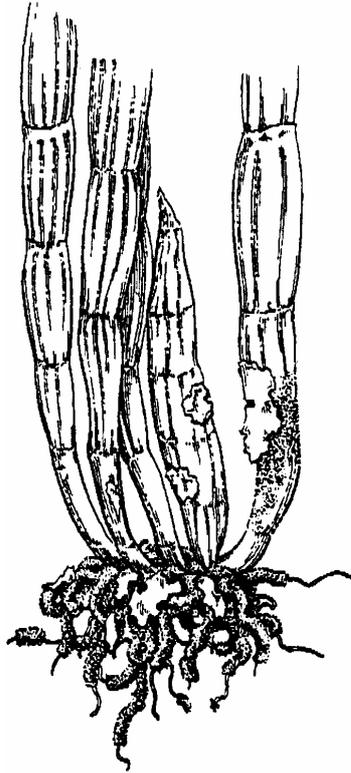
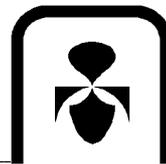


Figure 15

Finally, look to see whether there are bits of material attached to the roots. Artificially propagated epiphytic orchids may have pieces of chopped fir bark, osmunda, charcoal, tree fern roots, rock wool or perlite firmly attached. Roots of terrestrials may have peat moss, perlite or sphagnum attached to them. Other potting media include Styrofoam pellets, lava, expanded shale and cork. Materials other than these attached to roots should be suspect. If the material attached to roots is animal matter (snails, insect egg cases, etc.) or other plant material such as strips of tree bark, lichens or mosses (Fig. 17 and 18), the plant is probably of recent wild origin.

Roots or root clumps may reflect the shape of the branch, stem or rock on which the plant was growing. Figure 10 shows a wild-collected specimen, as can be deduced not only from the configuration of the roots but also from the damaged leaves and the presence of an old inflorescence. On trees, the roots of orchids are generally parallel to one another following the path of water runoff, whereas in cultivation they may grow in different directions. Wild-collected plants often produce new roots very quickly, usually in a different direction than the original ones. In the root systems of terrestrial paphiopedilums, one may find evidence of the natural substrate on the roots or an evident change in direction of root growth caused by a rock or a thick tree root in the natural substrate that would not occur in cultivation.



### 3.2 Leaves

Basal (lowest or oldest) leaves of wild-collected orchids are often brown, dried or dead, either due to natural causes, desiccation during shipment or damage by bending or tearing. During packing and transport from the natural sites in the forest, the leaves of collected plants are often crushed, torn or bent (Colour plate 11; Fig. 13, 14, 16). On the other hand, basal leaves of artificially propagated orchids are generally still green and firm. They may have some yellow, brown or black streaks or spots, but these are most likely symptoms of poor culture, insect damage in the greenhouse or shadehouse or fungal or bacterial diseases (see below). Dead leaves on artificially propagated plants are normally removed prior to shipping.



Figure 16



Figure 17

Leaves of artificially propagated plants are generally not damaged mechanically because they have been unpotted by the exporter just before careful packing. Furthermore, such plants are in transit for only a week or less, so that opportunities for damage and desiccation are minimized.

Desiccation damage to wild orchids (Fig. 13, 16, 19) occurs during prolonged periods of storage prior to shipment or during prolonged shipments. As water is lost from the plant, leaves lose their turgidity. Cracks in the cuticle appear on the blade, especially along the midrib, exposing the green tissue beneath or causing a lesion in those areas. Groups of cells in the epidermis may collapse, assuming the form of clustered depressions (Fig. 19, 20), although in association with other causes this may be confused with a number of cultural problems as well (see below).



Figure 18

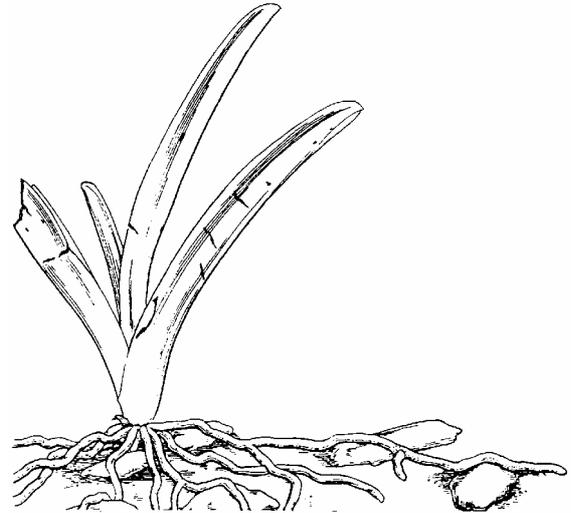


Figure 19



Figure 20

One of the most telltale signs that a plant is recently from the wild is the presence of mining furrows caused by burrowing insect species which occur in the wild but are very rare in greenhouses. Chewing insects or small mammals in the wild often produce irregularly damaged leaf margins or holes in the leaf blade (Fig. 21). Other pest damage (Colour plate 12; Fig. 22) such as that caused by mites, scale and



mealybugs is common in nature, but may sometimes also be found in private greenhouse collections. This is very uncommon in commercial greenhouses. By itself, this can not be used as conclusive evidence, but identification of the species involved may provide helpful or even conclusive evidence.



Figure 21

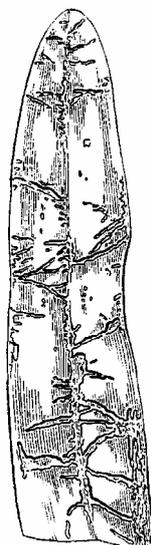


Figure 22

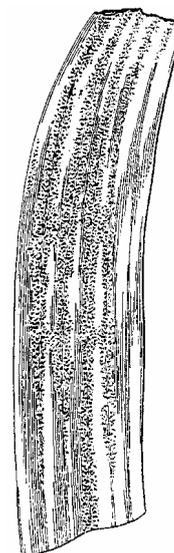


Figure 23

Leaves with lichens, mosses or liverworts on them (Fig. 23, 24) are invariably from wild-collected plants. The species concerned grow only under nutrient-poor conditions and are very sensitive to fungicides, insecticides, herbicides and fertilizers frequently used in commercial nurseries and private collections.

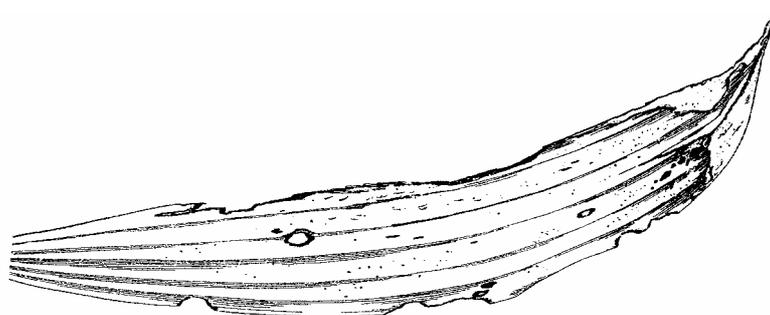


Figure 24

Characteristics of possible wild origin do not immediately disappear in the greenhouse. They remain as long as the leaves or other plant parts live. The size and surface features of leaves of wild-collected plants are often quite different from the characteristics of nursery-grown leaves on the same plant.

### 3.3 Stems/pseudobulbs

Many of the same signs on leaves of wild-collected plants can be applied to the stems or pseudobulbs of orchids. Older pseudobulbs that are brown, hollow, dead, with insect damage or lichens and mosses (Fig. 15, 24) are recently collected. It is also possible to find small roots attached to the rhizome or the

pseudobulb that do not belong to the orchid but to other plants (e.g. ferns) growing together with the orchids. While back pseudobulbs (backbulbs) of cultivated orchids may also be brown, generally they are firm rather than desiccated and hollow and rarely show signs of boring or chewing insects. Artificially propagated plants are rarely sold with many old, leafless backbulbs. These are normally removed by the nursery because they are a potential source of rot and infection and increase transport costs. The presence of many old backbulbs, therefore, also indicates possible wild origin.

In the case of species of *Pleione*, plants in the wild are buried just below the surface of the substrate and are whitish due to the lack of sunlight. Cultivated pleiones, however, are typically grown with the pseudobulbs exposed above the potting medium and are green.

### 3.4 Inflorescences

Cultivated orchids are rarely shipped with dried inflorescences, unripe, old or dehiscent (open) seed capsules (fruits or pods) because they drain the plant's resources and invite bacterial and fungal infections. In addition, viable seed capsules will always be retained by the grower for further propagation. Whenever these are present, the plant is most probably from the wild.

### 3.5 Other Signals

The size of the plant is another indicator of its origin. Large specimens, too large to fit easily in a conventional-size pot, may possibly be wild-collected.

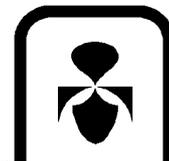
## 4. Symptoms of Diseases in Cultivated Orchids

It is important to be able to distinguish between the characteristics of wild-collected plants and some problems normally associated with cultivated orchids.

Bacterial and fungal problems are diagnosed with relative ease. Bacterial rots may appear on leaves, roots, rhizomes and pseudobulbs as brown to black lesions, often soft and mushy, as in bacterial brown rot. Fungal leaf spottings commonly first appear as brown or yellow spots, sunken or not, on the lower side of leaves. As the diseases develop, the spots darken, enlarge, cause a sunken pitting and spread over the rest of the leaf surface. In some cases there is a yellow area surrounding the lesion. Rust fungi are first recognizable as yellow-orange or reddish brown spots on the lower surface of leaves, which enlarge and eventually penetrate the upper surface. Botrytis is a fungus that causes brown spotting of flowers under humid conditions with poor air circulation.

Though the symptoms of orchid viruses often resemble those of fungal infections or improper culture, they need to be discussed because viruses do not occur (or at least are not expressed) in wild orchids. Therefore, plants with viruses have been in cultivation for some time. The most common orchid viruses are cymbidium mosaic virus, tobacco mosaic virus, and bean yellow mosaic virus. Cymbidium mosaic is known in *Cattleya*, *Dendrobium*, *Laelia*, *Phalaenopsis*, *Vanda* and other genera. Leaves develop white to yellow streaks (chlorosis) and black or brown spots and streaks representing dying tissue (necrosis). Necrotic streaks may also be evident in flowers after the buds open. Tobacco mosaic also affects *Cattleya* and many other genera such as *Oncidium* and *Vanda*. Leaves typically have chlorotic spots or V-shaped patterns, while the chief symptom in the flowers is colour break--differences in pigment intensity, often as streaked or irregular patches. Bean yellow mosaic virus infects *Masdevallia* and its allies, *Calanthe* and other genera. Spread by aphids, it causes chlorotic areas and later sunken, necrotic spots on leaves and also disfigures flowers.

The symptoms of disease are well described and illustrated in the American Orchid Society's [Handbook on Orchid Pests and Diseases](#), 1995 edition, available from the American Orchid Society, 6000 South Olive Avenue, West Palm Beach, FL 33405 USA.



### Glossary

anther:	the pollen-bearing portion of the stamen
axil:	the point of attachment of a leaf, an inflorescence or a pseudobulb to the stem
capitulum:	a dense head of flowers
column:	the portion of an orchid flower formed by the fusion of the anther, stigmas, and styles (Fig. 2)
conduplicate:	folded once longitudinally down the middle
coriaceous:	having a hard or leathery texture
corymb:	a broad, flat-topped inflorescence in which the outermost flowers open first
cyme:	an inflorescence in which the terminal flower opens first
dorsiventral:	flattened and having distinct upper and lower surfaces
embryo:	the young plant encased within the seed
equitant:	with leaves overlapping and arranged in two rows; fan-shaped
genus:	a group of related species
hybrid:	the result of a sexual cross between species, a species and another hybrid or two hybrids
inflorescence:	the flowering axis of a plant consisting of one or many flowers
internode:	the region of an axis between two successive nodes
labellum:	the median, modified petal of an orchid flower, often large and showier than the other flower parts; (the lip)
meristem:	the growing point at the apex of a stem or root
monopodial:	referring to a growth habit in which new leaves develop from the same meristem, located at the top of the stem
mycorrhiza:	fungi that form a relationship with the roots and seedlings of orchids and other plants
node:	the point on an axis (stem, rhizome, inflorescence) to which other plant parts (leaves, pseudobulbs, flowers) are attached
ovary:	the part of the flower that contains the ovaries (in orchids the ovary is situated below the point of insertion of the other flower parts)
panicle:	a branched inflorescence of stalked flowers
petal:	the whorl of flower parts inside the sepals
pistil:	the female portion of the flower, consisting of the stigma, style and ovary with ovules
pleated:	folded longitudinally many times

pollen:	cells that produce the male sex cells of plants, borne in an anther
pollinia:	a mass of pollen grains
pseudobulb:	the thickened portion of an orchid stem
raceme:	an unbranched inflorescence of stalked flowers
rhizome:	the axis of a sympodial orchid plant that gives rise to new shoots and flowers
sepal:	the outermost whorl of flower parts
species:	the basic unit of plant classification; a group of plants with common genetic heritage and morphological characteristics, able to interbreed and often separated from other groups of plants by various barriers to reproduction
spur:	a tubular extension of the lip or labellum of an orchid flower, often containing nectar
sterile:	non-flowering
stigma:	the portion of the pistil that receives the pollen
style:	the elongate portion of the pistil between stigma and ovary
sympodial:	referring to a growth habit in which new shoots arise successively from axillary buds of a rhizome
terete:	pencil-like; round in cross-section
tuber:	a thickened, underground storage stem or root
umbel:	a flat-topped inflorescence in which the flower stalks arise from the same point, like an umbrella or a daisy
velamen:	the epidermis or outer cell layer of orchid roots, responsible for absorption and short-term storage of water and nutrients



Figure 1. *Angraecum rutenbergianum* is one of many orchid species from Africa and Madagascar with long, curved, nectar-bearing spur (extension of the lip or labellum).



Figure 2. Close-up of the column of a paphiopedilum to show the two anthers that characterize the slipper orchids. The white structure below and between the anthers is the sterile stamen or staminode.

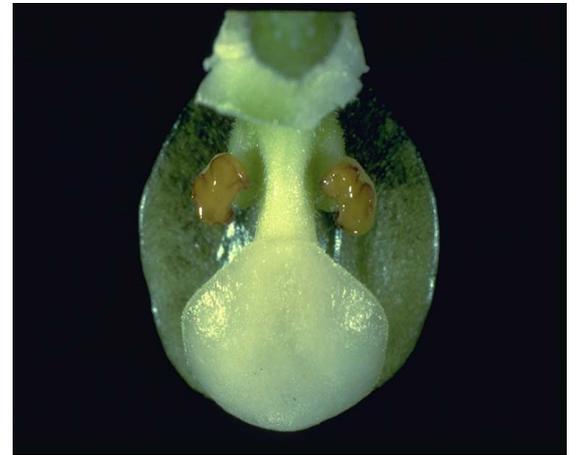


Figure 3. Two pollinia attached to a stalk and a sticky pad (viscidium) comprise the pollination unit for many orchids. The entire apparatus is carried from flower to flower by the insect pollinator.

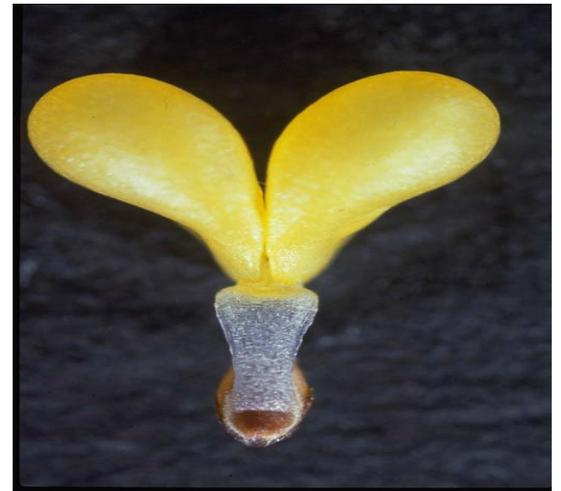


Figure 4. Sympodial orchids such as this *Bulbophyllum* grow laterally with a creeping rhizome. At nodes along the rhizome are swollen stems called pseudobulbs. Each pseudobulb may bear up to several leaves, depending on the species. Flowers may arise from the base or top of the pseudobulb or from the rhizome itself. These simple pseudobulbs have only one node.



Figure 5. Species of *Cattleya* show the sympodial habit well. The rhizome may branch before giving rise to a new pseudobulb with leaves and flowers.

Figure 6. This *Bulbophyllum* shows how sympodial orchids grow in nature, with the rhizome spreading up the tree and its roots adhering to the bark.





Figure 7. Pseudobulbs exhibit a variety of sizes and shapes. These pseudobulbs of a *Dendrobium* are spindle-shaped.



Figure 8. The stems of *Dendrobium findlayanum* have irregularly swollen internodes and resemble coral.



Figure 9. Many dendrobiums and other orchids have stems that resemble canes. Flowers of these species often arise from leafless canes.



Figure 10. *Dendrobium bullenianum* and other species produce leafy canes with several nodes as well as leafless, flowering canes at the same time.



Figure 11. This wild-collected plant of *Paphiopedilum sanderianum* shows all the characteristics of a plant from the wild-leaves with mechanical and insect damage and roots that have been cut off to prevent desiccation and disease in transit.



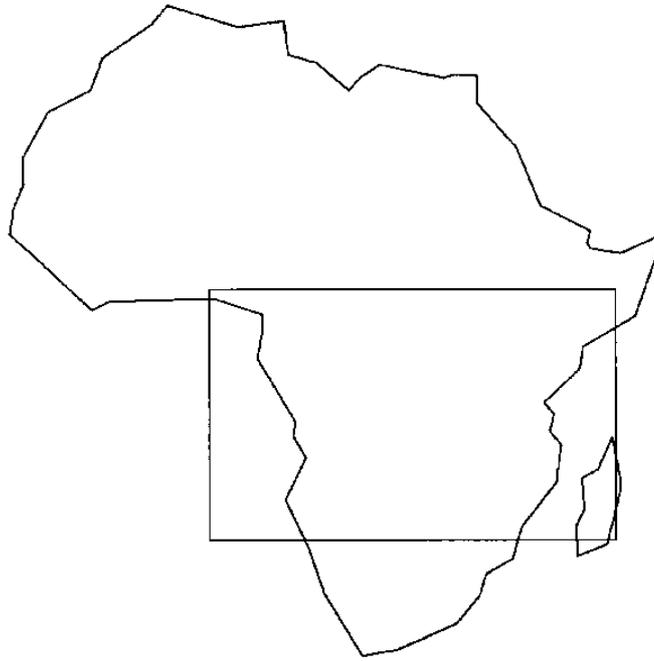
Figure 12. This wild-collected plant of *Paphiopedilum victoria-regina* has desiccated leaves with silvery spots, which reflect burrowing damage by mites or insects.



<b>Commercial names:</b>	engl.: Red stinkwood esp.: fr.:
<b>Common names:</b>	Cameroon: Alummy (Bamenda), Kirah (Banso), Lluo (Kom), Vla (Oku), Wotangué (Bakweri) Kenya: Muri (Kikuyu), Tenduet Others: African cherry, Gwane, Mgambo, Mkomohoyo, Mseneo, Ntasesa
<b>Scientific synonyms:</b>	<i>Pygeum africanum</i> Hook. f.
<b>Subject to CITES regulations:</b>	All parts and derivatives, except seeds, spores, pollen (including pollinia), seedling or tissue cultures obtained in vitro, in solid or liquid media, transported in sterile containers and cut flowers of artificially propagated plants.
<b>Macroscopic characteristics of the wood:</b>	Wood uniform golden brown, diffuse porous, growth rings absent, seldom fine and marked by bands of zoned parenchyma. The sapwood and heartwood are well differentiated; the sapwood is light brown and the heartwood is golden brown with pink lines. Fibres slightly flattened radially, fibres straight, sometimes wavy and interlocked. Hardness: moderately hard and heavy Grain: medium to fine Specific weight: 0.72 – 0.76 g/cm <sup>3</sup>
<b>Microscopic characteristics of the wood:</b>	Growth rings absent or indistinct, diffuse porous. Vessels solitary and in radial multiples of 2 – 8, oval to round, 5 – 30/mm <sup>2</sup> . Average tangential diameter (75 –) 100 (– 175 µm); walls 2 – 5 µm thick, 380 – 710 µm long. Perforation plates simple and oblique. Intervascular pits alternate, usually polygonal with a diameter of 2 – 5 µm, the thinnest elements occasionally have spiral thickenings. Gum deposits frequently present. Parenchyma moderately abundant, diffuse apotracheal and scanty paratracheal, sometimes forming narrow irregular marginal lines. Rays heterocellular, uni- and multiseriate 1 – 4 (6) cells wide; uniseriate ones homocellular, multiseriate ones heterocellular, 4 – 14 per mm <sup>2</sup> . The multiseriate rays have wings of 1 – 6 erect and square cells, crystals infrequent. Fibretracheids 720 – 2010 µm long with very thin to medium thick walls, pits minute.
<b>Characteristics of the trees:</b>	A tree that grows to 40 – 60 centimetres in diameter and 30 metres high with a crown of 20 metres diameter, rarely 1 metre in diameter and up to 40 metres high. Straight trunk, with four buttress roots at the base with concave or convex profile, 8 – 10 centimetres thick, to 1 metre from the tree and 1 metre high sometimes branched in V - shape near the ground. Bark rough, blackish brown. Tropical forests with a precipitation of more than 1000 mm, between 2000 and 2200 metres above sea level, especially on volcanic soils.
<b>Characteristics of trade:</b>	It is usually sold as bark or extracts, the wood is mainly used locally.

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**Distribution:** Tropical Africa: Cameroon, Kenya, Malawi, United Republic of Tanzania, Uganda, Republic of the Congo, South Africa, Zimbabwe, Madagascar, Comoros, Santo Tomé and Fernando Poo.

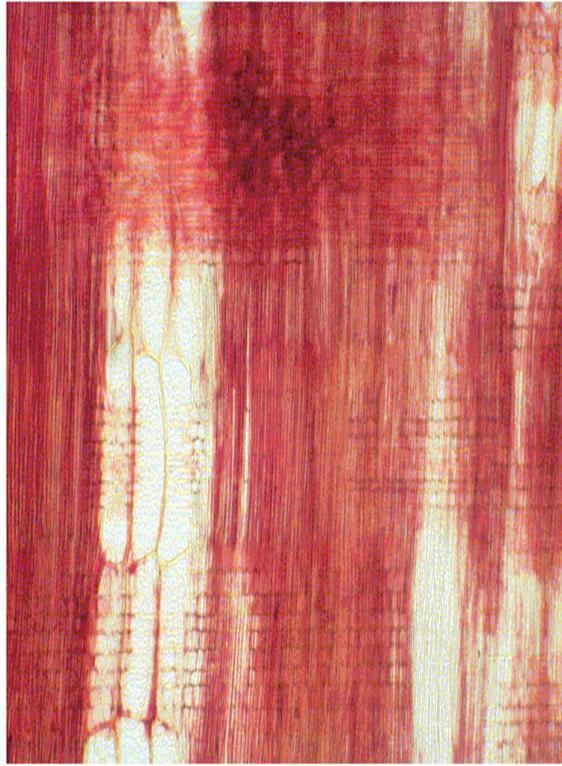


**Use:** Extracts from the bark are used for the treatment of prostate diseases. The wood is used to build wagons and carts, furniture and cabins, interior finishing, farming implements, tool handles and articles for sports and lath work.

**Similar species:** There are 400 species in this genus. There is another African species called *Prunus crassifolia* (Haum.) Kalkman, which has a more limited distribution and grows between 2800 and 3000 metres, although it could be considered as a variety of *Prunus africana*.

# Prunus africana





transverse section



tangential section

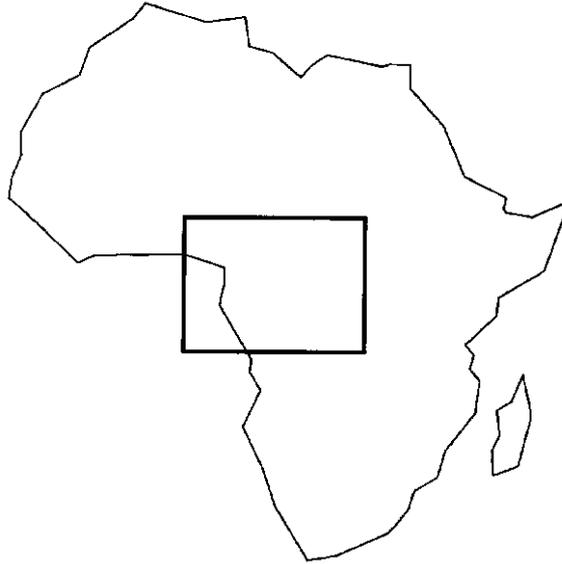


radial section



<b>Commercial names:</b>	engl.: Afrormosia; African teak esp.: Teca africana fr.: Assamela
<b>Common names:</b>	Anyesan, Ayin, Egbi, Elo (Nigeria); Ejen (Cameroon); Awawai, Kokrodua (Ghana); Mohole (the Netherlands); Ole (Zimbabwe); Satinwood (Benin)
<b>Scientific synonyms:</b>	<i>Afrormosia elata</i> Harms
<b>Subject to CITES regulations:</b>	Only logs, sawn wood and veneer sheets
<b>Macroscopic characteristics of the wood:</b>	<p>Wood: light brown, diffuse porous with distinct growth rings. The sapwood and heartwood are easily distinguishable; the sapwood is yellowish white to light brown, rarely more than 25 mm wide. The heartwood is initially orangish brown to brown, but usually becomes yellowish brown or olive green that later darkens. The wood resembles teak, but when exposed to light it darkens to brown and its texture is finer with interlocked grain, which forms a banded pattern. Without characteristic odour or taste. The fibres are typically straight, sometimes slightly interlocked.</p> <p>Hardness: semihard to hard          Grain: fine to medium (as fine as teak, but not as oily)          Specific weight: 0.69 – 0.76 g/cm<sup>3</sup></p>
<b>Microscopic characteristics of the wood:</b>	<p>Growth rings distinct. Vessels diffuse, few, up to 20/mm<sup>2</sup>, solitary or in radial multiples of up to four elements. Tangential diameters of (85 –) 120 (-180) µm. Perforation plates simple. Intervascular bordered pits alternate, vestured and with a diameter of 8 µm. The vessels contain abundant deposits or gum. Parenchyma predominantly vasicentric aliform and confluent, although sometimes arranged in marginal zones, usually layered. Rays homogeneous, usually 4 to 10 cells wide, layered. Fibres thick-walled. Crystals present in septate crystalliferous cells.</p>
<b>Characteristics of the trees:</b>	<p>Trees reach an average height of 40 metres. The trunk usually has buttressed roots, which gives straight trunks of up to 30 metres suitable for timber, with a diameter of up to 1.2 –1.5 metres. The bark peels off in thin sheets, leaving bright reddish brown spots. The species grows in dry areas of semi-deciduous humid forests, with precipitation between 1000 and 1500 mm per year.</p>
<b>Characteristics of trade:</b>	<p>According to the National Academy of Sciences (1979), this species has a texture, fibre and general aspect similar to those of teak. 'Teak' furniture sold in the United States of America is actually African teak.</p>

**Distribution:** Central and western Africa (from Côte d'Ivoire, Ghana, Nigeria to Congo and the Democratic Republic of Congo)



**Use:** The wood of this species is used for naval construction, chairs, fine furniture, flooring, veneers for interior decoration, television and radio cases.

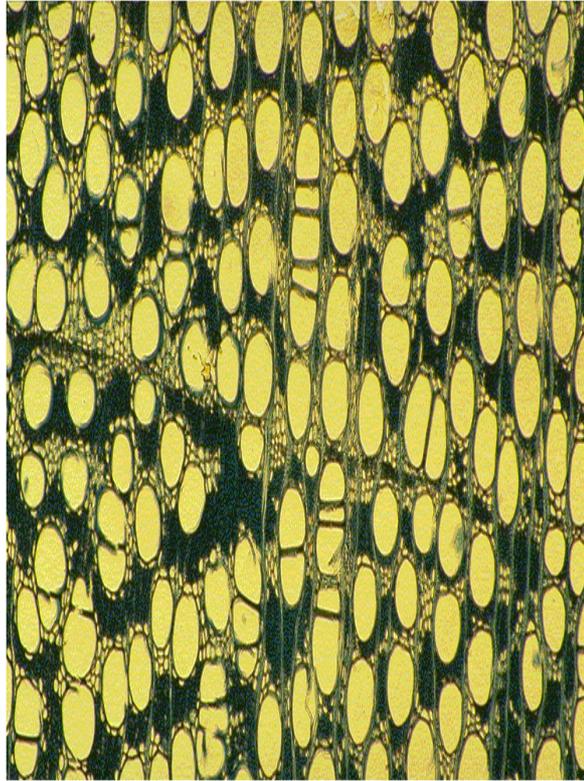
**Similar species:** There are four species in this genus, three of which are found in tropical Africa, although only *Pericopsis elata* is commonly traded.

Other similar species	Distribution	Common name
<i>Clarisia racemosa</i>	South America	Guariuba
<i>Enterolobium schomburgkii</i>	South America	Batibatra

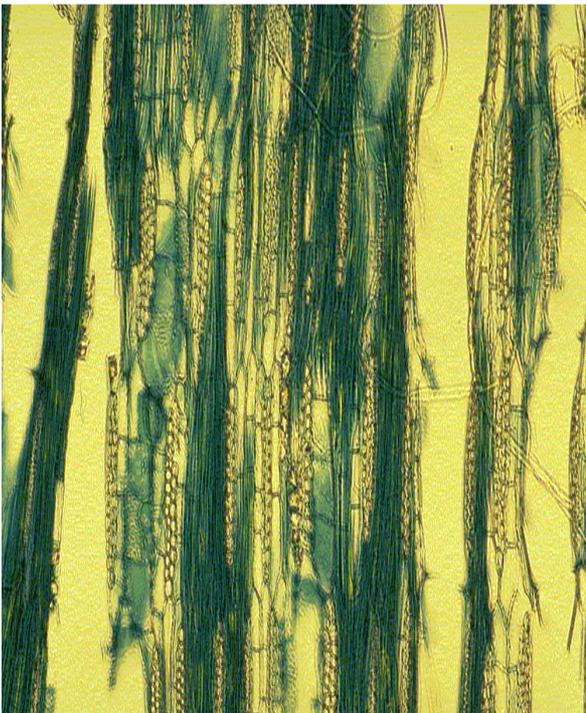
Species →			
Characteristics ↓	<i>Pericopsis elata</i>	<i>Clarisia racemosa</i>	<i>Enterolobium schomburgkii</i>
Colour sapwood	yellowish white	white	light yellow
Colour heartwood	light brown	light brown	light brown
Grain	fine to medium	thick	medium to thick
Fibres	straight, sometimes interlaced	variable	straight to wavy
Hardness	hard	hard	very hard
Specific weight	0.69 - 0.76 g/cm <sup>3</sup>	0.60 - 0.65 g/cm <sup>3</sup>	1.1 g/cm <sup>3</sup>

# Pericopsis elata

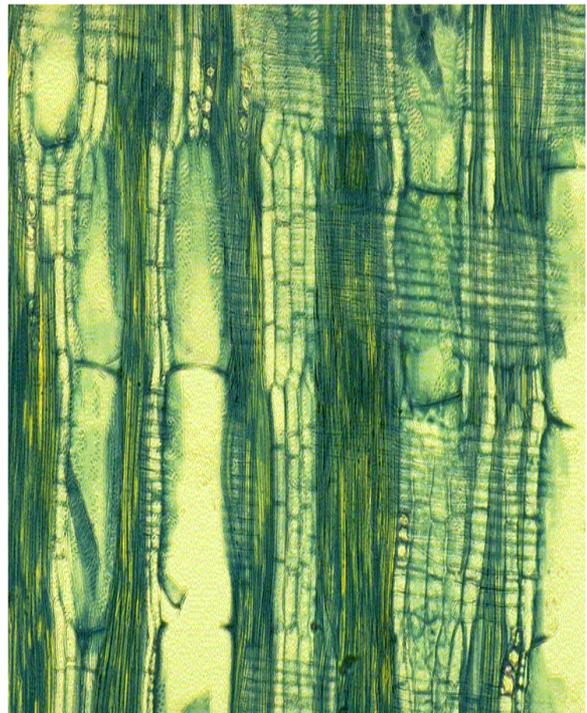




transverse section



tangential section



radial section



**Commercial names:**

engl.:	Red sanders
esp.:	Sándalo rojo
fr.:	Faux santal rouge; Papita

**Common names:**

Reino Unido	Red Sandal Wood
Beng. & Hindi:	Lalchandan, Raktachandan
Guj.:	Ratanjali
Kan.:	Agaru, Honne
Mal.:	Patrangam, Tilaparnni
Tam.:	Atti; Sivappu; Chandanam, Lal Chan
Tel.	Agarugandhamu, Raktagandhamu Yerra, Chandanum

**Subject to CITES regulations:** Logs, wood-chips and unprocessed broken material

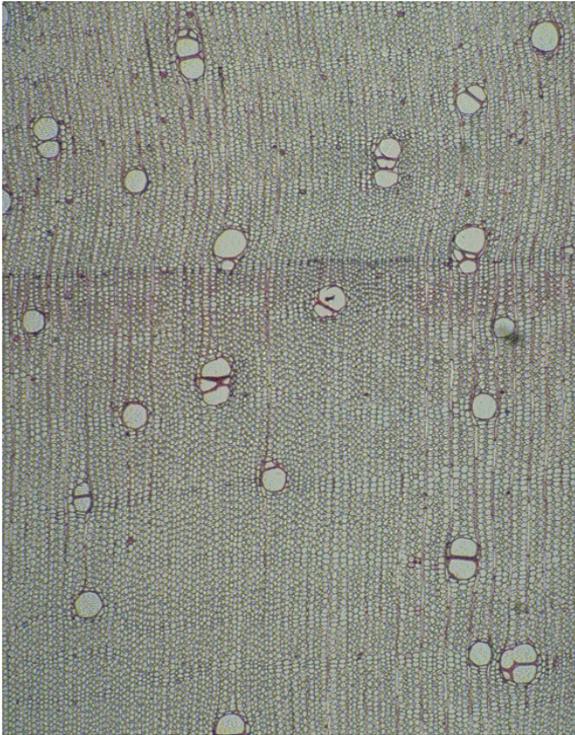
**Macroscopic characteristics of the wood:** Wood pinkish purple, diffuse porous, growth rings distinct. Sapwood and heartwood well differentiated. The sapwood is white, the heartwood is orangish red when recently cut, later it turns pinkish purple with blackish purple lines. Fibres interlocked, sometimes straight.  
Hardness: hard and heavy  
Grain: fine to medium  
Specific weight: 0.80 – 0.99 g/cm<sup>3</sup>

**Microscopic characteristics of the wood:** Growth rings distinct. Diffuse porous. Vessels of medium and small dimensions 110 – 250 µm long, sometimes very small; usually solitary sometimes in radial multiples, 4 – 14 per mm<sup>2</sup>. Average tangential diameter 150 – 175 µm short, 110 – 250 µm long. Perforation plates simple. Intervascular pit vestured. Reddish brown deposits or gum inside the vessel elements. Axial parenchyma predominantly paratracheal aliform or confluent, sometimes in bands, layered, sometimes apotracheal marginal. Rays uniseriate, occasionally biseriate, very fine, homocellular and arranged in layers. Libriform fibres thin, not septate, 500 – 1420 µm long. Crystals frequent in septate cells.

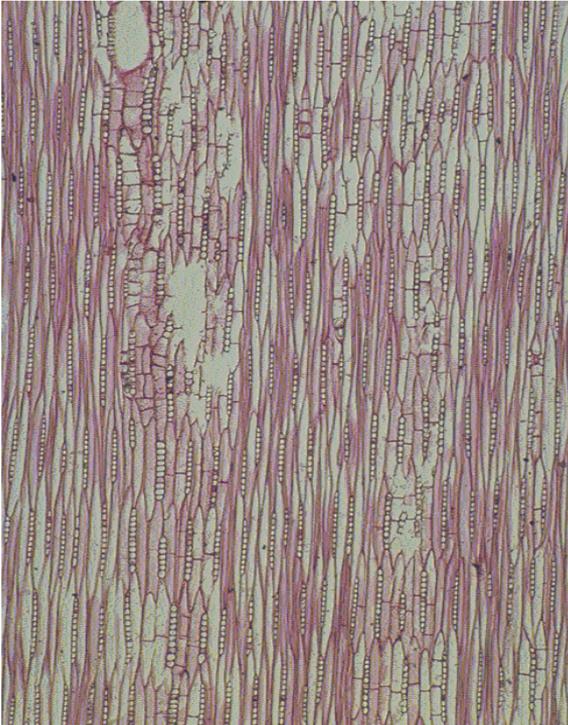
**Characteristics of the trees:** It is a deciduous tree of medium to small height (approximately 10 metres tall), with straight trunk and rounded crown. The bark is blackish to brown and is divided with rectangular plaques. When cut, the bark produces a red exudate. It grows on dry, often rocky, hills, occasionally on cliffs, at altitudes between 150 and 900 metres.

**Characteristics of trade:** Commonly known as Raktachandan, its wood is of high quality. It is traded primarily in the form of logs, sawn wood or as sawdust.

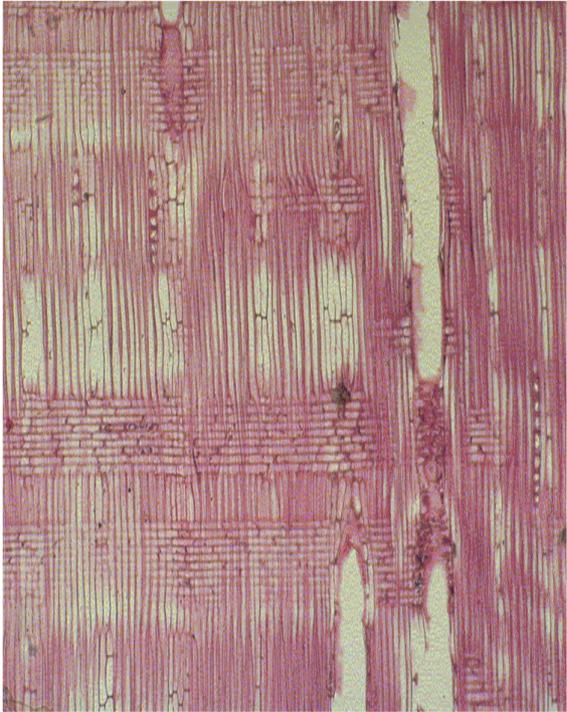
# Pterocarpus santalinus



transverse section



tangential section



radial section



# Pachycereus militaris

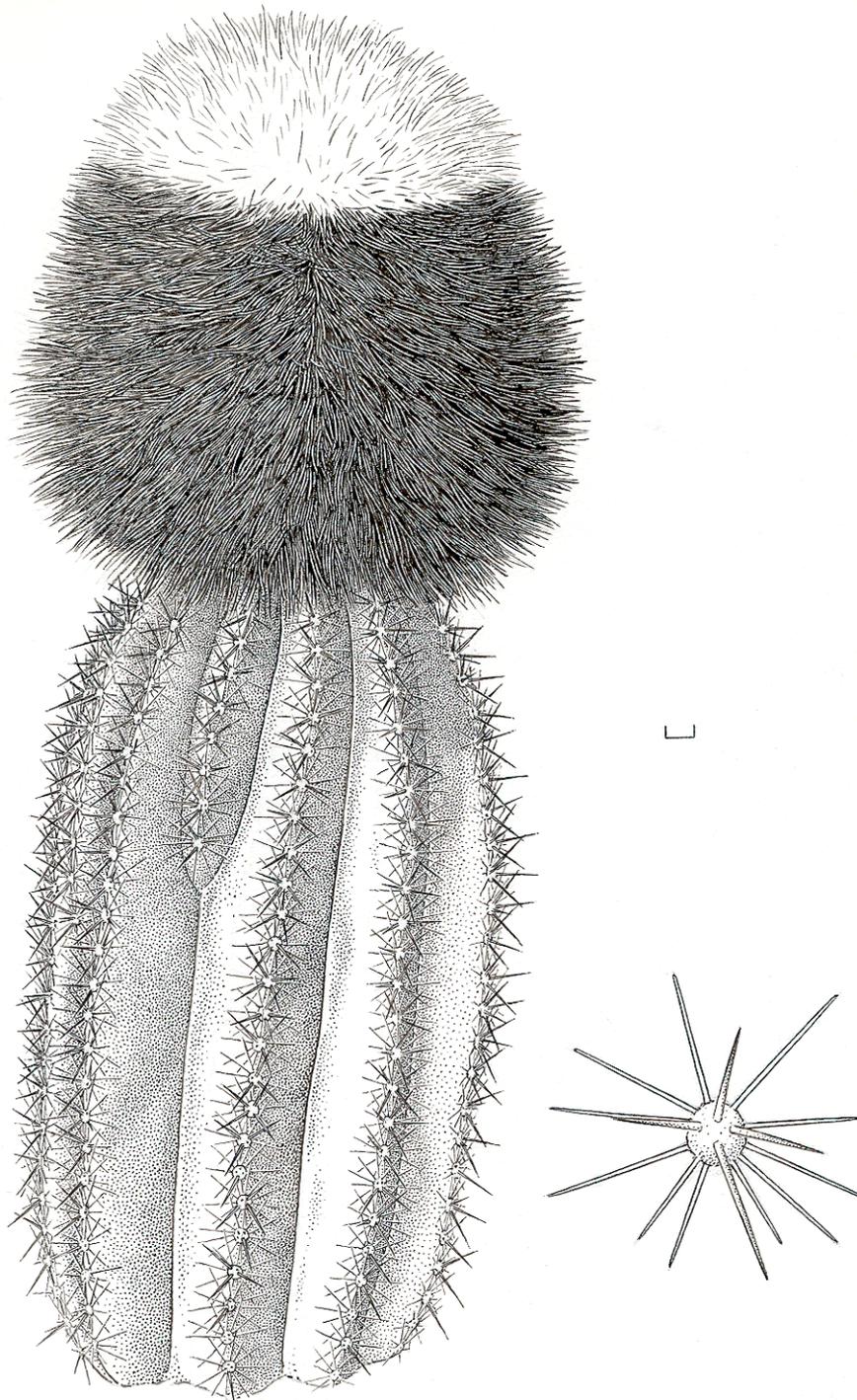
(Audot) Hunt 1987

**Common names:** engl.: Grenadier's Cap

**Scientific synonyms:**

- = *Cereus militaris* Audot 1845
- = *Mitrocereus militaris* (Audot) Bravo 1961
- = *Backebergia militaris* (Audot) Sanchez Mejorada 1973
- = *Cephalocereus militaris* (Audot) Moore 1975
- *Pilocereus chrysomallus* Lem. 1847
- = *Cephalocereus chrysomallus* (Lem.) Schumann 1894
- = *Pachycereus chrysomallus* (Audot) Britton & Rose 1909
- = *Backebergia chrysomalla* (Lem.) Bravo 1953

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



bar = 1 cm

<b>Characteristics:</b>	Tall, candelabriform tree with many upright branches, some branches crowned with characteristic, apically golden, below dark brown to black, densely bristly cephalia (flowering regions), similar in appearance to the headwear of the British palace guards (hence the species name). Wild collected specimens were introduced to cultivation as rooted, cephalium-bearing cuttings, ca. 1 m tall or less. Seedlings and immature specimens are without special characteristics, compared with related columnar cacti, especially of the genus <i>Pachycereus</i> .
Roots:	Fibrous.
Stem:	Arborescent and much branched, to 5 or 6 m tall, with a well defined trunk, branches $\pm$ erect, dark greyish green, about 12 cm $\varnothing$ .
Ribs:	(5-) 9-11, about 3.5 cm high.
Areoles:	Small, 5-10 mm apart.
Spines:	
Radial spines:	7-13, straight, thin, acicular, about 1 cm long.
Central spines:	1-5, similar to the radials.
Cephalium:	Fertile, terminal part of stem densely bristly, golden yellow in the apex, dark brown to almost black below, 18-20 cm $\varnothing$ , usually up to 25-30 cm tall, but occasionally twice that size or more at which age it tends to rot and disintegrate. Not all branches bear this flowering head or cephalium, but in some plants a quarter to a third of the branches bear cephalia.
Flowers:	Arising from the cephalium, nocturnal, staying open into the morning, 3.5-4 cm $\varnothing$ , 6-7 cm long, opening widely, greenish cream, tube covered with abundant scales and hairs.
Fruits:	Subglobose, fleshy with red or purple pulp, generally densely bristly.
Seeds:	4 mm long, 3 mm $\varnothing$ , shiny black, seedcoat punctuate.

**Distribution:** States of Michoacán and Guerrero, Mexico.



**Trade:** Heavy exploitation for commercial trade was reported in the 1970s and 1980s (U. S. Fish and Wildlife Service 1983), rooted cuttings of cephalium-bearing branches, collected in the habitat, were popular as collectors items. Whole trees were felled in order to obtain these cuttings. They usually didn't last long in cultivation and at best produced new branches below the cephalium, which may be cut off and rooted and after many years may reach adult morphology again. Most specimens have disappeared since. There is not much demand for seedlings, as the cephalium is, what collectors really want. Cephalium-bearing specimens from artificial propagation are not yet reported in trade. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001.

**Similar species:** No other columnar cactus produces similar cephalia. Sterile specimens (lacking a cephalium) however are not easily identifiable, but they are probably seldom in trade anyhow. *Melocactus* (CITES App. II with 4 species in App. I) and *Discocactus* (CITES App. I), which also can bear conspicuous cephalia, are small to medium sized, unbranched, globose or barrel-shaped cacti with the diameter of the cephalium considerably smaller than the stem diameter and rather woolly than bristly cephalia.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Bravo-Hollis, H. (1978): Las Cactáceas de México, ed. 2 (vol 1). Mexico: Universidad Nacional Autónoma de México.  
 Glass, C. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
 Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Panax quinquefolius

L.



**Family:** Araliaceae

**Synonyms:** *Aralia canadensis* Tourn.  
*Aralia quinquefolia* Decne. & Planch.  
*Aureliana canadensis* Lafit.  
*Ginseng quinquefolium* Wood  
*Panax americanum* Raf.

**Vernacular names:**

english:	American ginseng, Canadian ginseng, celery-leaved panax, dwarf groundnut, five fingers, ginseng, man's health, manroot, occidental ginseng, wulong ginseng
french:	Ginseng américain, ginseng d'Amérique, ginseng à cinq folioles
spanish:	Ginseng americano
german:	Amerikanischer Ginseng, Finger-Kraftwurz
italian:	Ginseng americano

**Geographical range:** Mainly in the east of North America; in Canada from the south of Quebec and Ontario to Manitoba, in the United States of America in the south to Georgia and Alabama and eastwards to Minnesota, Iowa (Nebraska), Missouri, Oklahoma and Louisiana.

**Distribution by country:** Canada, United States of America.

**Protection:** CITES Appendix II (#3), since 01.07.1975

**Use:** Medicinal and aromatic plant, also used in TEAM, horticultural plant.

## Botanical drugs in trade

**Plant parts used:** Roots.

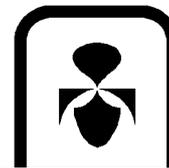
**Pharmaceutical names:**

latin:	Panacis quinquefolii radix, Ginseng radix, Radix Panax quinquefolius, Radix quinquefolium, Aralia quinquefolia (homeopathy.), Panax quinquefolium (homeopathy.)
english:	American ginseng root, five fingers root, five-leaved panax root, red berry, Tatar root
french:	Racine de ginseng américain
spanish:	
chinese:	Huaqishen, Xiyangshen, Babaiguangshen
german:	Amerikanische Ginsengwurzel, amerikanischer Ginseng, Ginsengwurzel, Panax-quinquefolius-Wurzel
italian:	Radice di ginseng americano
japanese:	Seiyojin
korean:	Soyangsam

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<b>Countries of export:</b>	<b>Canada</b> (commodities obtained by cultivation), <b>United States of America</b> (commodities obtained by cultivation and wild collection); for more details see under source. Re-exports : Australia, Japan, Malaysia, Myanmar, the Netherlands, Russian Federation, Singapore, China (including Hong-Kong SAR and the Province of Taiwan), and Republic of Korea.
<b>Source:</b>	Mainly cultivation [above all Canada and United States of America, additionally i.a. Australia, Belgium, China, France, Japan, Taiwan (Province of China), and the Netherlands], but also from cultivation on wild stands (United States of America, so-called "woodsgrown" -commodity) and wild collection (United States of America).
<b>Commodities in trade:</b>	Mainly dried, whole roots, variable in size and shape (degree of quality), obtained from cultivation, cultivation on wild stands ("woodsgrown") or wild collection (crude drug), mainly whitish (white ginseng), sometimes peeled, very rarely treated differently after harvest and then becoming reddish coloured (red ginseng); also variably-diminished roots (cut drug); in addition powdered roots (not subject to CITES) and fresh roots.
<b>Characteristics:</b>	
Crude drug:	(Fig. 1-4) Roots cylindrical or spindle-shaped, (2-)5-20 cm long, 0.5-3 cm thick at the top, tapering towards the bottom and often bent, from the mid-section sometimes repeatedly divided (forked) into root branches, very hard, brittle and not easily broken (but absorbing water easily and softening after swelling); fracture not fibrous; external surface longitudinally wrinkled and with distinct transverse ringings, and scattered, elliptical root scars; often with the remains of the shoots (rootstock, also known as neck or collar) with elliptical to circular, somewhat impressed stem scars, at the top; <b>White Ginseng:</b> Roots unpeeled, surface (dark) grey-yellow, light brown to yellowish-white with scattered small orange dots (resin glands); transverse section pale yellow to whitish with distinct brownish yellow ring and yellowish to brown dots (resin ducts) in the outer part; partly or completely peeled roots are traded as Babaiguangshen; <b>Red Ginseng:</b> External surface dark reddish brown with light to dark brown spots, horny, tough, partly glassy translucent; longitudinal and transverse ringing less visible as in White Ginseng; branches often torsive or crossed over; Cultivated roots: Roots mainly thick, strong; transverse ringing distinctly remoted; colour of white ginseng light brown to yellowish white; rootstock head-shaped, short, thick, with 3-5 big, circular to elliptical, densely covered (stem) scars; Woodsgrown roots: This commodity shows characters of the wild roots as well as of the cultivated roots, but resembles the cultivated roots more: roots stronger than wild roots, the transverse ringing partly distinctly remote, the rootstock strong and the stem scars big, but in contrast to the cultivated roots of dark grey yellow colour; Wild roots: Roots mainly long and slender, of (dark) grey-yellow colour; very densely transverse ringed in particular at the top; rootstock clearly separated from the root, small, elongated, often bent or tortuous, often with numerous small, ovate to almost circular, stem scars; Wild simulated roots: These roots are very similar to wild roots, and in many cases distinguishing them from genuine wild roots is very difficult or even impossible; Remarks: 1) The number of stem scars depends on the age of the root when harvested. In cultivation one shoot is formed annually, but in the wild not necessarily. The roots of cultivated plants are harvested after 3-4 years, accordingly the number of stem scars amounts to 3-4. "Woodsgrown" roots often show more than 3-4 stem scars since they are only harvested after 5-6(-7) years. "Wild-simulated" roots are even harvested after 6 years at the earliest and may stay up to 12 years or even longer in the soil. Accordingly, the number of stem scars is higher. The age of the wild-collected roots varies greatly, and the

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older ones are more valued. The great majority of such roots show (distinctly) more than 4 stem scars.

- 2) Wild and "wild-simulated" roots are traded mainly (always?) whole, since the age of the roots are only recognizable in whole roots and in this state only may their value be assessed (see previous paragraph).
- 3) Red ginseng is always obtained from cultivated roots.

Cut drug:	(Fig. 5) Root slices: Roots cut into thin, 1-3 mm thick, circular to ovoid, oblique slices or chips; margin irregularly slightly lobed and bent upwards;
	<b>White ginseng:</b> Transverse section white to yellowish, cartilaginous, brittle; in the outer third with distinctly visible dark ring and with yellowish to brown dots (resin ducts) in the outer part (see also "Crude drug");
	<b>Red Ginseng:</b> Transverse section smooth, translucent, reddish brown; in the outer third part with clearly visible lighter ring; centre darker coloured than the margin;
	Root pieces: Roots cut in irregular pieces, to about 10 mm long; characters (see "Root slices") hardly visible;
Odour:	Weakly aromatic, somewhat peculiar;
Taste:	weakly aromatic, at first slightly bitter, then sweetish and mucilaginous.

#### Similar drugs/ adulterations:

***Panax ginseng*** C.A. Meyer (English: Chinese ginseng, ginseng, Korean ginseng, Oriental ginseng; German: Ginseng, Koreanischer Ginseng, Chinesischer Ginseng): in trade known as Ginseng radix or Radix ginseng (English: Ginseng root; French: racine de ginseng chinois; Chinese: Renshen; German: Ginsengwurzel, Kraftwurzel);

Distribution: Northeast China, Democratic People's Republic of Korea (probably extinct) and in the southeast of the Russian Far East (province Primorje);

Countries of origin: Mainly Republic of Korea (only artificially propagated), then China (including Hong Kong SAR), Democratic People's Republic of Korea Japan;

Commodities in trade: Roots obtained from cultivation (Yuanshen) are traded at different ages and in many different commodities: fresh whole roots, also in alcohol, dried whole roots, thick or long and slender, peeled (Baiganshen) or unpeeled, straight ("straight") or rolled in the lower part ("curved"), white (English: Asian/China/Korean white, white chinese ginseng root; Chinese: Baishen, Shenghaishen; German: weißer Ginseng; Korean: Paksam) or red, glassy, horny roots (Latin: Ginseng radix rubra; Chinese: Hongshen; German: roter Ginseng; Korean: Hongsam), lateral roots ("slender tails" or "fibres"), the same cut in slices or in small pieces, additionally the powdered roots, freeze-dried roots (Huoxingshen) or roots soaked in syrup (Tangshen, Taopishen). Wild-collected roots (Shanshen) are always processed by sun drying or by hot air;

Characteristics: The cultivated and the wild roots are very similar to those of *P. quinquefolius*, but they show many more lateral roots, which are mainly cut when producing the drug. The Russian wild roots are easily recognizable, since main and lateral roots are wrapped with a thin string. In most cases neither macroscopic nor microscopic examinations allow to the differentiation of roots of *P. ginseng* and of *P. quinquefolius*. Identification is only possible by using thin layer chromatography and other chemical investigations (polymerase chain reaction).

**References:**

- Carlson, A.W. (1986): Ginseng. America's botanical drug connection to the Orient. – *Economic Botany* 40: 233-249.
- Persons, W.S. (1994): *American ginseng, green gold*, rev. ed. – 201 pp.; Asheville, North Carolina (Bright Mountain Books, Inc.).
- Robbins, C.S. (1998): *American ginseng: The root of North America's medicinal herb trade*. – 94 pp.; Washington (TRAFFIC North America).
- Small, E., P.M. Catling & E. Haber (1994): Poorly known economic plants of Canada. 4. Ginseng, *Panax quinquefolius* L. – *CBA/ABC Bulletin* 27(4): 70-72.



Figure 1. Crude drug of whole roots, wild collected, *Panax quinquefolii* radix ; species: *Panax quinquefolius*, (copyright BfN).



Figure 2. Crude drug of cultivated roots, *Panax quinquefolii* radix ; species: *Panax quinquefolius*, (copyright BfN).



Figure 3. Crude drug of cultivated roots, Ginseng radix; species: *Panax quinquefolius*, (copyright BfN).



Figure 4. Crude drug of woodsgrown roots, Ginseng radix; species: *Panax quinquefolius*, (copyright BfN).



Figure 5. Cut drug of cultivated roots, *Panax quinquefolii* radix – Chips; species: *Panax quinquefolius*, (copyright BfN).

# Pediocactus bradyi ssp. bradyi

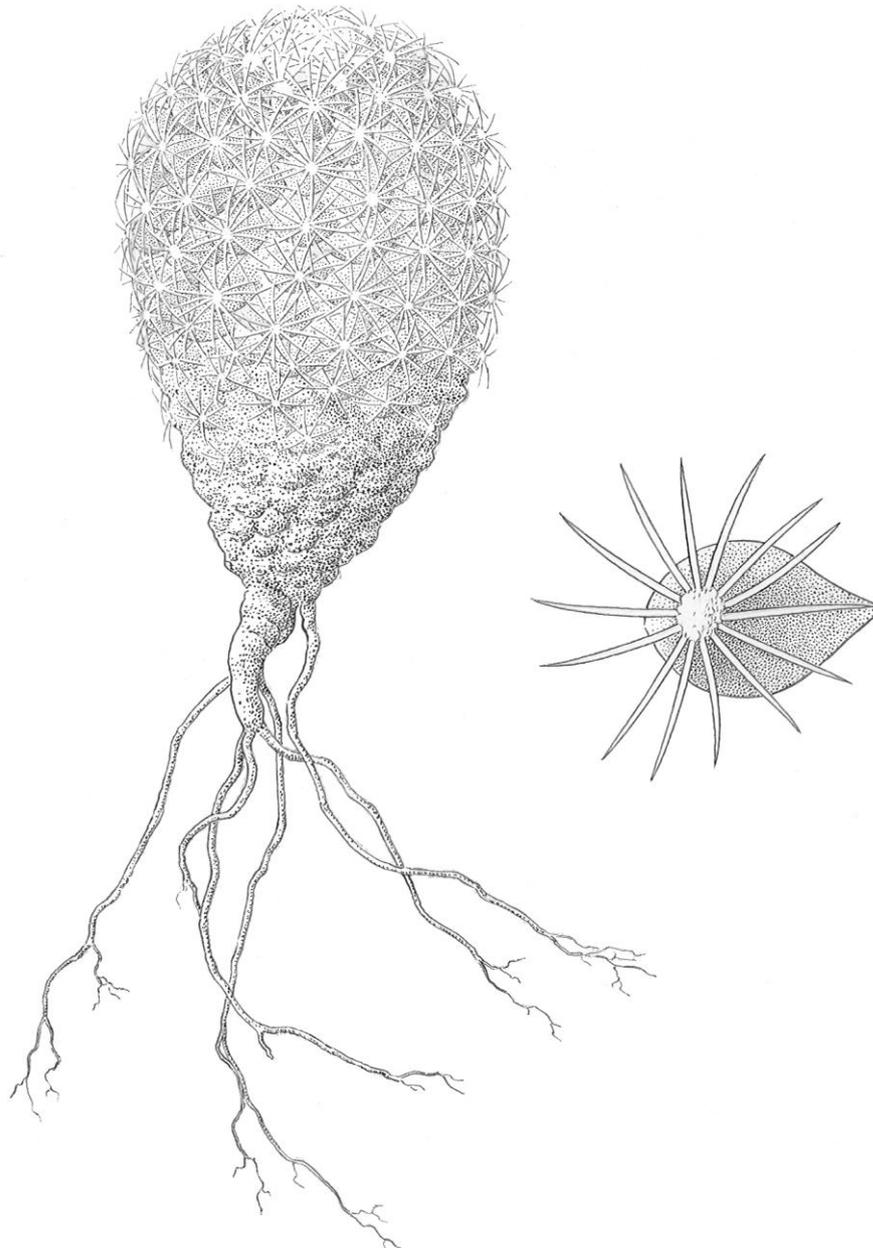
L. Benson 1962



**Common names:** engl.: Marble Canyon cactus, Brady pincushion cactus

**Scientific synonyms:** = *Toumeyia bradyi* (L. Benson) W. E. Earle 1963  
= *Pediocactus simpsonii* ssp. *bradyi* (L. Benson) J. J. Halda 1998  
= *Puebloa bradyi* (L. Benson) Doweld 1999

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Extremely cryptic and dwarf, soft textured, globular cactus, solitary, whitish-green with rounded tubercles, densely covered by white, radiating, partly interwoven spines with characteristic, slightly pectinate arrangement. The plants are blending extremely well with the white limestone gravel, in which they exclusively grow. Barely protruding from the substrate in habitat in spring and largely retreating underground during dormant periods. Found on low hills with gravelly, alkaline soil in Navajoan Desert.

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**Roots:** Napiform, branching, strongly succulent.  
**Stem:** Solitary (even when grafted), globose to ovoid, 3-6 cm high, 2-5 cm Ø, whitish-green, obscured by the spines; with a deep-seated, tapering subterranean stem base, only the stem apex emerging from the substrate.  
**Tubercles:** Rounded, apically truncate, 3.0-4.5 mm long and Ø.  
**Areoles:** Elongated, elliptic, 1.5-3.0 mm long, 0.7-1.5 mm wide, typically ± 3 mm apart, with quite persistent, short, white wool.  
**Spines:**  
    **Radial spines:** (7-) 14-15 (-18), 3-6 mm long, ± 0.7 mm Ø at base, horizontally spreading, slightly pectinate, white or yellowish-tan, straight, acicular, partly interwoven.  
    **Central spines:** Normally lacking, rarely 1-2, straight, darker than radials, ± 4 mm long.  
**Flowers:** March, 1-6 from the centre of the stem apex, 1.5-2.5 cm long, 1.5-3.2 cm Ø, straw-yellow to cream.  
**Fruits:** Spherical, greenish, drying and splitting open at maturity, 6 mm long, 7.5 mm.  
**Seeds:** 2.8 mm long, 1.7-2 mm wide, 1.5 mm thick, black with finely tuberculate and remarkably wrinkled seedcoat.

**Distribution:** State of Arizona, USA



**Trade:** Regional endemic of northern Arizona, restricted to Marble Canyon in Coconino County. Scattered and hard to locate in the field. Not very easy in cultivation, usually grafted in early seedling stage or more often propagated vegetatively by grafting branches of grafted motherplants. Branching can be forced by cutting off the stem apex of a grafted specimen. Cultivated and traded mainly as grafted specimens, artificially propagated in USA and Europe. Not much distributed in collections and demand quite moderate. Rather a curiosity collected by specialists than appreciated by the general public. The fame of rareness rather than its attractiveness makes this cactus interesting for collectors. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** Can easily be confounded even by experts with ssp. *winkleri* (K. D. Heil) Hochstätter and ssp. *despainii* (S. L. Welsh & Goodrich) Hochstätter without locality data, because of partly overlapping characters. Differs from both by the distinctly elongated areoles with slightly pectinate arrangement of the spines, which are notably thicker, obscuring the stem and lending the plant a distinctively whiter aspect. Ssp. *winkleri* differs additionally by a characteristic, prominent woolly tuft in the centre of the areole, ssp. *despainii* by usually nearly naked areoles and slightly longer, very thin spines. *P. knowltonii* L. Benson could be confounded for similar stem characters, but can easily be identified for its strongly appressed (directed backwards), very short, more numerous spines. Further, small specimens of *Sclerocactus pubispinus* (Engelmann) L. Benson could be confounded for similar appearance of stem, spines and flowers, but has thicker and longer spines and a bigger areole diameter; older specimens have central spines and tubercles confluent into ribs and don't resemble *Pediocactus* anymore.

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Günther, F. (1993): *Pediocactus despainii* Welsh & Goodrich. *Kakt. and. Sukk.* 44 (3): 49-53.  
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Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Pediocactus bradyi

## ssp. despainii

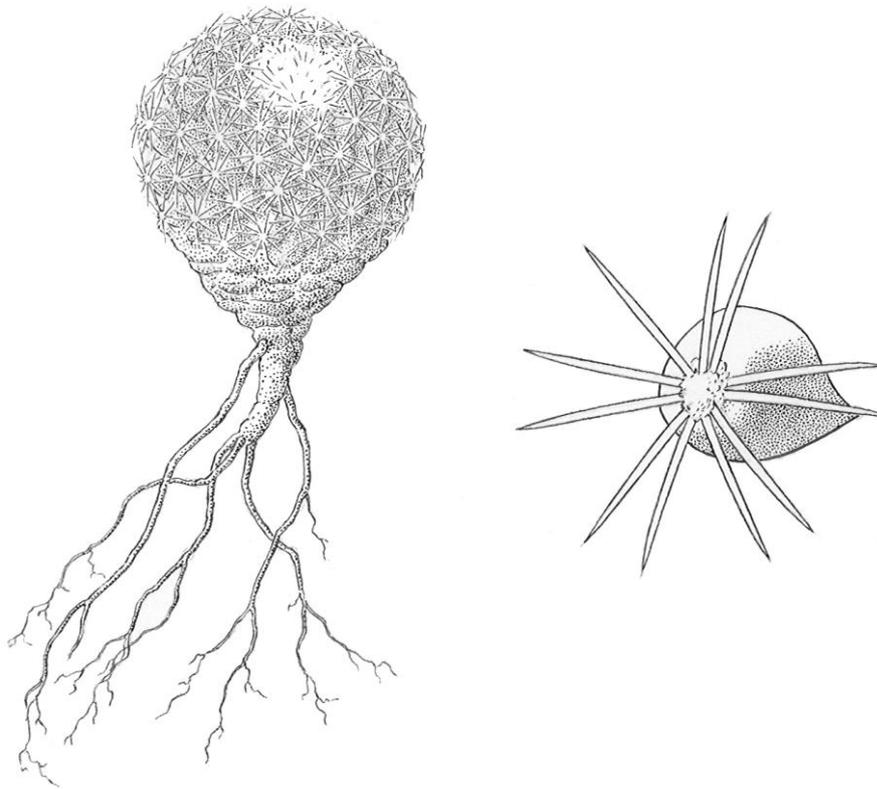
(S. L. Welsh &amp; Goodrich) Hochstätter



**Common names:** engl.: San Rafael cactus

**Scientific synonyms:** = *Pediocactus despainii* S. L. Welsh & Goodrich 1980  
 = *Pediocactus bradyi* var. *despainii* (S. L. Welsh & Goodrich) Hochstätter 1994  
 = *Pediocactus simpsonii* var. *despainii* (S. L. Welsh & Goodrich) J. J. Halda 1998  
 = *Puebloa bradyi* var. *despainii* (S. L. Welsh & Goodrich) Doweld 1999

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Rather unspectacular, extremely cryptic and dwarf, soft textured, globular cactus, solitary, whitish-green with rounded tubercles and rather sparse, white spination. Barely protruding from the substrate in habitat in spring and largely retreating underground during dormant periods. Found on plains with gravelly, alkaline soil in open Juniper-Pinyon woodland.

**Roots:** Napiform, branching, strongly succulent.

**Stem:** Solitary or (less frequently) branching, globose or slightly elongated, 3-9 cm high, 3-6 (-9.5) cm Ø, whitish-green, sparsely covered with thin, white spines; deep-seated, tapering subterranean stem base, only the stem apex emerging from the substrate..

**Tubercles:** Rounded, apically truncate, 6-12 mm long, and Ø.

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**Areoles:** Elliptic, 1.6-3 mm long, 0.7-1.6 mm wide, with sparse, deciduous, white wool.  
**Spines:**  
    **Radial spines:** 7-15, 2-6 mm long, to 0.7 mm  $\varnothing$  at base, radiating, horizontally spreading, thin, acicular, white to grey.  
    **Central spines:** None.  
**Flowers:** May, 1-4 from the centre of the stem apex, 1.5-2.5 cm long, 1.8-2.5 (-4) cm  $\varnothing$ , yellowish-orange (apricot) to faint rose, fragrant.  
**Fruits:** Spherical, greenish, drying and splitting open at maturity, 10-12 mm long, 8-12 mm  $\varnothing$ .  
**Seeds:** 3.0-3.5 mm long, 2.0-2.5 mm high, black with finely tuberculate and remarkably wrinkled seedcoat.

**Distribution:** State of Utah, USA.



**Trade:** Regional endemic of central Utah, restricted to the San Rafael Swell in Emery County. Extremely scattered and hard to locate in the field. Under severe threat from all-terrain vehicles and cattle breeding. Not very easy in cultivation, usually grafted in early seedling stage or more often propagated vegetatively by grafting branches of grafted motherplants. Branching can be forced by cutting off the stem apex of a grafted specimen. Cultivated and traded mainly as grafted specimens, artificially propagated in USA and Europe. Not much distributed in collections and demand quite moderate. Rather a curiosity collected by specialists than appreciated by the general public. The fame of rareness rather than its attractiveness makes this cactus interesting for collectors. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** Can easily be confounded even by experts with ssp. *bradyi* L. Benson and ssp. *winkleri* (K. D. Heil) Hochstätter without locality data, because of partly overlapping characters. Differs from ssp. *winkleri* by considerably bigger maximum stem diameter, usually nearly naked areoles (vs. a persistent, prominent woolly tuft in the centre of the areole) and slightly longer, very thin spines as well as a tendency not to branch even when grafted. Ssp. *bradyi* has a smaller stem, rather more and distinctively stronger spines, more persistent wool in the areoles, elongated areoles with a slightly pectinate arrangement of the spines, an overall whiter and more densely spined aspect and yellow flowers. *P. knowltonii* L. Benson is quite similar, but easily identifiable for its strongly appressed (directed backwards), very short, more numerous spines. Subadult specimens of *P. paradinei* B. W. Benson, still lacking the characteristic, long central spines, look very similar, but have more (13-22) and longer radials. For its thin spines and nearly naked areoles, it could be confounded further with subadult specimens of *Pediocactus simpsonii* (Engelmann) Britton & Rose (CITES App. II), which still lack central spines, but these usually have much more (12-30) radials.

**Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California.  
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Günther, F. (1993): *Pediocactus despainii* Welsh & Goodrich. *Kakt. and. Sukk.* 44 (3): 49-53.  
Heil, K., B. Armstrong & D. Schleser (1981): A Review of the genus *Pediocactus*. *Cact. Succ. J. US* 53 (1): 17-39.  
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Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Pediocactus bradyi

## ssp. winkleri

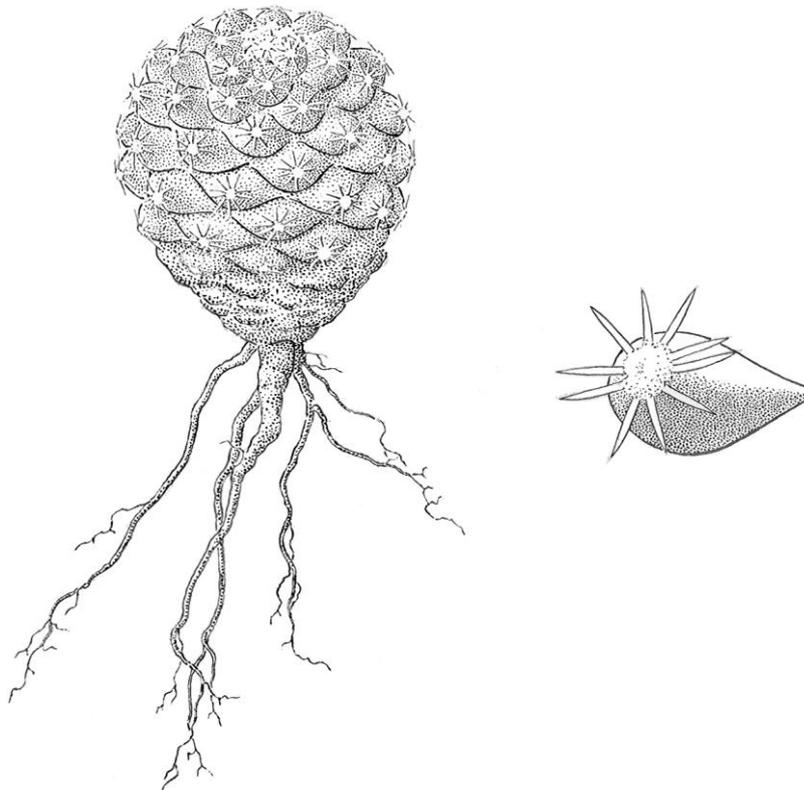
(K. D. Heil) Hochstätter 1995



**Common names:** engl.: Winkler's cactus

**Scientific synonyms:** = *Pediocactus winkleri* K. D. Heil 1979  
 = *Pediocactus bradyi* var. *winkleri* (K. D. Heil) Hochstätter 1994  
 = *Pediocactus simpsonii* var. *winkleri* (K. D. Heil) Halda 1998  
 = *Puebloa bradyi* ssp. *winkleri* (K. D. Heil) Doweld 1999

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Extremely cryptic and dwarf, soft textured, globular cactus, solitary, whitish-green with rounded tubercles, sparsely covered by white, radiating, spines. Areoles with small, protruding clusters of white wool. The plants are blending extremely well with the grey limestone gravel and clay, in which they grow. Barely protruding from the substrate in habitat in spring and largely retreating underground during dormant periods. Found on low clay hills (bentonite) with alkaline soil in Navajoan Desert.

**Roots:** Napiform, branching, strongly succulent.

**Stem:** Mostly solitary (rarely branching with 2-4 stems, readily branching when grafted), globose to obovoid, 3.5-7 cm high, 2.5-5 cm Ø, whitish-green, not obscured by the spines; with a deep-seated, tapering subterranean stem base, only the stem apex emerging from the substrate.

Tubercles:	Rounded, apically truncate, 4-6.5 mm long and 5-7 Ø.
Areoles:	Mostly elliptic, 1.4-2.8 mm long, 1 mm wide, with abundant and very persistent, short, white wool, forming a small, protruding tuft.
Spines:	
Radial spines:	(8-) 9-11 (-16), 1.5-4 mm long, ± 0.7 mm Ø at base, horizontally spreading, sometimes slightly pectinate, white, straight, acicular, not interwoven.
Central spines:	0
Flowers:	April to may, 1-8 from the centre of the stem apex, 1.7-2.2 cm long, 1.7-3 cm Ø, pale salmon-coloured or peach-coloured to deep pink.
Fruits:	Spherical, greenish, drying and splitting open at maturity, 7-10 mm long, 8-12 mm Ø.
Seeds:	2.8-3 mm long, 1.6-2.2 mm wide, black with finely tuberculate and remarkably wrinkled seedcoat.

**Distribution:** State of Arizona, USA



**Trade:** Regional endemic of southern Utah, restricted to east of Capitol Reef in Wayne County. Scattered and hard to locate in the field. Not very easy in cultivation, usually grafted in early seedling stage or more often propagated vegetatively by grafting branches of grafted motherplants. Branching can be forced by cutting off the stem apex of a grafted specimen. Cultivated and traded mainly as grafted specimen, artificially propagated in USA and Europe. Not much distributed in collections and demand quite moderate. Rather a curiosity collected by specialists than appreciated by the general public. The fame of rareness rather than its attractiveness makes this cactus interesting for collectors. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** Can easily be confounded even by experts with ssp. *bradyi* L. Benson and ssp. *despainii* (S. L. Welsh & Goodrich) Hochstätter without locality data, because of partly overlapping characters. Differs from both by the protruding tufts of wool in the areoles and the rather short, not interwoven spines, not obscuring the stem. *P. knowltonii* L. Benson could be confounded for similar stem characters, but can easily be identified for its strongly appressed (directed backwards), very short and more numerous spines.

**Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California.  
 Benson, L. (1961-62): A revision and amplification of *Pediocactus*. *Cact. Succ. J. (US)* 33: 49-54, 34: 17-19, 57-61, 163-168.  
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 Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.



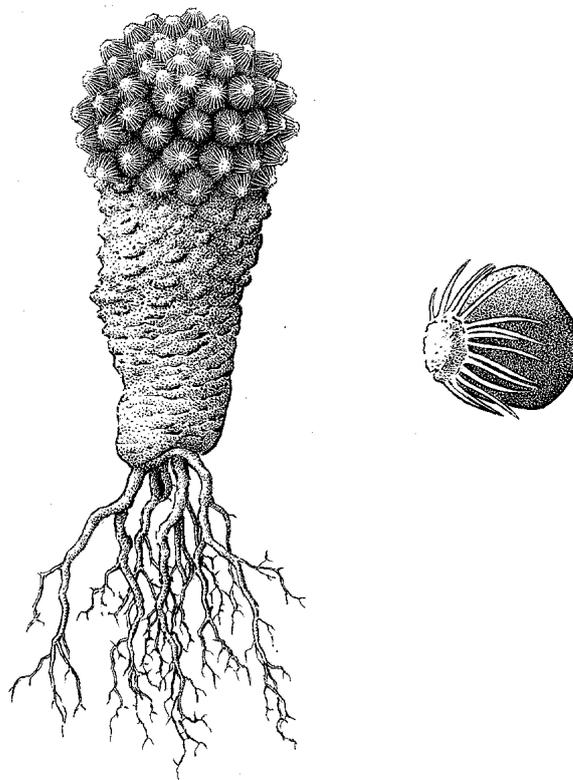
# Pediocactus knowltonii

L. Benson 1960

**Common names:** engl.: Knowlton's cactus

**Scientific synonyms:** = *Pediocactus bradyi* var. *knowltonii* (L. Benson) Backeberg 1976 (nom. inval.)  
= *Pediocactus simpsonii* var. *knowltonii* (L. Benson) J. J. Halda 1998  
→ *Toumeyia knowltonii* Hort. (invalid name)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** One of the most distinctive cacti. Extremely cryptic and dwarf, soft textured globular cactus, solitary or branching, barely protruding from the substrate in habitat in spring and retreating underground during dormant period. Easily identifiable for the numerous, very short, white, characteristically strongly appressed (directed backwards) spines and a woolly, protruding tuft in the centre of the areole. Found on low hills with open Juniper-Pinyon woodland and gravelly soil.

**Roots:** Fibrous, from a napiform, subterranean stem base.

**Stem:** Solitary or moderately branching (strongly clustering in grafted specimens), (1-) 1.5-2.5 (-3) cm Ø, light grey-green, the stem apex mostly level with the substrate in habitat, with a conspicuous subterranean, contractile, napiform stem base, up to ca. 4 cm long.

**Tubercles** Conical, 1.2-2.5 mm long, 1.5-2 mm Ø at base.

**Areoles:** Round, ± 1 mm Ø, typically 1-3 mm apart, bearing spines and a very characteristic, protruding,

- 
- Spines: woolly tuft in the centre.
- Radial spines: 18-23, dense but not obscuring tubercles, usually white, rarely turning reddish-tan or pink, finely pubescent, characteristically appressed (directed backwards), a character rarely encountered in cacti, 1-1.5 mm long, basally 0.1-0.2 mm  $\varnothing$ , slightly flattened, elliptic in cross section.
- Central spines: Usually none, exceptionally 1-2, minute.
- Flowers: 2-6 from the centre of the stem apex, campanulate, pink, 1-3 cm long,  $\pm$  2 cm  $\varnothing$ . Flower buds often already appearing in autumn, but not further developing until april.
- Fruits: Spherical, greenish, drying and splitting open at maturity,  $\pm$  4mm long, about 3 mm  $\varnothing$ .
- Seeds: 1.5-2 mm long, 1-1.5 mm wide,  $\pm$  0.6-0.7 mm thick, black with tuberculate seedcoat.

**Distribution:** State of New Mexico, USA.



**Trade:** Local endemic with extremely restricted range in the border region of New Mexico towards Colorado, reported from both states in some sources. Has been reduced to near extinction in the wild because of persistent collecting following its description (Fletcher & al. 1984). Probably one of the rarest and geographically most restricted taxa of *Cactaceae*, but fortunately relatively easy in cultivation. Propagated by grafting branches of freely clustering, grafted motherplants or also grown from seeds, which can be produced by pollinating the readily flowering cultivated plants. Relatively widely distributed in collections. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** *P. knowltonii* is one of the easily identifiable cacti. It could be confounded however with sub-adult specimens of *Pediocactus simpsonii* (Engelmann) Britton & Rose (CITES App. II), which still lack central spines, but these have fewer and longer (3-4 mm), not appressed radials and lack the characteristic, protruding, woolly tuft in the centre of the areole. An other dwarf species of *Pediocactus*, *P. bradyi* L. Benson with ssp. *winkleri* (K. D. Heil) Hochstätter and ssp. *despainii* (S. L. Welsh & Goodrich) Hochstätter, is similar in shape, but has fewer and longer, more conspicuous spines (7-18, 2-6 mm long), which are horizontally radiating and not strongly appressed. Especially ssp. *winkleri* also shows very similar, protruding woolly tufts in the centre of the areoles. *Escobaria sneedii* ssp. *leei* (Bödeker) Hunt has similarly appressed, numerous, white radials in subadult stage, but else is a very different, strongly clustering, columnar plant.

**Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California.

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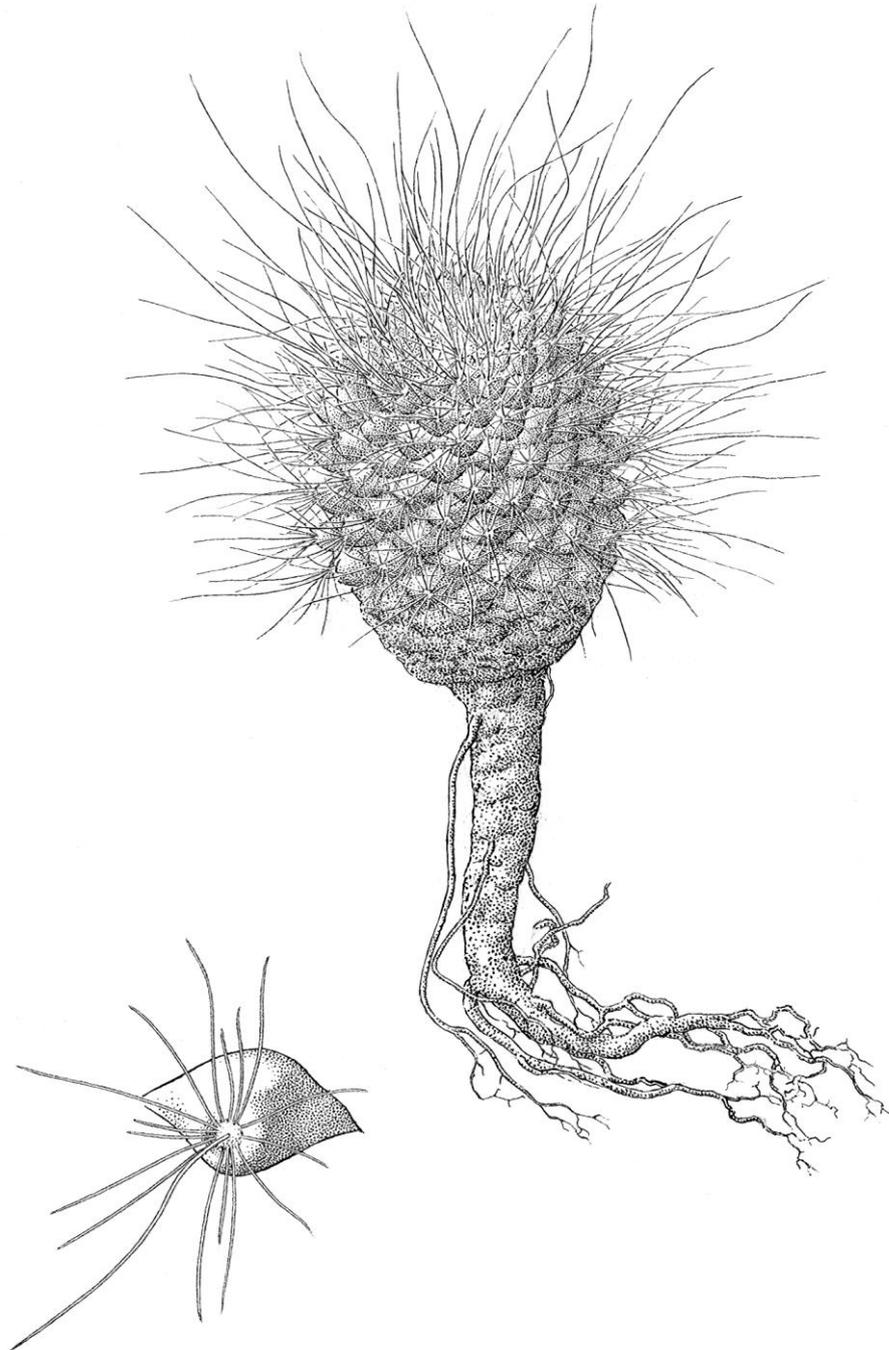
# Pediocactus paradinei

B. W. Benson 1957

**Common names:** engl.: House Rock Valley cactus, Paradine's cactus

**Scientific synonyms:** = *Pilocanthus paradinei* (B. W. Benson) B. W. Benson & Backeberg 1957  
= *Pediocactus simpsonii* var. *paradinei* (B. W. Benson) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



- Characteristics:** Rather small, globose, solitary, tuberculate, soft-textured cactus with an unusually long, napiform root and dimorphic spination. Juvenile and young adult (flowering) specimens only with short, white radial spines, older specimens with unusual, long, hair-like spines. Largely retreating underground during dormant periods. Found on slopes with gravely limestone soils within Pinyon-Juniper Woodland and in grassland.
- Roots:** Napiform tap root, up to 15 cm long.
- Stem:** Solitary, globose to elongated, up to 2.5-7 cm high, 2.5-4 cm Ø, green to bluish-green.
- Tubercles:** Conical-cylindrical, apically obliquely truncate, 4-4.5 mm long, 3 mm Ø.
- Areoles:** Circular, 2-3 mm Ø, typically 3 mm apart, woolly, white to grey.
- Spines:** White with light brown tips, 5-7 cm long, flexible, erect.
- Radial spines:** 13-22, 2-5 mm long, thin, 0.2-0.3 mm Ø at base, radiating horizontally to slightly protruding, variable, straight or twisted, white to grey.
- Central spines:** 4-6, only on adult specimens, 1-3 cm long, thin, 0.3 mm Ø at base, white to pale grey, hair-like, becoming straw- or cream-coloured in age, the apical portions sometimes darker. Straight, curved or twisted. Not readily distinguishable from the radial spines.
- Flowers:** Appearing in april-may from the centre of the stem apex, up to 2.5 cm long, 2-3 cm Ø, campanulate, yellow.
- Fruits:** Ovate, 7.5-10.5 mm long, 4.5-6 mm Ø, greenish-yellow tending to red, drying and splitting open at maturity.
- Seeds:** Cap-shaped, black, 2 mm long, 1.5 mm wide, 1 mm thick, with finely tuberculate surface.
- Juvenile plants:** Lacking the long, hair-like central spines. May reach maturity before the central spines appear.

**Distribution:** State of Arizona, USA.



**Trade:** Regional endemic of the Houserock Valley in northern Arizona. Widely scattered and hard to find in open Juniper-Pinyon Woodland and grassland on limestone slopes. Not very easy in cultivation, usually grafted in early seedling stage or more often propagated vegetatively by grafting branches of grafted motherplants. Branching can be forced by cutting off the stem apex of a grafted specimen. Cultivated and traded mainly as grafted specimens, artificially propagated in USA and Europe. Not much distributed in collections and demand quite moderate. Rather a curiosity collected by specialists than appreciated by the general public. The fame of rareness rather than its attractiveness makes this cactus interesting for collectors. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** Seedlings, lacking the characteristic hair-like central spines, may be confounded with *Escobaria vivipara* var. *kaibabensis*, with which it shares the habitat. The latter however has a furrow on the upper side of the tubercles, at least in adult stage. Only the long, hair-like spines of adult specimens make *Pediocactus paradinei* a very characteristic species, quite easy to identify.

- Bibliography:**
- Benson, L. (1961-62): A revision and amplification of *Pediocactus*. *Cact. Succ. J. (US)* 33: 49-54, 34: 17-19, 57-61, 163-168.
- Benson, L. (1982): *The Cacti of the United States and Canada*. Stanford University Press, Stanford, California.
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- Hochstätter, F. (1993): *The Genera Pediocactus – Navajoa – Toumeyia (Cactaceae)*. Revised. Published by the Author. Fritz Hochstätter, Mannheim.
- Hochstätter, F. (1995): *The Genera Pediocactus – Navajoa – Toumeyia (Cactaceae) Revised*. Druckbild GmbH, Titisee-Neustadt, Germany.
- Hunt, D. (1999): *CITES Cactaceae Checklist, 2<sup>nd</sup> Edition*. Royal Botanic Gardens Kew, UK.

# Pediocactus peeblesianus

## ssp. fickeisenii

(Hochstätter) J. Lüthy 1999

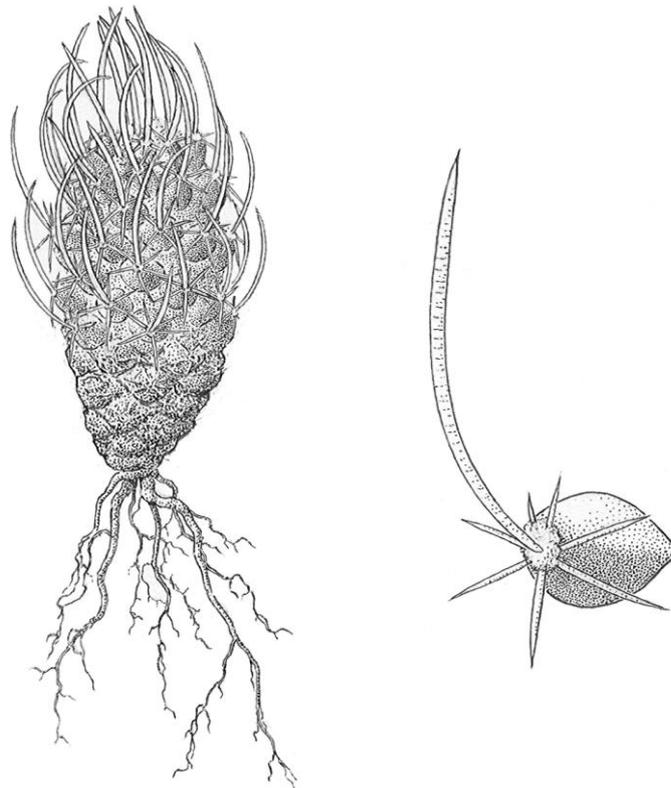


**Common names:** engl.: Fickeisen plains cactus.

**Scientific synonyms:**

- = *Navajoa peeblesiana* var. *fickeisenii* Backeberg ex Hochstätter 1994
- = *Navajoa peeblesiana* ssp. *fickeisenii* (Backeberg ex Hochstätter) Hochstätter 1995
- = *Neonavajoa peeblesiana* ssp. *fickeisenii* (Hochstätter) Doweld 1999
- *Navajoa fickeisenii* Backeberg 1960 (nom. inval.)
- = *Toumeyia fickeisenii* (Backeberg) Kladiwa 1963 (nom. inval.)
- = *Toumeyia fickeisenii* (Backeberg) Earle 1963 (nom. inval.)
- *Pediocactus peeblesianus* var. *fickeisenii* L. Benson 1962 (nom. inval.)
- *Pediocactus peeblesianus* var. *fickeiseniae* L. Benson 1969
- *Navajoa peeblesiana* fa. *maia* Denis Cowper ex Hochstätter 1995 (nom. inval.)
- = *Navajoa peeblesiana* fa. *maia* Denis Cowper ex Hochstätter 1999 (nom. inval.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Extremely cryptic and dwarf, soft textured globular, usually solitary, dull (grey-) green cactus with rounded tubercles, barely protruding from the substrate in habitat in spring and largely retreating underground during dormant periods. Easily identifiable for the very remarkable, corky-spongy and soft, non-pungent, greyish-white, usually quite long spines. Found on low hills with gravelly soil in Navajoan Desert and Great Plains Grassland.

**Roots:** Fibrous, from a napiform, subterranean stem-base.

**Stem:** Solitary, occasionally with 2-4 branches (usually more branching in grafted specimens), globose,

tuberculate, 2.0-6.5 cm long including the stem base, 2.0-5.5 cm Ø slightly glaucous or greyish, the stem apex mostly little protruding from the substrate in habitat, with a conspicuous subterranean, contractile stem base.

**Tubercles:** Rounded, 2.7-7 mm long, 3-6 mm broad.

**Areoles:** 1-3 mm Ø, circular, with rather persistent, white wool.

**Spines:** Appressed to ascending, very characteristically corky-spongy (non-pungent), flexible, curved, greyish-white, finely transversally fissured.

**Radial spines:** (3-) 6 (-8), 3-8 mm long, rather straight, spreading, rather thin, 0.25-0.5 Ø.

**Central spines:** 1, erect and prominent (small or lacking in young plants), usually curved towards the apex, clearly differentiated from radials, 1 mm Ø at base, 10-25 mm long.

**Flowers:** April to may, 1 (-4) from the centre of the stem apex, yellowish, 10-25 mm long, 20 mm Ø.

**Fruits:** Spherical, greenish, drying and splitting open at maturity, 8 mm long, about 6.5 mm Ø.

**Seeds:** 1.5-3.0 mm long, 2.0-2.5 mm broad, ± 1 mm thick, black with tuberculate and remarkably wrinkled seedcoat.

**Distribution:** State of Arizona, USA



**Trade:** Regional endemic of northern Arizona, northern Colorado Plateau, Grand Canyon Monument eastward to Little Colorado River. Extremely scattered and hard to locate in the field. Not very easy in cultivation, usually grafted in early seedling stage or more often propagated vegetatively by grafting branches of grafted motherplants. Not much distributed in collections and demand quite moderate. Rather a curiosity collected by specialists than appreciated by the general public for its appearance. Plants from the Little Colorado river, that are attributed to ssp. *fickeiseniae* but show distinctively shorter spines and rather appressed, short centrals (5-12 mm), are known in cultivation as "forma *maia*" (not identical with *Pediocactus peeblesianus* var. *maianus* L. Benson 1969, which is a doubtful taxon, probably not belonging to *Pediocactus*). Nurseries registered for artificial propagation: Czech Republic P-CZ-1002, Switzerland P-CH-1001 (also "*maia*").

**Similar species:** *P. peeblesianus* is one of the easily identifiable cacti for its outstanding, corky spines. Its ssp. *fickeisenii* is nearly identical, having more slender and more numerous radial spines, always 1 dominant central and more woolly areoles and is distributed to the north of ssp. *peeblesianus*. The status as a different taxon is not generally accepted. Ssp. *peeblesianus* is often found in cultivation with 4 short spines, arranged in a cross, but this is not representing the full potential and variability of this taxon. Similar, strange, corky spines are found also in *Turbinicarpus schmiedickeanus* (Bödeker) Buxbaum & Backeberg and its various subspecies, which however have slightly angled, more elongated tubercles, are rather hard textured, have one to several ascending central spines and lack radial spines in adult stage.

**Bibliography:**

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Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Pediocactus peeblesianus

## ssp. peeblesianus

(Croizat) L. Benson 1962

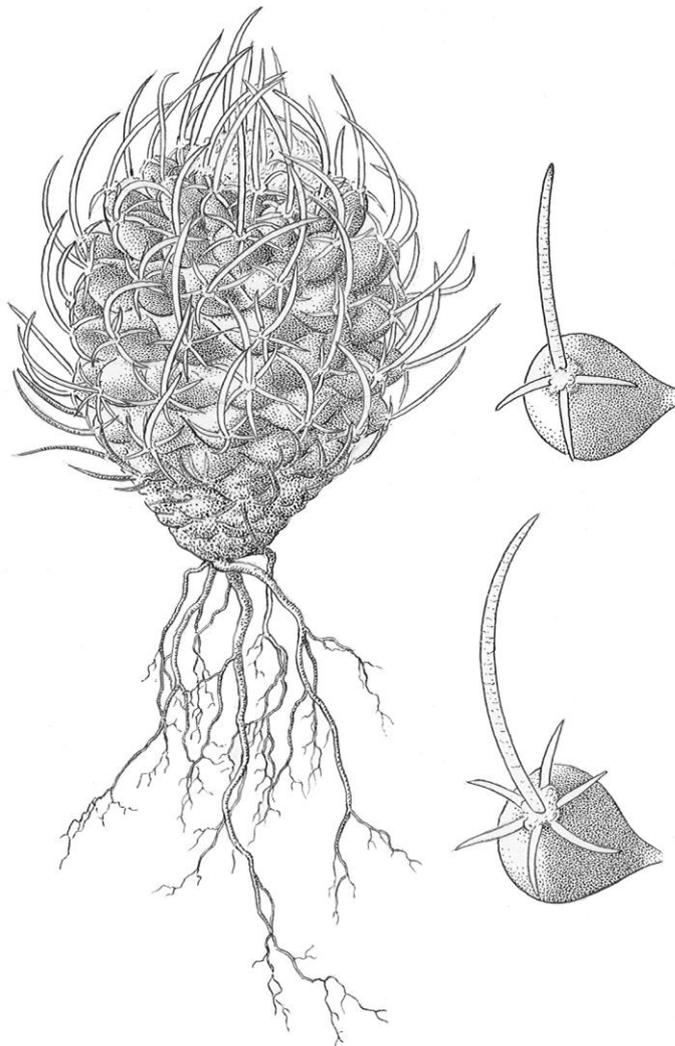


**Common names:** engl.: Peebles Navajo cactus, Navajo plains cactus.

**Scientific synonyms:**

- = *Navajoa peeblesiana* Croizat 1943
- = *Toumeyia peeblesiana* (Croizat) W. T. Marshall 1947
- = *Echinocactus peeblesianus* (Croizat) L. Benson 1950
- = *Utahia peeblesiana* (Croizat) Kladiwa 1969
- = *Neonavajoa peeblesiana* (Croizat) Doweld 1999
- ? *Pediocactus peeblesianus* var. *maianus* L. Benson 1969 (possibly missidentified, not belonging to *Pediocactus*)
- *Navajoa durispina* Y. Ito 1981 (nom. inval.)
- *Pediocactus peeblesianus* fa. *menzelleri* Hochstätter 1995 (nom. inval.)
- = *Pediocactus peeblesianus* fa. *menzelleri* Hochstätter 1999 (nom. inval.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Extremely cryptic and dwarf, soft textured globular, solitary, dull (grey-) green cactus with rounded tubercles, barely protruding from the substrate in habitat in spring and largely retreating underground during dormant periods. Easily identifiable for the few very remarkable, corky-spongy and soft, non-pungent, greyish-white, quite variably shaped spines. Found on low hills with gravely soil in Navajoan Desert.

**Roots:** Fibrous, from a napiform, subterranean stem base.  
**Stem:** Solitary, seldom branching (usually branching in grafted specimens), globose, tuberculate, 1.5-6 cm long including stem base, 2-5 (-6) cm Ø, slightly glaucous or greyish, the stem apex mostly level with the substrate in habitat, with a conspicuous subterranean, contractile stem base.  
**Tubercles:** Rounded, (2-) 3-4.5 (-6) mm long, (2-) 3-5 (-9) mm broad.  
**Areoles:** 1-3 mm Ø, circular, typically 3-6 mm apart, with inconspicuous wool.  
**Spines:** Appressed to ascending, very characteristically corky-spongy (non-pungent), flexible, curved, greyish-white, finely transversally fissured.  
     **Radial spines:** (3-) 4 (-6), (2-) 4-7 (-10) mm long, 0.3-1.0 mm Ø at base, irregularly curved, very often 4 in a cruciform arrangement, the upper one ascending and longer (in "typical" specimens of horticulture).  
     **Central spines:** 0-1, ascending, remarkably variable in size and shape from plant to plant, straight to curved and pointing in a variety of directions, (0.5-) 6-22 mm long, 0.5-1.2 mm Ø at base, often lacking (in "typical" specimens of horticulture). The illustration shows a specimen with maximum spine number; these plants often are confounded with ssp. *fickeisenii* for having a central spine, but spines are distinctively more slender in ssp. *fickeiseniae*.  
**Flowers:** April to may, 1 (-4) from the centre of the stem apex, yellowish, 10-25 mm long, 12-20 mm Ø.  
**Fruits:** Spherical, greenish, drying and splitting open at maturity, 6-9 mm long, about 4.5-7.5 mm Ø.  
**Seeds:** 1.5-2 mm long, 2.5 mm broad, ± 1 mm thick, black with finely tuberculate and remarkably wrinkled seedcoat.

**Distribution:** State of Arizona, USA



**Trade:** Regional endemic of northern Arizona, southern Colorado Plateau, along the watershed of the Little Colorado River. Extremely scattered and hard to locate in the field. Not very easy in cultivation, usually grafted in early seedling stage or more often propagated vegetatively by grafting branches of grafted motherplants. Not much distributed in collections and demand quite moderate. Rather a curiosity collected by specialists than appreciated by the general public for its appearance. Plants from "south of Grand Canyon" with robust spines are known in cultivation as "*menzeli*". Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, Switzerland P-CH-1001 (also "*menzeli*").

**Similar species:** *P. peeblesianus* is one of the easily identifiable cacti for its outstanding, corky spines. Its ssp. *fickeisenii* is nearly identical, having more slender and more numerous radial spines, always 1 dominant central and woolly areoles and is distributed to the north of ssp. *peeblesianus*. The status as a different taxon is not generally accepted. Ssp. *peeblesianus* is often found in cultivation with 4 short spines, arranged in a cross, but this is not representing the full potential and variability of this taxon. Similar, strange, corky spines are found also in *Turbincarpus schmidickeanus* (Bödeker) Buxbaum & Backeberg and its various subspecies, which however have slightly angled, more elongated tubercles, are rather hard textured, have one to several ascending central spines and lack radial spines in adult stage.

**Bibliography:**

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Busek, J. (1987): *Pediocactus peeblesianus* (Croizat) L. Benson und seine Varietäten – kleine Juwelen aus dem Südwesten der USA. *Kakt. and. Sukk.* 38 (7): 158-161.

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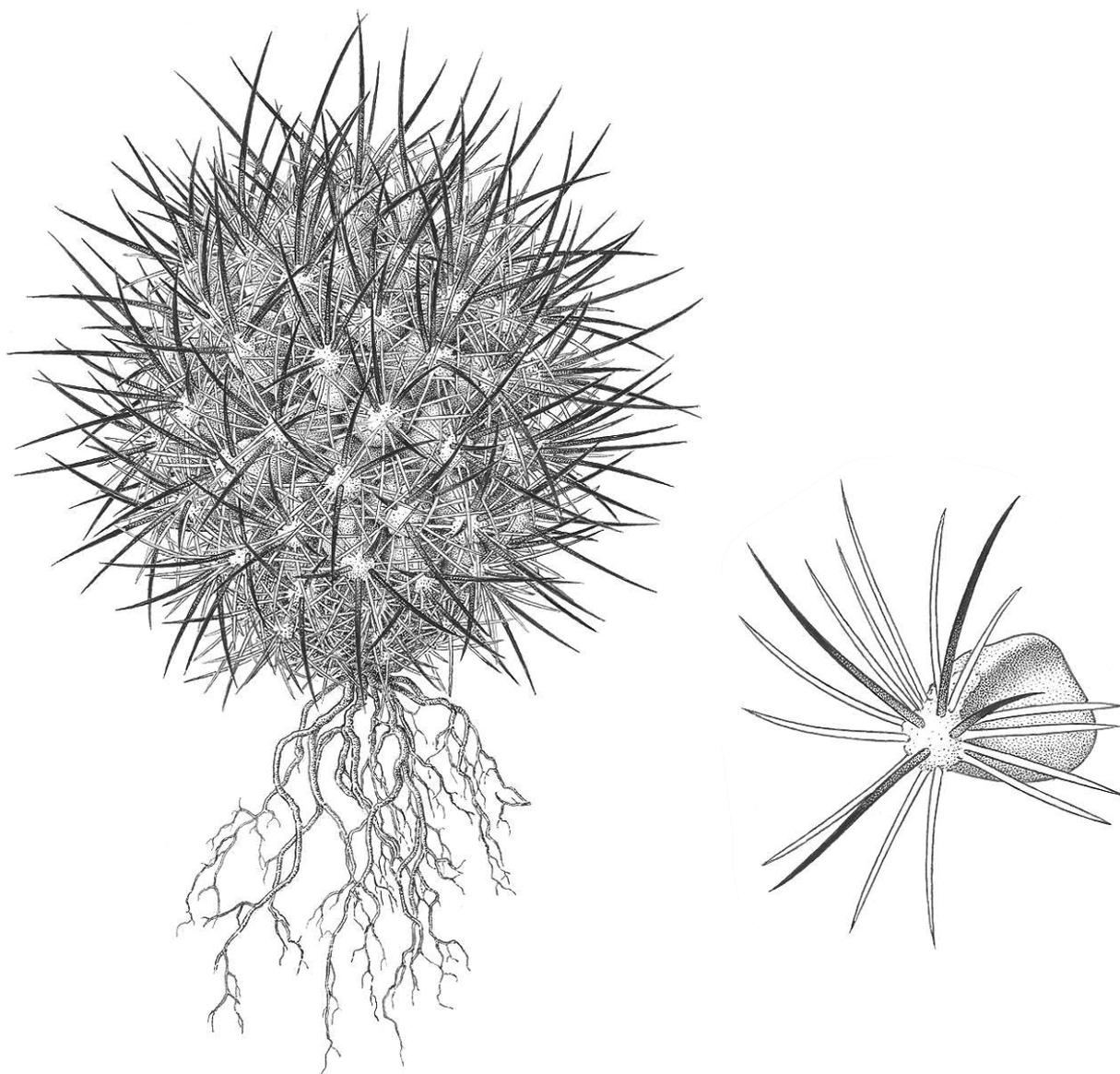
# Pediocactus sileri

(Engelmann) L. Benson 1961

**Common names:** engl.: Siler pincushion, Gypsum cactus

**Scientific synonyms:** = *Echinocactus sileri* Engelmann ex Coulter 1896  
= *Utahia sileri* (Engelmann ex Coulter) Britton & Rose 1922

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Small to medium sized, dull greyish-green, globular, soft-textured cactus with characteristic white, woolly areoles and relatively thick spines, the dark centrals contrasting with the white radials. Yellow flowers with distinctly ciliated perianth segments. Found on highly alkaline, bare clay soils containing gypsum (hence the vernacular name).

- Roots: Fibrous, much branched, from subterranean stem base.  
 Stem: Solitary, ovoid, tuberculate, 5-10 (-15) cm high, 5-7.5 (-12) cm Ø.  
 Tubercles: Truncate-conical, 1-1.5 cm long, 6-10.5 mm Ø at base.  
 Areoles: ± 6 mm Ø, typically ± 12 mm apart, bearing conspicuous, quite persistent, dense white wool. Areole little prolonged beyond the spines on the upper (adaxial) side of tubercles of mature specimens..  
 Spines: Quite densely covering the stem.  
     Radial spines: 11-15, 1.25-1.85 cm long, white, rigid, acicular, non-transparent.  
     Central spines: 3-5 (-7), wholly or partly brownish-black (red in new growth), withering and becoming pale grey or nearly white in age, nearly porrect, straight or slightly curved, 2-2.8 cm long, basally 0.7-1 mm Ø, acicular, nearly circular in cross-section, tapering evenly from base to tip.  
 Flowers: From the centre of the stem apex, yellowish, ± 2.5 cm Ø, ± 2cm long, with distinctly ciliated perianth segments,  
 Fruits: Greenish-yellow, 12-15 mm long, 6-9 mm Ø, semi-dry, splitting along one side.  
 Seeds: Grey, obliquely obovate, 3-4 mm long, 4.5-5.0 mm broad, 1.5 mm thick, with tuberculate seedcoat.

**Distribution:** States of Arizona and Utah, USA.



**Trade:** Endemic to the border region between Utah and Arizona, sharply restricted to gypsum soils. Seldom seen in collections in any reasonable size, or producing flowers, for extreme difficulties with cultivation. Very prone to fungal infections and diseases. Only secure as grafted specimens, usually grafted very early in seedling stage. Mainly in international trade as seeds, which may still be wild-collected today, for lack of successful cultivation. Nurseries registered for artificial propagation: Czech Republic P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** *Pediocactus simpsonii* (Engelmann) Britton & Rose (CITES App. II), which is a variable species, may come close in stem shape and spination. It can be distinguished immediately however by lack of the conspicuous white wool in the areoles and distinctively thinner, more numerous spines (5-8 centrals, 12-30 radials). The superficially somewhat similar *Sclerocactus glaucus* (K. Schumann) L. Benson has tubercles confluent into ribs and often the upper spines flattened.

**Bibliography:** Benson, L. (1961-62): A revision and amplification of *Pediocactus*. *Cact. Succ. J. (US)* 33: 49-54, 34: 17-19, 57-61, 163-168.  
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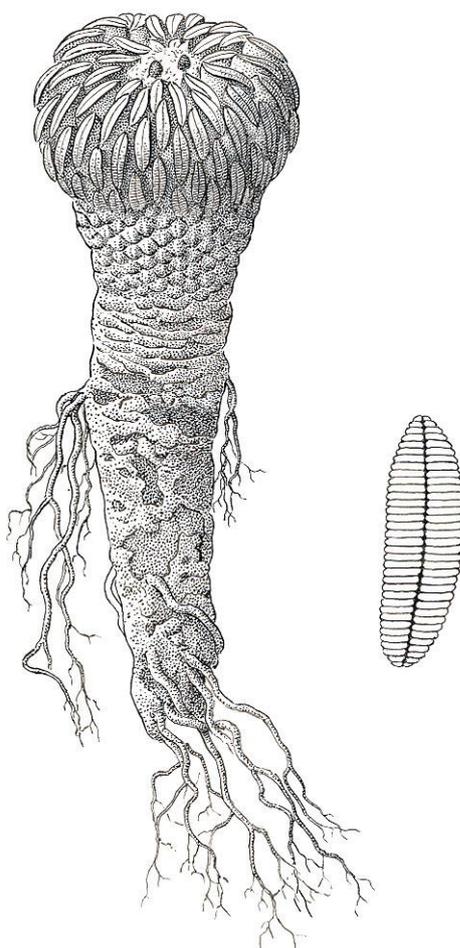
# Pelecocyphora aselliformis

Ehrenberg 1843

**Common names:**  
 engl.: Hatchet cactus  
 esp.: Peyotillo  
 de.: Asselkaktus  
 fr.: Cactus hache, cactus cloporte

**Scientific synonyms:**  
 = *Mammillaria aselliformis* (Ehrenberg) W. Watson 1889  
 = *Anhalonium aselliforme* (Ehrenberg) F. A. C. Weber 1898  
 = *Ariocarpus aselliformis* (Ehrenberg) F. A. C. Weber 1898  
 → *Mammillaria asellifera* F. A. C. Weber 1898

**CITES category:** Appendix II since 01.07.1975, Appendix I since 06. 06. 1981 (Prop. USA).



**Characteristics:** Small cactus with a very unusual, distinctive spination, showing a symmetrical, comb-like (pectinate) arrangement of the spines, the areoles resembling wood-lice (hence the specific name). Very cryptic in habitat, the flattened apex hardly emerging from the substrate and the dense, greyish-white spination blending with the limestone gravel of the habitat, on gentle hills in Chihuahuan desert vegetation. Stem and tubercles of a hard consistence. The very distinctive, comb-like arrangement of the spines is shared with a few other Mexican cacti, but the big, truncate tubercles (hence the genus name) are exclusive.

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Roots: Subterranean stem base and taproot forming a napiform unit.  
Stem: Largely subterranean in habitat, only the stem apex emerging from the substrate, almost flat with the ground, in cultivation elongated, club-shaped, later cylindrical, 2-5 cm Ø, grey to greyish-tan or greenish-grey in colour. First solitary, later branching in very old specimens.  
Tubercles: 2-4 mm high with flattened, truncate apex, elliptic in cross-section, ca. 5-9 mm long.  
Areoles: Bi-partite, the spine-bearing part at the tubercle-apex, the woolly floriferous part hidden in the axil of the tubercle, the two parts connected by an inconspicuous, narrow groove.  
Spines: Up to 60, arranged in 2 pectinate rows, 0.7-1 mm long, flattened, basally somewhat connected, non pungent, totally appressed, whitish, slightly tan with age.  
Flowers: Originating from the centre of the stem apex, campanulate, 1.3-2.2 cm Ø, magenta.  
Fruits: Dry, papery, 5-8 mm long, 4-6 mm Ø, whitish, remaining attached and desintegrating.  
Seeds: 1-1.3 mm long, 0.8-1 mm wide, brown.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Various populations are reported from central San Luis Potosí, but only a single population is well known among collectors. *P. aselliformis* has been heavily collected in its habitat over many years and recently, 3'200 specimens have been removed in a private "rescue operation" (Glass 1998), but surprisingly, it is still very abundant even in this heavily impacted site and seedlings are not rare (pers. observ. 1981-1996). The species seems to reproduce prolifically in habitat and to grow faster than in cultivation, where it is known as slow growing. Big, old specimens in nurseries and collections are often of wild origin, but they may well be pre Convention specimens. They can be identified by their characteristically withered, corky stem bases. Cultivation from seeds is not difficult. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Resembles other Mexican cacti with very similar, pectinate or comb-like spine arrangement: *Mammillaria pectinifera* (Solisia) and *Turbincarpus pseudopectinatus* (Normanbokea). But the big, truncate tubercles are exclusive for *Pelecyphora aselliformis*. *Mammillaria pectinifera* has overlapping, interwoven spines, *Turbincarpus pseudopectinatus* has considerably smaller areoles (3-4 mm vs. 5-9 mm long). The closely related and somehow similar *Pelecyphora strobiliformis* has scale-like, triangular, appressed tubercles and only a few weak, dehiscent spines in adult specimens. Young seedlings however have a higher number of radiating, whitish spines and might be confused with seedlings of *P. aselliformis*, but the latter soon form their characteristic, pectinate spine arrangement.

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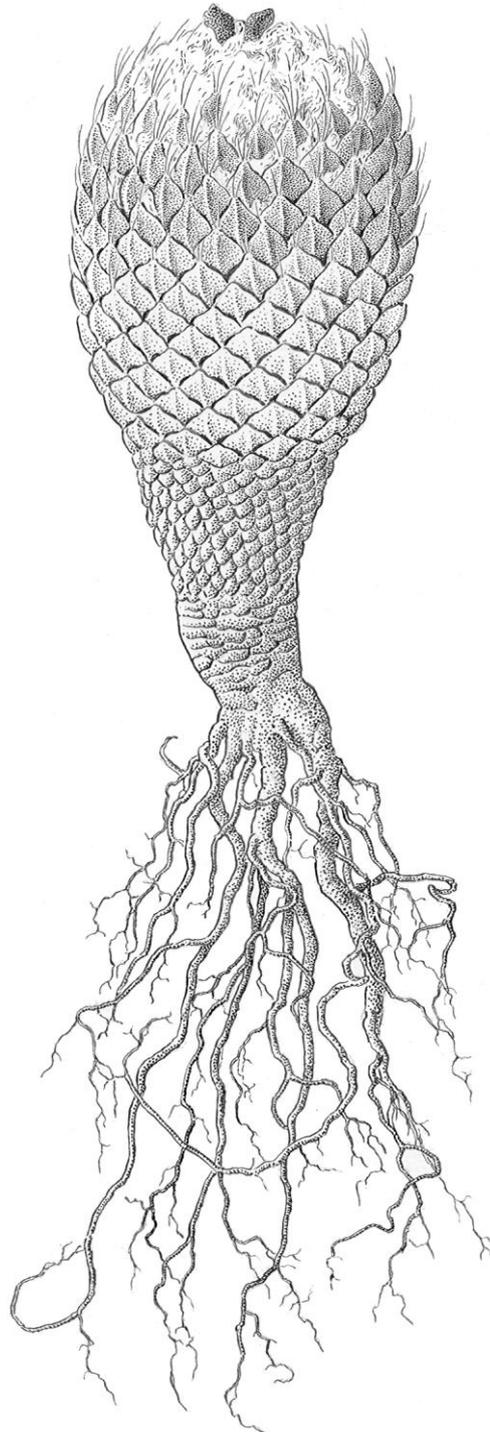
# Pelecocyphora strobiliformis

(Werdermann) Kreuziger 1935

**Common names:** engl.: Pine-cone cactus

**Scientific synonyms:** = *Ariocarpus strobiliformis* Werdermann 1927  
= *Encephalocarpus strobiliformis* (Werdermann) A. Berger 1929

**CITES category:** Appendix II since 01.07.1975, Appendix I since 06. 06. 1981 (Prop. USA).



**Characteristics:** Rather small, globular cactus of a hard consistence, with very characteristic, scale-like, appressed tubercles, over all resembling a pinecone (hence the scientific and vernacular English names). Quite cryptic in habitat, blending with the grey limestone gravel, in which it occurs; on gentle hills in Chihuahuan desert vegetation.

**Roots:** Stem base and roots forming a napiform unit.

**Stem:** Usually solitary, occasionally branching and forming small groups, depressed globose in habitat, in cultivation elongated and club-shaped, 1-4 cm high (above substrate), 4-8 cm Ø, with some wool in the apex.

**Tubercles:** Flattened, ascending and tightly appressed, scale-like, triangular in outline, keeled below (on outer surface), arranged in spirals, 6 mm long, 1 cm wide at base, grey to greyish tan, becoming corky when ageing.

**Areoles:** Bi-partite, the small, spiniferous part of the areole on the tip of the tubercle, the floriferous part in the axil of the tubercle, producing white, quite persistent wool.

**Spines:** 7-14, 1-2 mm long, the upper ones in the areole the longest, radiating horizontally, soft, bristle-like, non pungent, white, soon shed, only present in the youngest areoles (more persistent in cultivated specimens).

**Flowers:** From the centre of the stem apex, 2-2.8 cm long, 1.5-3.5 cm Ø, magenta.

**Fruits:** Small, dry at maturity, hidden between the tubercles, where they disintegrate.

**Seeds:** 1-1.3 mm long, 0.8-1 mm wide, reddish brown.

**Juvenile specimens:** Tubercles not scale-like, but rather prismatic, areoles elliptic, with numerous short, white, horizontally radiating, slightly pectinate, white spines.

**Distribution:** States of Tamaulipas, Nuevo Leon and San Luis Potosí, Mexico.



**Trade:** Local endemic of the 3 states corner region of Tamaulipas, Nuevo Leon and San Luis Potosí, reported from various limited sites. Highly prized by collectors. The originally only known population in Tamaulipas has been virtually extinguished and subsequently discovered populations are suffering from collecting too, but the species is locally still quite abundant, well reproducing and little threatened, especially in Nuevo Leon (pers. observ. 2001) and in the newly discovered populations in San Luis Potosí (Sotomayor & al. 2000). Big, old specimens in nurseries and collections are often of wild origin, but they may well be pre Convention specimens. They can be identified by their withered stem bases. Cultivation from seeds is not difficult, but rather slow. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Cannot easily be confounded with any other cactus for its unique, cone-like appearance..

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
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Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Sotomayor, J. M., A. Arredondo & M. Martinez (2000): Pelecyphora strobiliformis: Erster Fund im Bundesstaat San Luis Potosi. Kakt. and. Sukk. 51 (8): 197-200.



**Family:** Scrophulariaceae

**Synonyms:** *Picrorhiza lindleyana* (Wall.) Wettst.

**Vernacular names:**

- english: Indian gentian
- french:
- spanish:
- german:
- hindi/sanskrit: Katki, Katuka, Kuru, Kutki
- italian:

**Geographical range:** In the western Himalayas, at altitudes of 2500-4000 m, from Afghanistan to the southernmost part of China.

**Distribution by country:** Afghanistan, Bhutan, China, India, Nepal, Pakistan.

**Protection:** CITES Appendix II (#3), since 18.09.1997.

**Use:** Medicinal plant (also used in TEAM).

## Botanical drugs in trade

**Plant parts used:** Rootstock.

**Pharmaceutical names:**

- latin: Picrorhizae rhizoma, Rhizoma Picrorhizae, Picrorhiza
- english: Picrorhiza rhizome
- french:
- spanish:
- chinese: Hu Huang Lian
- german: Picrorhiza-kurrooa-Rhizom, Picrorhiza-Wurzelstock
- hindi: Katukarosana, Kuru, Kutki
- italian:

**Countries of export:** Bhutan, China (Tibet), India, Nepal.

**Source:** Wild collection, unknown whether cultivated.

**Commodities in trade:** Mainly the dried, coarsely cut rootstock (crude drug).

### Characteristics:

Crude drug: (Fig. 1, 2) Rootstock cut or broken into pieces, mainly without rootlets; fragments cylindrical, light-weighted, straight or slightly bent, mainly unbranched, 2-8 cm long and 4-10 mm thick, light grey to dark grey-brown, longitudinally wrinkled, irregularly thick, sometimes nodose or even head-shaped at the top, highly inflammable; surface with scars of numerous scaly leaves and roots and remotely transversely ringed; transverse section dark grey to brown, with brighter outer bark and inner part

with a ring of up to about 1 mm wide, clearly visibly white and sometimes interrupted (especially visible in fresh fracture or fresh cut), in longitudinal section seen as 2 white lines parallel to the margin; commodity often with remains of the dark brown and longitudinally wrinkled stems;

Odour: Pleasant, slightly aromatic;

Taste: Very bitter.

**Similar drugs/  
adulterations:**

The rootstocks of *Picrorhiza scrophulariiflora* Pennel are also traded as Kutki. Its taxonomic treatment as a separate species from *Picrorhiza kurrooa* is subject to controversy and information on the species' distribution is contradictory: it varies from "rare and restricted to Sikkim" to a range extending from "Nepal to China". The rootstocks of both taxa are impossible to distinguish.

**References:**

Mulliken, T.A. (2000): Implementing CITES for Himalayan medicinal plants *Nardostachys grandiflora* and *Picrorhiza kurrooa*. – TRAFFIC Bulletin 18(2): 63-72; Cambridge.

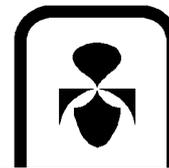
Olsen, C.S. (1999): CITES Appendix II re-visited: Is the listing of *Nardostachys grandiflora* and *Picrorhiza kurrooa* appropriate? – Medicinal Plant Conservation 5: 8-10; Bonn.



Figure 1. Crude drug, Picrorhizae rhizoma; species: *Picrorhiza kurrooa*, (copyright BfN).



Figure 2. Crude drug, Picrorhizae rhizoma; species: *Picrorhiza kurrooa*, (copyright BfN).



**Family:** Rosaceae

**Synonyms:** *Pygeum africanum* Hook.f.

**Vernacular names:**

english:	African cherry, pygeum
french:	Pygeum
spanish:	Ciruelo africano
german:	Afrikanisches Stinkholz
italian:	Pigeo
malagasy:	Kotofihy

**Geographical range:** Mountain areas of tropical Africa and Madagascar.

**Distribution by country:** Angola, Burundi, Cameroon, Comoros, Democratic Republic of Congo, Equatorial Guinea, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Nigeria, Rwanda, São Tomé and Príncipe, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

**Protection:** CITES Appendix II (#1), since 16.02.1995

**Use:** Medicinal plant, timber (furniture, household items, etc.).

## Botanical drugs in trade

**Plant parts used:** (1) bark and (2) the extract made thereof.

### Bark

**Pharmaceutical names:**

latin:	Pygei africana cortex, Cortex Pygei africana
english:	Pygeum africanum bark, red stinkwood
french:	Écorce de prunus (africana), écorce de pygeum, pygeum
spanish:	Corteza de pigeum, pigeum
german:	Afrikanische Stinkholz-Rinde
italian:	Corteccia di pygeum africanum, corteccia di prunus africana, corteccia di pigeo

**Countries of export:** **Cameroon**, Democratic Republic of Congo, **Equatorial Guinea**, **Kenya**, Madagascar, Tanzania, Uganda;

**Source:** Wild collection.

**Commodities in trade:** Mainly dried, big or coarsely cut bark pieces (crude drug), rarely bark pieces minutely diminished (cut drug) or even powdered (Fig.4).

**Characteristics:**

Crude drug:	(Fig. 1) Bark pieces of variable size and shape, varying from very big pieces to small, only a few cm long fragments or cut pieces; bark 0.5-3 cm thick, especially the bark of older trees irregular and scaly in texture; external surface of bark dark, reddish-brown to almost black, sometimes with whitish spotting, surface rough, scaly to knotty, even fissured in parts; internal surface reddish-brown (fresh: almost pink-coloured, darkening when exposed to air), dull and strongly fibrous;
Cut drug:	(Fig. 2) Small, up to 1 cm long and 0.5 to a few mm wide, slightly matted wood fibres or wood cuttings, of dull, reddish brown colour;
Odour:	Smell of bitter almonds when freshly broken;
Taste:	–

**Extract**

<b>Pharmaceutical names:</b>	latin:	Pygei extractum
	english:	Prunus extract, pygeum extract, pigenil, pygenil, pygeum africanum powdered/soft extract
	french:	Prunus extrait, pygeum extrait
	spanish:	(Extractos) pigeum
	german:	Pygeum Extrakt
	italian:	Estratto di prunus africana, estratto di pygeum africanum, estratto di pigeo

**Countries of origin:** Kenya, Madagascar;

**Commodities in trade:** Either as soft extract or as powdered extract.

**Characteristics:**

Crude drug:	(Fig. 3) Dark brown, solid, easily sectile, sticky mass (soft extract) or brown, granular, freeze-dried powder, similar to instant coffee powder (powdered extract);
Odour:	Like freshly broken bitter almonds;

**References:**

- Cunningham, M., Cunningham, A.B. & Schippmann, U. (1997): Trade in *Prunus africana* and the implementation of CITES. – 52 pp.; Bonn (German Federal Agency for Nature Conservation).
- Sunderland, T. & Tanyi, T.C. (2000): The exploitation of *Prunus africana* on the island of Bioko, Equatorial Guinea. - Medicinal Plant Conservation 6: 18-20; Bonn.



Figure 1. Crude drug, Pygei africana cortex; species: *Prunus africana*, (copyright BfN).



Figure 2. Cut drug of bark, Pygei africana cortex; species: *Prunus africana*, (copyright BfN).



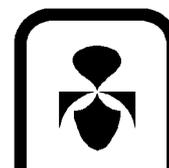
Figure 3. Crude drug of extract, pieces of variable size, Pygei africana extractum; species: *Prunus africana*, (copyright BfN).



Figure 4. Powdered bark, Pygei africana cortex; species: *Prunus africana*, (copyright BfN).

# Pterocarpus santalinus

L.f.

**Family:** Fabaceae**Synonyms:** –

**Vernacular names:**

english:	Caliatur wood tree, red sandalwood tree, red sanders tree
french:	Santal rouge
spanish:	Sandalia, sándalo rojo
german:	Kaliaturholzbaum, roter Sandelbaum, Rotsandelholzbaum
italian:	Sandalo

**Geographical range:** Endemic to south India; southern parts of the Eastern Ghats in the States of Andhra Pradesh, Karnataka and Tamil Nadu.**Distribution by country:** India.**Protection:** CITES Appendix II (#6), since 16.02.1995**Use:** Medicinal and aromatic plant, horticultural tree, timber (carvings, wind breaks, musical instruments).

## Botanical drugs in trade

**Plant parts used:** Heartwood (without bark and sapwood) of the lower part of the stem.

**Pharmaceutical names:**

latin:	Santali rubri lignum, Santali lignum rubri, Lignum Santali rubri (rubrum), Lignum Santalinum, Lignum Santalinum rubrum, Pterocarpi lignum, Santalum rubrum, Pterocarpus
english:	Red sandalwood, red sanders (wood), red saunderswood, rubywood
french:	Bois de santal rouge
spanish:	Algum, leño caliatur, leño de sándalo rojo
german:	Pterocarpus-santalinus-Kernholz, rotes Kaliaturholz, Rotsandelholz, rotes Sandelholz
italian:	Legno di sandalo

**Countries of export:** India.**Source:** Wild collection, doubtful whether in cultivation.**Commodities in trade:** Dried, irregular, sometimes big pieces, logs, cubes or discs, or at most longitudinally cut pieces of the heartwood (crude drug) or the same rasped or cut into small pieces (cut drug); in addition the powdered heartwood, essential oil and extract (powder, oil and extract are not subject to CITES).**Characteristics:**

Crude drug: Logs of the heartwood variably shaped and sized: *inter alia* very big, ±quadrangular, cut into discs or longitudinally cut into thick pieces, the light-coloured sapwood almost removed; heartwood blood-red to dark red, surface darkening on exposure, thick pieces in particular brown-red to black-violet, heavy, dense, hard, but readily split longitudinally; cut surfaces coarse to oblique-fibred, silky lustrous and dark blood-red; cut surfaces with fine lighter transverse lines;

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Cut drug:	(Fig. 1, 2) Wood chips or splinters cube-like or irregular in outline, up to 1 cm long and wide, reddish brown to dark blood-red, silky shining, coarse to oblique-fibred; transverse fractures with dots and minute pinholes (vessels, easily seen with the naked eye); longitudinally cut surfaces with lighter transverse striations (medullary rays) and fine streaks;
Odour:	On rubbing, very faintly spicy;
Taste:	Weakly astringent.

**Similar drugs/  
adulterations:**

Santali rubri lignum is the source of the officinal drug but this may also be obtained from several other *Pterocarpus* species: *P. dalbergioides* Roxb. Ex DC. (English: Andaman padauk, Andaman redwood, Indian mahogany; German: Rotsandelholz, Pad(o)ukholz; distribution: Andaman Islands, cultivated from India to Indonesia and in Madagascar), *P. erinaceus* Poir. (English: Rosewood, barwood, African kino; German: afrikanisches Rotsandelholz; distribution: tropical west Africa), *P. indicus* H.B. Willd. (English: Amboina, Burmese rosewood, Malay padouk, padauk, padouk; German: indisches Rotsandelholz, Pad(o)ukholz, Narraholz, Kajoeholz; distribution: Southeast Asia), *P. macrocarpus* Kurz (English: Burma padauk; German: Rotsandelholz, Pad(o)ukholz; distribution: Southeast Asia), *P. soyauxii* S. Taub. (English: African padauk, barwood; German: afrikanisches Rotholz, afrikanisches Sandelholz, Pad(o)ukholz; distribution: tropical west Africa) and *P. marsupium* Roxb. (English: east Indian kino, Indian kino, malabar kino; German: Bastard-Teak; Pad(o)uk; distribution: India, Sri Lanka). The wood of *P. marsupium* is traded as Indian kino (German: Pterocarpus-marsupium-Rotsandelholz).

The drug Santali rubri lignum is mainly sourced in south India, Sri Lanka, Malacca, the Philippines and the Sunda Islands (Timor). Only red sandalwood originating in India may have been harvested from wild trees of *Pterocarpus santalinus*.

**References:**

- Konda Reddy, C.V. (1972): Red Sanders and its history of utilisation. – Indian Forester 98: 589-593.
- Lohi Das, T. & T. Dayanand (1984): Some distinguishing characteristics between wavy-grained and straight-grained trees of Red Sanders (*Pterocarpus santalinus* Linn.f.). – Indian Journal of Forestry 7(1): 69-71.
- Rojo, J.P. (1972): *Pterocarpus* (Leguminosae – Papilionaceae) revised for the world. – 119 pp.; Lehre (J. Cramer).



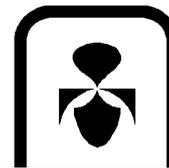
Figure 1. Cut drug, Santali rubri lignum; species: *Pterocarpus santalinus*, (copyright BfN).



Figure 2. Cut drug, Santali rubri lignum; species: *Pterocarpus santalinus*, (copyright BfN).

# Rauwolfia serpentina

(L.) Benth. ex Kurz.

**Family:** Apocynaceae

**Synonyms:** *Rauwolfia obversa* (Miq.) Baill.  
*Rauwolfia trifoliata* (Gaertn.) Baill.  
*Ophioxylon serpentinum* L.  
*Ophioxylon obversum* Miq.

**Vernacular names:**

english:	Snakewood, serpentwood
french:	Arbres aux serpents, rauwolfia
spanish:	Boboró
german:	Schlangenholz
italian:	Rauv(w)olfia

**Geographical range:** From Pakistan through the Himalayas to southeast China, in India from the Himalayas disjunct to Sri Lanka and the Andaman Islands, as well as in southeast Asia to Sumatra, Borneo and Java.

**Distribution by country:** Bangladesh, Bhutan, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Viet Nam.

**Protection:** CITES Appendix II (#2), since 18.01.1990.

**Use:** Medicinal plant.

## Botanical drugs in trade

**Plant parts used:** Mainly roots, occasionally leaves.

**Pharmaceutical names:**

latin:	Rauwolfiae radix, Radix Rauwolfiae, Lignum serpentinum, Radix Mustelae, Rauwolfia (homeopathy.), Rauwolfia serpentina (homeopathy.)
english:	Rauwolfia root, serpentine root, serpentine wood, snake root
french:	Racine de serpentine, sarpaganda, rauwolfia
spanish:	
german:	Indische Schlangenwurzel, Marderwurzel, Rauwolfia-serpentina-Wurzel, Rauwolfiawurzel
hindi:	Chandra, Chandrabhaga, Chota-chand
italian:	Radice di rauwolfia
sanskrit:	Sarpagandha

**Countries of export:** Bhutan, **India**, Java Myanmar, Nepal, Pakistan, Thailand, Malaysia.

**Source:** Mainly wild collection.

**Commodities in trade:** Dried, at most coarsely cut roots (crude drug) or the same cut in small, irregular pieces (cut drug); in addition powdered roots, extract (reserpine) and essential oil (extract and oil are not subject to CITES).

**Characteristics:**

Crude drug:	(Fig. 1) Roots and rootstocks $\pm$ cylindrical, somewhat tortuous or bent, rarely branched, 4-10 cm long, (2-)5-17(-22) mm in diameter; small lateral rootlets in most cases lacking; external surface grey to yellowish-brown, dull, weakly longitudinally wrinkled, rough, with few small, circular root scars in 4 rows; older roots yellowish-white when abraded; roots highly inflammable; fractures short and irregular, fresh transverse section whitish to bright yellow later turning grey-brown, with dense, fine-pored root wood, which makes up $\frac{3}{4}$ of the transverse section showing annual growth rings, bark yellowish-brown, narrow; roots rich in starch, located in the wood as well as in the bark, provable by colour reaction with alcoholic or aqueous Iodine-Potassium-Iodide-solution (Lugol's solution, see below);
Cut drug:	(Fig. 2) Wood pieces irregular, to about 1 cm long and wide, with or without root bark; characters as mentioned in section "Crude drug", however not always recognizable;
Odour:	Odourless;
Taste:	Very bitter.

**Similar drugs/  
adulterations:**

A helpful and simple feature to distinguish roots of different *Rauwolfia* species is the distribution of the starch in the transverse section of the root. The starch may be proved by using a Iodine solution, and the starch containing parts will turn violet to dark blue. Only in the case of *Rauwolfia serpentina* (almost) the complete transverse section will turn violet or dark blue.

***Rauwolfia tetraphylla* L.** (Syn. *R. canescens* L.; English: American serpentwood; German: Vierblättrige Rauwolfia): in trade known as *Rauwolfiae tetraphyllae radix* or *Rauwolfiae canescentis radix* (English: American serpentine root; German: Rauwolfia-tetraphylla-Wurzel, Rauwolfia-canescens-Wurzel);

Countries of origin: Central to south America, India (cultivated);

Characteristics: Roots similar to those of *R. serpentina*, but mostly shorter than 6 cm, (1-)4-36 mm in diameter, only partly and weakly tortuous, sometimes branched, hardly breakable; surface weakly longitudinally wrinkled, grey-brown or brown to dark-grey, abraded parts brownish, sometimes somewhat reddish; root wood making up to 9/10 of the transverse section, whitish-yellow, hard, concentrically layered; starch only in the centre of the root.

***Rauwolfia vomitoria* Afzel.** (English: African serpentwood; German: Brech-Rauwolfia): in trade known as *Rauwolfiae vomitoriae radix* or *Radix Rauwolfiae vomitoriae* (English: African rauwolfia, African serpentine root; German: Rauwolfia-vomitoria-Wurzel);

Origin: Tropical Africa;

Characteristics: Roots mainly longer than those of *R. serpentina* (to 14 cm and longer; commodity from Congo only 3-4 cm long), 1-37 mm thick; root wood very hard, almost unbreakable; surface grey-brown, darker brown when abraded; bark easily removable; root wood up to 9/10 of the transverse section, freshly cut whitish-yellow, later grey-brown; starch only in the centre of the root.



Figure 1. Crude drug, Rauvolfiae radix; species: *Rauvolfia serpentina*, (copyright BfN).

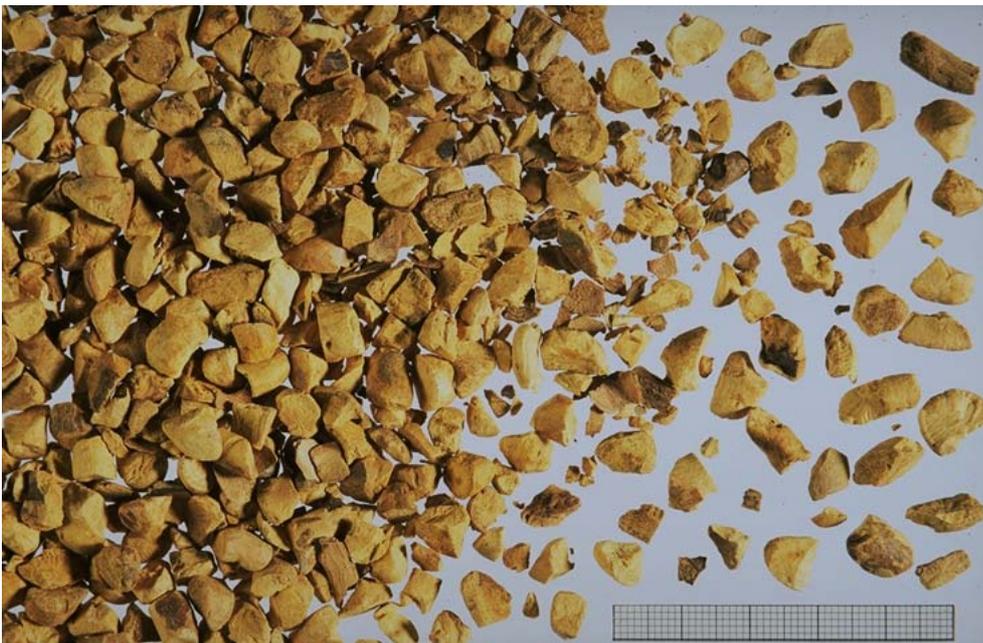


Figure 2. Cut drug, Rauvolfiae radix; species: *Rauvolfia serpentina*, (copyright BfN).



<b>Commercial names:</b>	engl.: Mahogany esp.: Caoba mexicana, Caoba de la costa del Pacífico fr.: Acajou de Mexique
<b>Common names:</b>	Zopilote, Gateado (México); Caoba de Honduras, Cóbano, Zapatón (Guatemala); Caobach, Cuabilla, Flor de venadillo, Guayach, Mabu, Mova, Palo de zopilote, Venadillo
<b>Scientific synonyms:</b>	<i>Swietenia bijuga</i> Preuss. <i>Swietenia cirrhata</i> S.F. Blake
<b>Subject to CITES regulations:</b>	All parts and derivatives, except seeds, spores, pollen (including pollinia), seedling or tissue cultures obtained in vitro, in solid or liquid media, transported in sterile containers and cut flowers of artificially propagated plants.
<b>Macroscopic characteristics of the wood:</b>	Wood: brown, diffuse porous, growth rings distinct, marked by marginal parenchyma. Well-distinguished sapwood and heartwood. The sapwood is greyish brown, and the heartwood is light reddish brown with gentle grain, partially created by the growth rings. Slight aromatic smell. Fibres interlocked and slightly wavy. The vessels and wood rays are visible to the naked eye. Hardness: hard Grain: medium Specific weight: 0.61 g/cm <sup>3</sup>
<b>Microscopic characteristics of the wood:</b>	Wood diffuse porous. Vessels in radial multiples of 2 to 3, occasionally solitary, few, 5 per mm <sup>2</sup> and medium sized, with an average tangential diameter of 176 µm. Vessels members are medium sized, on average 480 µm long, with bordered intervascular pits, alternate and minute. Perforation plates simple. Gum or deposits present. Parenchyma apotracheal, in short bands of 4 – 6 cells wide, marginal parenchyma bands 2 – 6 cells wide. Moderately numerous wood rays, 4 per mm <sup>2</sup> , heterocellular, uni- or up to triseriate; the cells contain gum and crystals. Libriform fibres septate, with thick walls.
<b>Characteristics of the trees:</b>	<i>S. humilis</i> is a tree with a straight trunk, which grows up to 25 metres tall and 80 centimetres in diameter. It grows in dry semideciduous forests and savannas up to 1200 metres above sea level.
<b>Characteristics of trade:</b>	Mahogany is the wood for which the largest number of species have been sought as substitutes. There are more than several hundred timber-producing species that have some similarity with Mahogany, at least in appearance, although without the quality for which it is known: dimensional stability. These “false” mahoganies are frequently sold under the name mahogany, with the addition of the country of origin.

**Distribution:** Costa Rica, El Salvador, Guatemala, Honduras, Mexico and Nicaragua



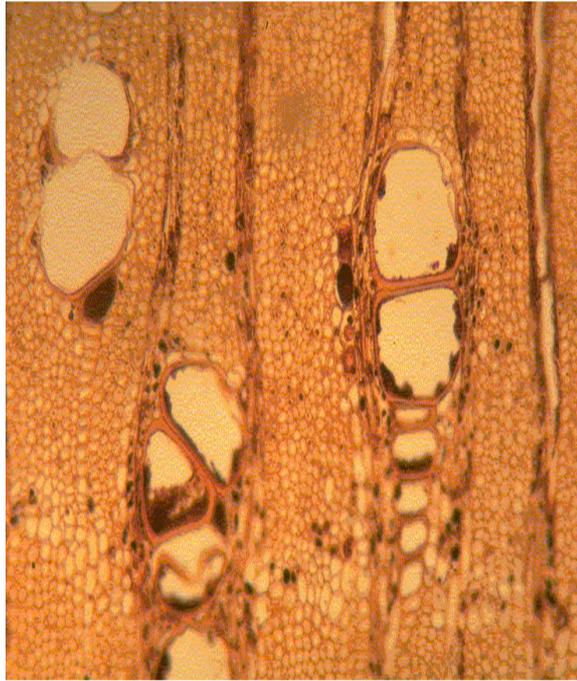
**Use:** High-quality furniture, interior finishing, pianos, industrial pattern making, woodcut blocks, musical instruments, boat interiors, carvings and sculptures.

**Similar species:** There are three species in this genus in tropical America: *Swietenia humilis*, *S. macrophylla* and *S. mahagoni*. There are several hybrids in Central and South America: *S. macrophylla* x *S. humilis*; *S. macrophylla* x *S. mahagoni* (probably a synonym of *S. x aubrevilleana* Stehlé & Cusin). In addition to these species, there are other similar species of African origin, generically called African mahoganies.

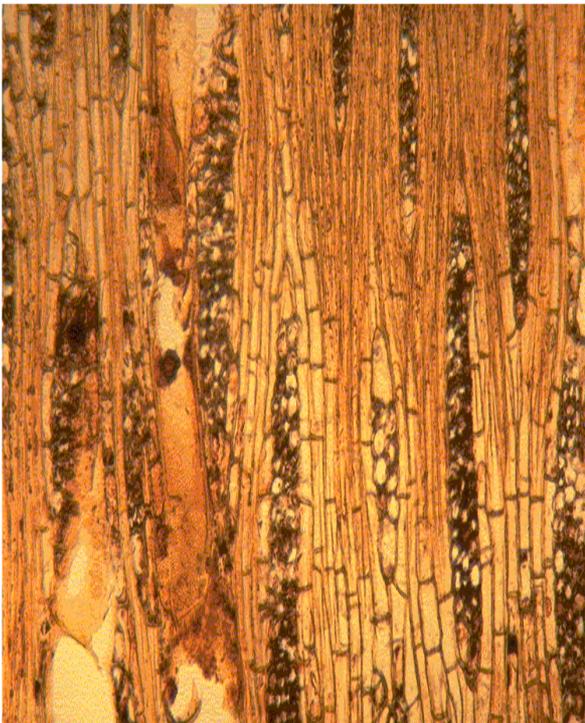
Other similar species	Distribution	Common name
<i>Swietenia macrophylla</i> King	Central and South America	American mahogany
<i>S. mahagoni</i> (L.) Jacq.	Caribbean and Florida	Cuban mahogany
<i>Entandrophragma angolense</i> (Welw.) C. DC.	Africa	Gedu nohor, Tiama, Kalungi
<i>E. candollei</i> Harms	Africa	Kosipo, Omu
<i>E. cylindricum</i> (Sprague) Sprague	Africa	Sapele
<i>E. utile</i> (Dawe & Sprague) Sprague	Africa	Utile
<i>Khaya anthotheca</i> (Welw.) C. DC.	Africa	African mahogany, white khaya
<i>K. grandifoliola</i> C. DC.	Africa	African mahogany, bigleaf khaya
<i>K. ivorensis</i> A. Chev.	Africa	African mahogany, red khaya
<i>K. nyasica</i> Stapf	Africa	Mozambique mahogany, Umbawa
<i>K. senegalensis</i> (Desr.) A. Juss.	Africa	African or Senegal mahogany
<i>Carapa guianensis</i> Aubl.	Central and South America	Andiroba, Crabwood

(See *Swietenia macrophylla* for a more detailed comparison of these species)

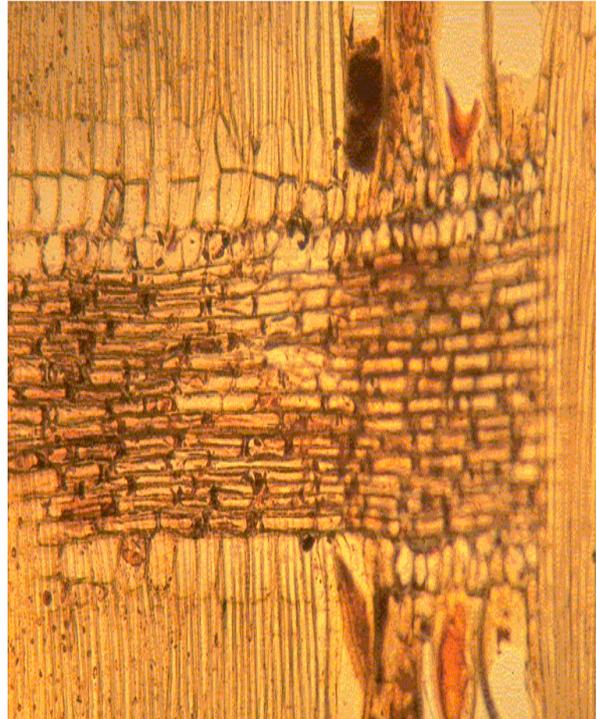




transverse section



tangential section



radial section



<b>Commercial names:</b>	engl.: Mahogany, American mahogany esp.: Caoba, Caoba de Centro América, Caoba de Honduras fr.: Acajou d'Amérique centrale
<b>Common names:</b>	Aguano, Araputanga, Bigleaf mahogany, Caoba del Atlántico, Caoba de hoja ancha, Caoba del Sur, Coabillo, Cóbano, Gateado, Gateads, Mara, Mara boliviana, Mogno, Mogu, New World Mahogany, Orura, Venadillo, Zapatón, Zopilote
<b>Scientific synonyms:</b>	<i>Swietenia candollei</i> Pittier <i>Swietenia tessmannii</i> Harms. <i>Swietenia krukovii</i> Gleason <i>Swietenia belizensis</i> Lundell <i>Swietenia macrophylla</i> var. <i>marabaensis</i> Ledoux & Lobato
<b>Subject to CITES regulations:</b>	Only logs, sawn wood and veneer sheets
<b>Macroscopic characteristics of the wood:</b>	<p>Wood: reddish brown, diffuse porous, vessels visible to the naked eye, of medium size. On the tangential and radial sections, the vessels appear as a small empty groove with a dark bottom. Growth rings; visible but not well marked, and of uneven width wood. Clearly distinguishable sapwood and heartwood. The very narrow sapwood is of a light colour, almost white, and the heartwood is bright pink immediately after being cut, but darkens with exposure to light, passing to reddish brown. The wood is somewhat lighter and smoother than Cuban mahogany (<i>S. humilis</i>). Odourless. Fibres straight, wavy or twisted with a tendency to be interlocked and irregular. Wood rays and parenchyma invisible to the naked eye.</p> <p>Hardness: medium</p> <p>Grain: fine to medium, but finer than that of the African caobas</p> <p>Specific weight: varies greatly depending on the origin: 0.45 – 0.70 g/cm<sup>3</sup>, with an average of 0.6 g/cm<sup>3</sup></p>
<b>Microscopic characteristics of the wood:</b>	<p>Wood diffuse porous, moderately few or few vessels (2 – 12, usually 8/mm<sup>2</sup>), solitary and in radial multiples. Average tangential diameter of the solitary vessels (100 –) 150 (–200) µm; with minute intervascular bordered pits. Simple and inclined perforation plates. The vessels are moderately short, (239 –) 307 (– 405) µm long, with deposits or gum in the interior. The axial parenchyma varies between two types: zoned marginal and vasicentric paratracheal. The parenchymal series are formed by 5 – 7 cells. This parenchyma is usually present in vertical layers (storied). Rays heterogeneous, multiseriate, usually between 3 – 4, but sometimes up to 7 cells wide and distributed in layers, although this varies. There are calcium oxalate crystals in the cells. Libriform fibres are very short: (875 –) 996 (– 1275) µm and septate. Variable forms of vertical canals can be found, arranged in tangential series.</p>
<b>Characteristics of the trees:</b>	The tree can reach 35 – 40 metres in height and 2 metres in diameter. It usually has buttress roots up to 5 metres above the base, which increases the diameter of the trunk to more than 10 metres, making it necessary to cut the tree at more than 2 metres above the ground. The trunk is straight and cylindrical, without branches for approximately 25 metres. The bark is reticulate, greyish brown sometimes with reddish marks. Young branches are glabrous, with fine patterns.

**Distribution:** Bolivia, Brazil, Central America, Colombia, Peru and Venezuela



**Characteristics of trade:** This species is probably the most valuable tree in all of Latin America. According to ITTO, this species is exported in the form of squared logs and veneers. There are several hundred species suitable for timber that are similar to mahogany, at least in general aspects, although without the quality that has made it famous: dimensional stability. These species are frequently sold as mahoganies with the addition of the name of the country of origin.

**Use:** High-quality furniture, interior finishing, pianos, industrial pattern making, woodcut blocks, musical instruments, boat interiors, carvings and sculptures.

**Similar species:** There are three species in this genus in tropical America: *Swietenia humilis*, *S. macrophylla* and *S. mahagoni*. There are several hybrids in Central and South America: *S. macrophylla* x *S. humilis*; *S. macrophylla* x *S. mahagoni* (probably a synonym of *S. x aubrevilleana* Stehlé & Cusin). In addition to these species, there are other similar species of African origin, which are generally called African mahoganies.

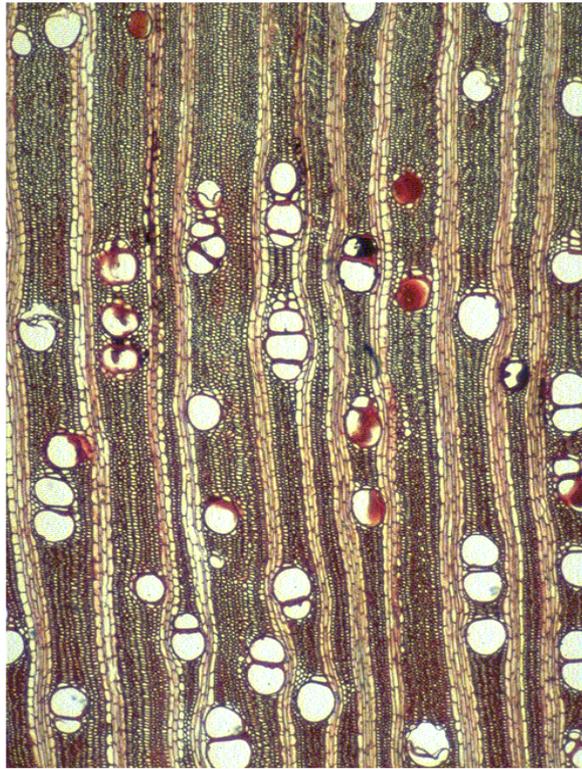
	<b>Distribution</b>	<b>Common name</b>
<i>S. humilis</i>	Central America	American mahogany
<i>S. mahagoni</i>	Caribbean and Florida	Cuban mahogany
<i>Entandrophragma angolense</i>	Africa	Gedu nohor, Tiama, Kalungi
<i>E. candollei</i>	Africa	Kosipo, omu
<i>E. cylindricum</i>	Africa	Sapele
<i>E. utile</i> (Dawe & Sprague) Sprague	Africa	Utile
<i>Khaya anthotheca</i> (Welw.) C. DC.	Africa	African mahogany, White khaya
<i>K. grandifoliola</i> C. DC.	Africa	African mahogany, red khaya
<i>K. ivorensis</i> A. Chev.	Africa	Acajou blanco
<i>K. nyasica</i> Stapf	Africa	Mozambique mahogany, Umbawa
<i>K. senegalensis</i> (Desr.) A. Juss.	Africa	African of Senegal mahogany
<i>Carapa guianensis</i> Aubl.	Central and South America	Andiroba, Crabwood



Species →	<i>Swietenia humilis</i>	<i>Swietenia mahogany</i>	<i>Swietenia macrophylla</i>	<i>Khaya anthoteca</i> <i>K. ivorensis</i> <i>K. nyasica</i>	<i>Khaya grandifolia</i>	<i>Khaya senegalensis</i>	<i>Entandrophragma angolensis</i>	<i>E. candollei</i>	<i>E. cylindricum</i>	<i>E. utile</i>
Characteristics ↓										
Colour sapwood	grey brown	light pink	light pink	yellowish white	pink	pink	pink	pink	whitish yellow	light brown
Colour heartwood	reddish brown	reddish brown	reddish brown	reddish brown	reddish brown	reddish brown	reddish brown	reddish brown with purple lines	reddish brown	reddish brown
Grain	medium	fine and uniform	fine to moderately pink	medium to thick	moderately thick	moderately thick	moderately thick	thick	fine	uniform
Fibres	inter-locked	straight	straight interlocked	sometimes straight usually interlocked	interlocked irregular	interlocked	interlocked	straight to inter-locked	interlocked sometimes wavy	inter-locked
Hardness	medium	medium	soft to medium	soft to medium	medium	medium	soft to medium	medium	medium	medium
Specific weight	1.61 g/cm <sup>3</sup>	0.7 - 0.8 g/cm <sup>3</sup>	0.45 - 0.70 g/cm <sup>3</sup>	0.53 - 0.59 g/cm <sup>3</sup>	0.56 - 0.77 g/cm <sup>3</sup>	0.88 g/cm <sup>3</sup>	0.54 g/cm <sup>3</sup>	0.64 g/cm <sup>3</sup>	0.56 - 0.69 (0.62) g/cm <sup>3</sup>	0.55 - 0.75 (0.66) g/cm <sup>3</sup>



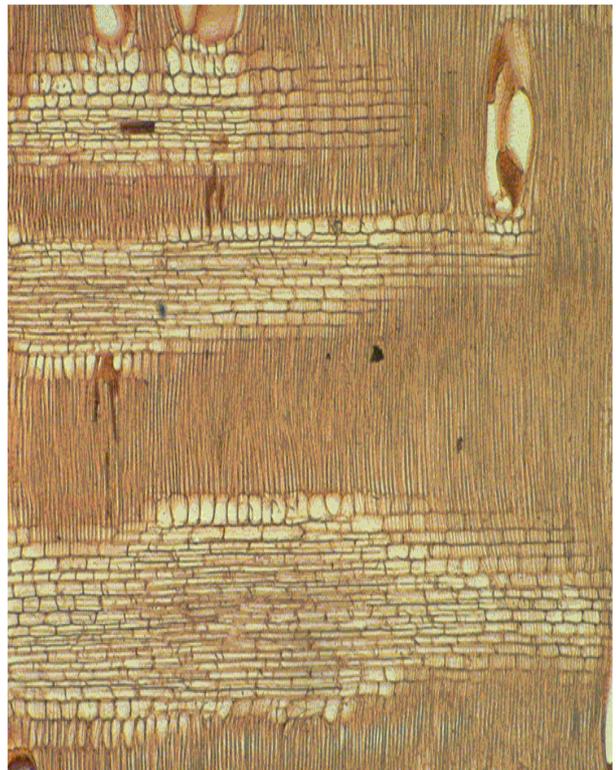




transverse section



tangential section



radial section



<b>Commercial names:</b>	engl.: Mahogany, Cuban Mahogany esp.: Caoba, Caoba de Cuba, Caoba española fr.: Acajou de Cuba, Acajou San Domingo
<b>Common names:</b>	Aguano, Caobilla, Chiculte, Cóbano, Coabillo, Dominican mahagoni, Gateado, Jamaican mahagoni, Madeira, Mahog, Mogno, Orura
<b>Scientific synonyms:</b>	<i>Cedrela mahagoni</i> L. <i>Cedrus mahogani</i> L. <i>Swietenia mahogoni</i> Lamarck <i>Swietenia fabrilis</i> Salisbury <i>Swietenia acutifolia</i> Stokes <i>Swietenia mahogani</i> C. DC. <i>Swietenia mahogani</i> var. <i>praecociflora</i> Hemsley in Hooker
<b>Subject to CITES regulations:</b>	Only logs, sawn wood and veneer sheets
<b>Macroscopic characteristics of the wood:</b>	Wood: brown, diffuse porous, growth rings distinct. Clearly distinguishable sapwood and heartwood. The sapwood is very narrow and light in colour, almost white, the heartwood is bright pink immediately after being cut, but darkens with exposure to light, passing to reddish brown. Odourless. Fibres straight with a tendency to be interlocked and irregular. The vessels and wood rays are visible to the naked eye. Hardness: hard Grain: uniform and fine to moderately coarse, but finer and more uniform than the African mahoganies Specific weight: 0.7 – 0.8 g/cm <sup>3</sup>
<b>Microscopic characteristics of the wood:</b>	Wood diffuse porous. Growth rings distinct. Vessels moderately numerous, 11 per mm <sup>2</sup> , solitary and in radial multiples. Tangential diameter of the solitary vessels (114 –) 143 (–198) µm. Intervascular pits bordered and minute, polygonal and alternate. Perforation plates simple. Vessel elements short, (330 –) 340 – (409) µm. Parenchyma vasicentric paratracheal; frequently also terminal, strands 4 – 9 cells long. Heterogenous rays moderately numerous, uniseriate and multiseriate, 2 – 3 (– 4) cells wide. Libriform fibres with very thin, short septa, (875 –) 1035 (– 1175) µm long.
<b>Characteristics of the trees:</b>	Trees that can grow up to 25 metres in height with a stem diameter of 1.5 metres. The trunks are sold stripped of branches and can reach lengths of up to 23 metres. New branches are glabrous and have abundant lenticels.
<b>Characteristics of trade:</b>	Mahogany is the wood for which many species have been sought as substitutes. There are more than hundred timber-producing species that have some similarity with mahogany, at least in appearance, although without the quality for which it is known: dimensional stability. Frequently, 'false' mahoganies are sold with the addition of the name of the country of origin.

**Distribution:** Florida (United States of America), the Bahamas, Cuba, the Dominican Republic and Jamaica (also introduced on other islands in the Caribbean)



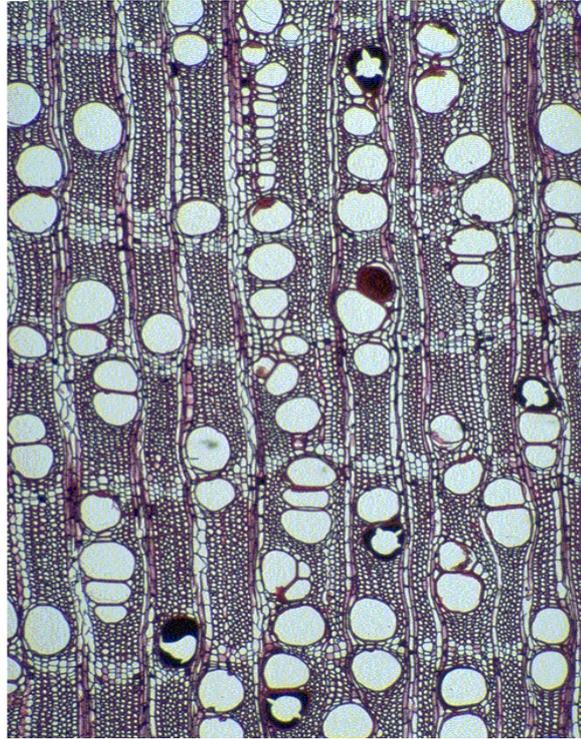
**Use:** High-quality furniture, interior finishing, pianos, industrial pattern making, woodcut blocks, musical instruments, boat interiors, carvings and sculptures.

**Similar species:** There are three species in this genus in tropical America: *Swietenia humilis*, *S. macrophylla* and *S. mahagoni*. It is also known under the name caoba. There are several hybrids in Central and South America: *S. macrophylla* x *S. humilis*; *S. macrophylla* x *S. mahagoni* (probably a synonym of *S. x aubrevilleana* Stehlé & Cusin). In addition to these species, there are other similar species of African origin, which are generically called African mahoganies.

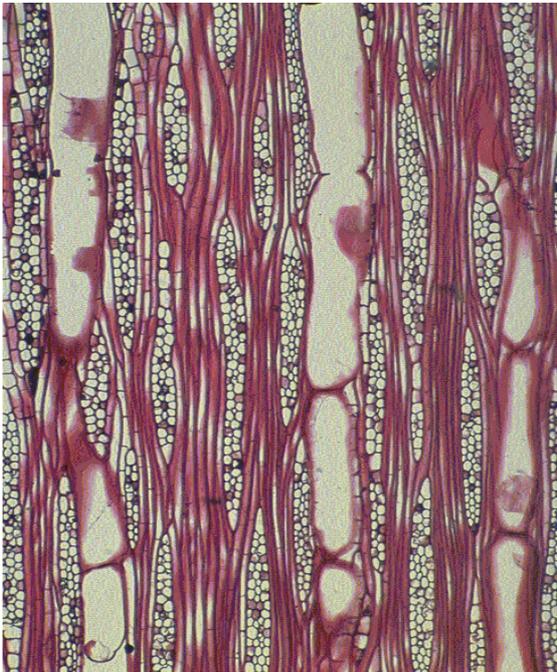
	<b>Distribution</b>	<b>Common name</b>
<i>S. macrophylla</i>	South and Central America	American mahogany
<i>S. humilis</i>	Central America	Cuban mahogany
<i>Entandrophragma angolense</i>	Africa	Gedu nohor, Tiama, Kalungi
<i>E. candollei</i>	Africa	Kosipo, omu
<i>E. cylindricum</i>	Africa	Sapele
<i>E. utile</i> (Dawe & Sprague) Sprague	Africa	Utile
<i>Khaya anthotheca</i> (Welw.) C. DC.	Africa	African mahogany, White khaya
<i>K. grandifoliola</i> C. DC.	Africa	African mahogany, red khaya
<i>K. ivorensis</i> A. Chev.	Africa	Acajou blanco
<i>K. nyasica</i> Stapf	Africa	Mozambique mahogany, Umbawa
<i>K. senegalensis</i> (Desr.) A. Juss.	Africa	African of Senegal mahogany
<i>Carapa guianensis</i> Aubl.	South and Central America	Andiroba, Crabwood

(See *Swietenia macrophylla* for a more detailed comparison of these species)

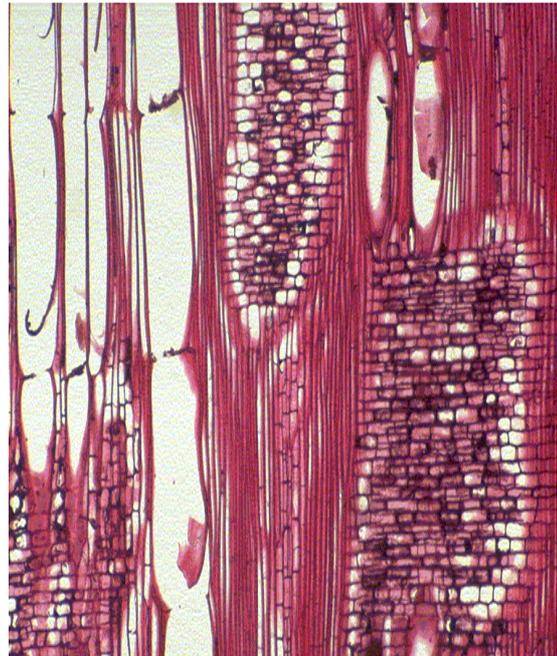




transverse section



tangential section



radial section



# genus *Sarracenia*

L.

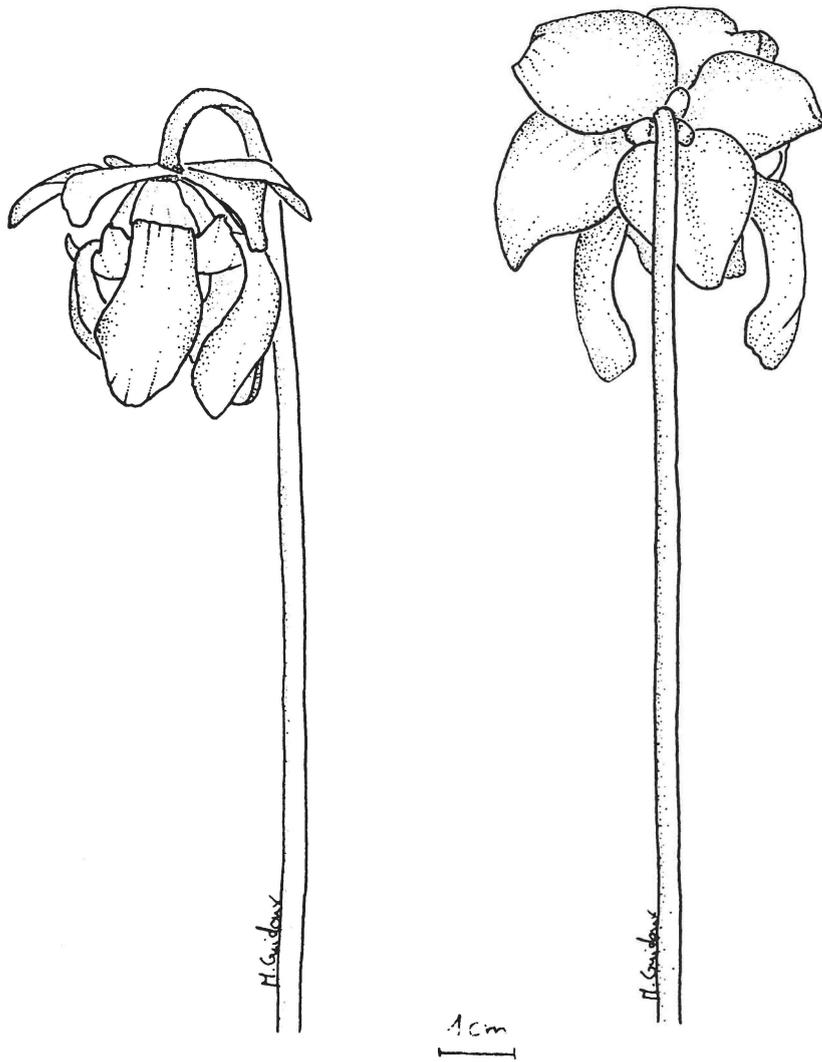
<b>Common names:</b>	engl.: (The Eastern North American) Pitcher Plants esp.: Jarra, Cántaros fr.: Sarracénie, Sarracénia
<b>Scientific synonyms:</b>	None
<b>Characteristics:</b>	
<b>Plants:</b>	Herbaceous, perennial.
<b>Size:</b>	10 cm to 1 m in height.
<b>Type of trap:</b>	Passive, forming a raised or prostrate tube.
<b>Traps:</b>	Leaves in the shape of narrow funnels standing up or lying on the ground, in varied colours. Gathered in rosettes, they grow from a rhizome.
<b>Leaves:</b>	In winter, some species form phyllodes. These are flat expanded non-carnivorous petioles used to capture solar energy.
<b>Inflorescence:</b>	Flowers in the spring with a very distinct form of flower.
<b>Prey:</b>	Primarily insects (hymenopteras and flies) and small crustaceans attracted to the traps by the colours or the nectar formed at the opening of the pitchers. While gathering pollen, they absorb a narcotic (coniine).
<b>Digestion:</b>	Bacteria and enzymes.
<b>Distribution:</b>	North America; East coast and Northwest Canada (B.C. and Great Slave Lake north of Houston, Texas).
<b>Habitat:</b>	Bogs, marshes and wet grasslands, often in the presence of sphagnum. Usually acidic soils, poor in nitrates and phosphates.
<b>Propagation:</b>	Easy by division of plants and from seeds (but requiring more time).
<b>Useful part:</b>	Traps are used for floral arrangements, rhizomes and whole plants as ornamentals.
<b>Trade:</b>	Primarily as rhizomes and pitchers. Sometimes, the pitchers are described as cut flowers.
<b>Number of species:</b>	8, with numerous subspecies and forms. Many varieties and horticultural hybrids are grown.
<b>Similar species:</b>	The rhizome is difficult to identify without attached leaves.
<b>Comment:</b>	These plants relatively easy to cultivate and of rapid growth in an acidic substrata (peat) using non-calcareous water.

Appendix I	Distribution	Entry	Appendix II	Distribution	Entry
<i>S. oreophila</i>	Ala, Ga	1981	<i>S. alata</i>	Ala, La, Miss, Tex	1987
<i>S. rubra</i> (complex) <i>jonesii</i> <i>alabamensis</i>	NC, SC, Ala	1981	<i>S. rubra</i> (complex) <i>rubra</i> <i>wherryi</i> <i>gulfensis</i>	Ga, NC, SC Ala (Miss) Fla	1987
			<i>S. flava</i>	Ala, Fla, Ga, NC, SC, Va	1987
			<i>S. leucophylla</i>	Ala, Fla, Ga, Miss	1987
			<i>S. minor</i>	Fla, Ga, NC, SC,	1987
			<i>S. psittacina</i>	Ala, Fla, Ga, La, Miss	1987
			<i>S. purpurea</i> <i>ssp. purpurea</i> <i>ssp. venosa</i> <i>ssp. heterophylla</i>	- Eastern America - north - south - north (Mich, eastern Canada)	1987

**Entry** = The year the species was included in the CITES appendices

Ala = Alabama, Fla = Florida, Ga = Georgia, La = Louisiana, Mich = Michigan, Miss = Mississippi

NC = North Carolina, SC = South Carolina, Tex = Texas, Va = Virginia



inflorescences of *Sarracenia* spp.

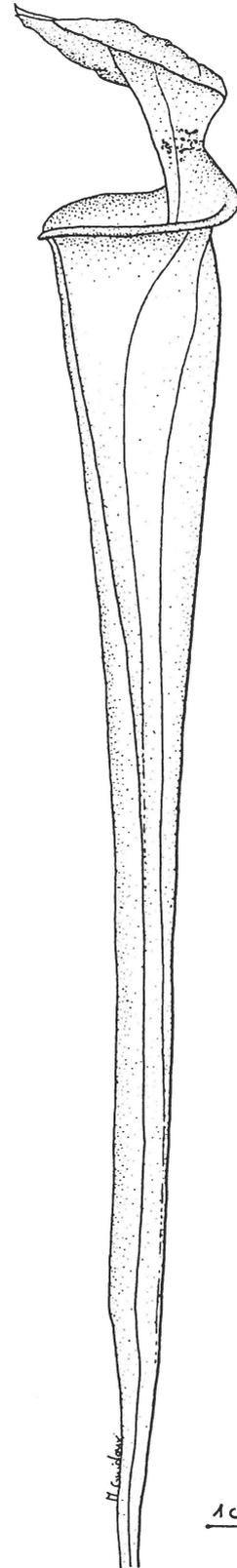


distribution of *Sarracenia alata*



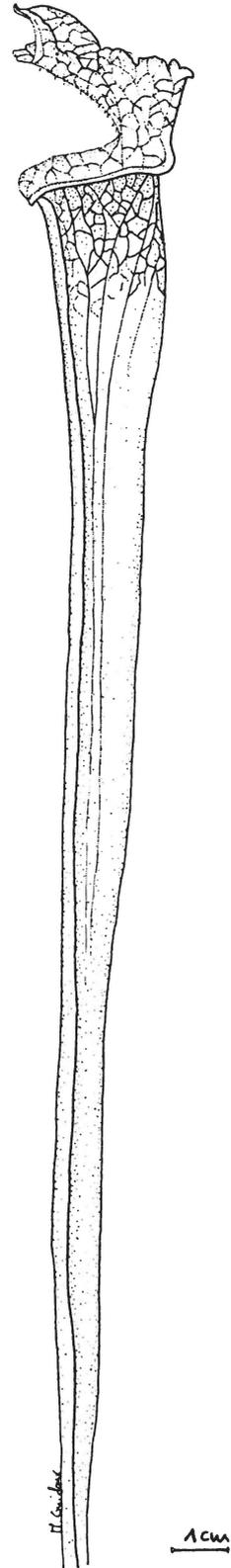
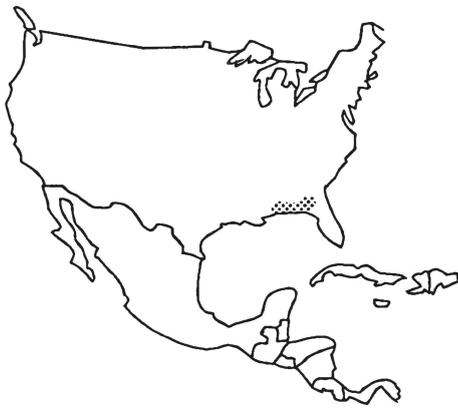
*Sarracenia flava* L.      Appendix II

See also *Sarracenia oreophila*



distribution of *Sarracenia flava*

*Sarracenia leucophylla* Rafin. Appendix II



distribution of *Sarracenia leucophylla*

***Sarracenia oreophila* Wherry**      **Appendix I**

**Common names:**            engl.:      Flycatcher, Green Pitcher Plant  
   esp.:      -  
   fr.:      -

**Scientific synonyms:**    None

**Characteristics:**            See also the sheet on genus *Sarracenia* and the text on intraspecific variation.

**Trap:**                            Pitcher (spring): greenish-yellow in colour with brown veins near the tip. It has the consistency of paper. Size: 20-75 cm. Almost circular opening.

  Trap (late summer): small leaves in the form of a hook (phyllodes), 5-20 cm, green.

**Inflorescence:**            pale yellow (flowering from mid-April until the end of June).

**Habitat:**                      Wet grasslands, stream banks, marshy forests always rather shaded.

**Threats:**                      Agriculture, forestry and collecting.

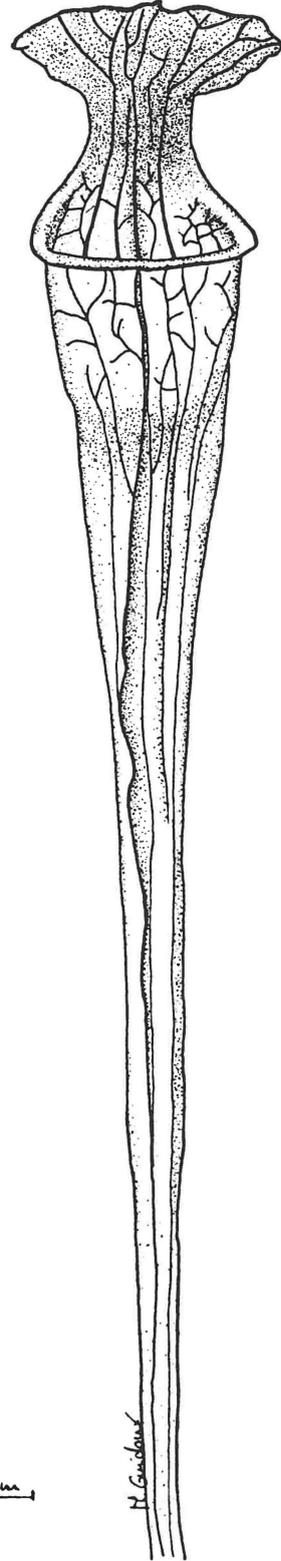
**Protection:**                 Included in the Red List of the U.S. Endangered Species List since 1979.

**Propagation:**              Easy, using seeds and by dividing rhizomes. Also available as *in vitro* cultures.

**Intraspecific variation:**    Cultivated plants can show modified characteristics owing to growing conditions or hybridization.

**Similar species:**            Closely resembles *S. flava* (see differences below).

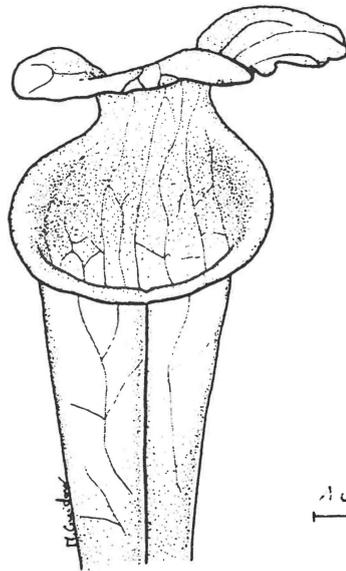
	<i>S. oreophila</i> *	<i>S. flava</i> *
Pitcher - size	short - average	long
Pitcher - opening	round or oval	heart-shaped
Pitcher - colour **	yellowish-green heavily veined with brownish-red	green, but sometimes darkly veined
Pitcher - colour	becomes reddish upon ageing	remains green
Pitcher - consistence	soft like paper; hairy	smooth, leather-like
Operculum - position	at right angle to the trap	more or less upright
Operculum - form	unraised borders, concave	edges very raised at the rear
Phyllodes	short and very bent	long and straight
*      See also illustrations on following pages.		
** <i>S. flava</i> presents several variations in colour, some of which are very close to <i>S. oreophila</i> .		



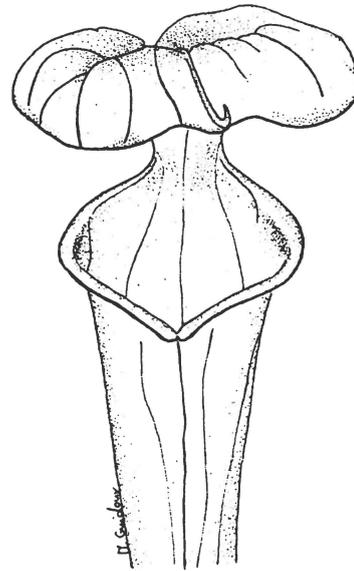
**Distribution:** USA (northeastern Alabama, Georgia and North Carolina)



distribution of *Sarracenia oreophila*



*Sarracenia oreophila*

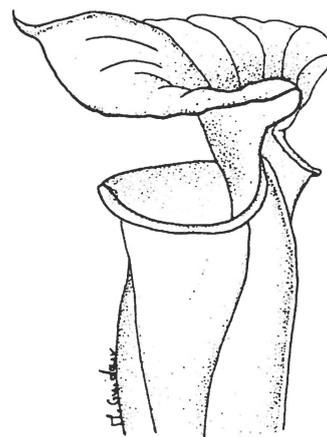


*Sarracenia flava*

opening of the trap



*Sarracenia oreophila*

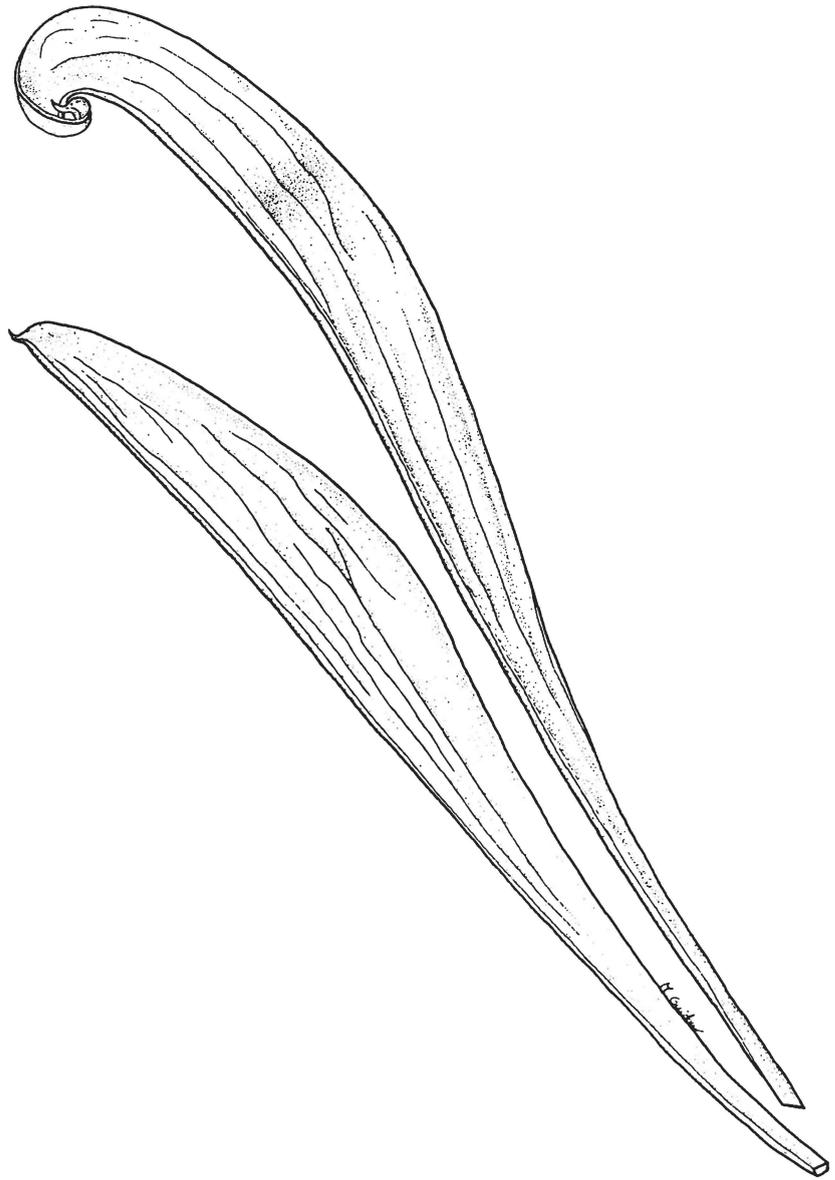


*Sarracenia flava*

position of the operculum

*Sarracenia flava*

phyllodes



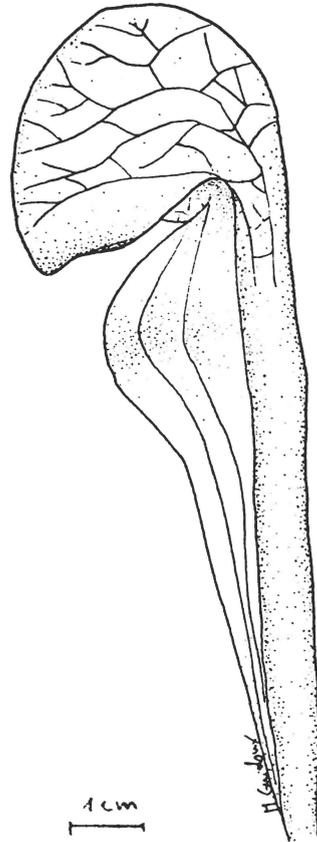
1 cm  
— 1

*Sarracenia oreophila*



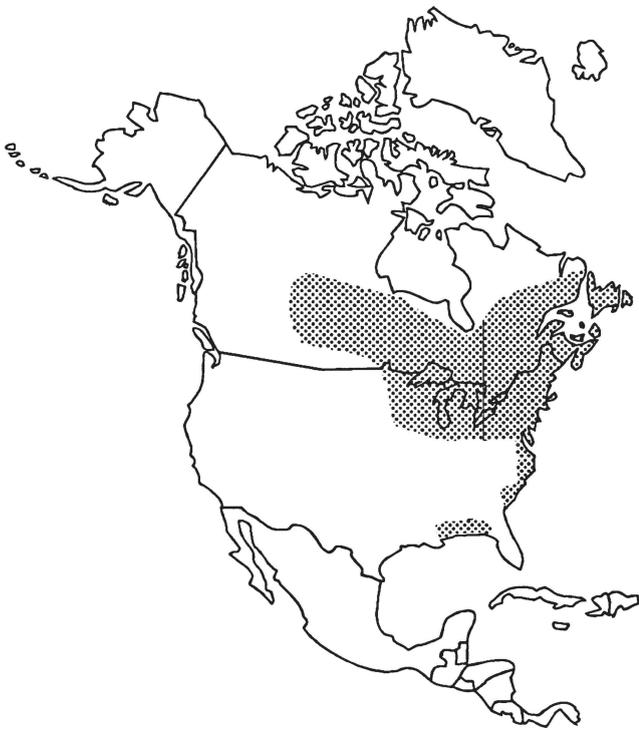
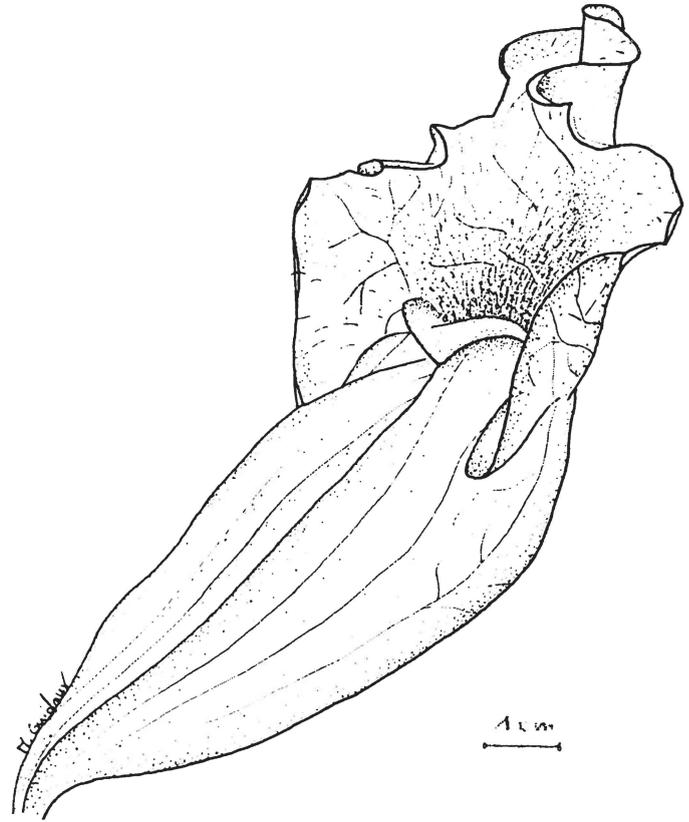


*Sarracenia psittacina* Michx.      Appendix II



distribution of *Sarracenia psittacina*

*Sarracenia purpurea* L. Appendix II



distribution of *Sarracenia purpurea*



*Sarracenia rubra* Walt. Appendices I + II

**Comments:**

Broad characteristics of this difficult group:

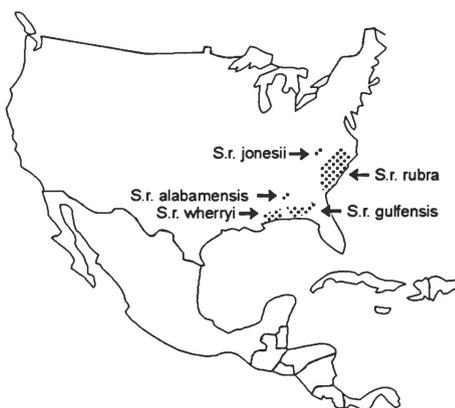
Usually traded in the form of rhizomes or pitchers.

It is impossible to identify precisely *Sarracenia* rhizomes, if their origin is not known.

There is wide variation among species, the production of different forms of pitchers (*S. rubra alabamensis*), as well as frequent hybridization making identification difficult and even more so when the traps are isolated.

Growing them is rather easy and quick to grow using a rhizome (in an acidic, humid, temperate and well lighted environment). This makes it possible to make quick decisions for identification.

In all cases, it is recommended that an expert be consulted in the event of doubt.



distribution of the *Sarracenia rubra* group

**Comparison of characteristics between various species of the group *Sarracenia rubra***  
[based on Case & Case (1976) in *Rhodora* vol. 78]

	<b>alabmanesis+</b>	<b>jonesii</b>	<b>rubra</b>	<b>wherryi</b>	<b>gulfensis</b>
<b>Description</b>	Case & Case, 1974	Wherry, 1929	Walter, 1788	Case & Case, 1976	Schnell, 1979
<b>Pitcher – size</b>	long (less than <i>jonesii</i> ) and wide	long and narrow	short and narrow	short and wide	long and wide
<b>Petiole (base of pitcher)</b>	average; ¼ of the length of the trap	long; 1/4-1/3 of the length of the trap	very short; less than ¼ of the length of the trap	short, less than ¼ of the length of the trap	short
<b>Pitcher – form</b>	widening progressively to a large orifice	widening very markedly in the last ¼ forming a bulge	widening progressively	widening progressively with a bulge at the top	widening progressively
<b>Pitcher – consistence</b>	fine, densely pubescent	thick, waxy, hairless	very thick, waxy, hairless	fine, very densely pubescent	
<b>Operculum – size (lid)</b>	barely covers the opening	about twice as long as the opening	about twice as long as the opening	barely covers the opening	about three times longer than the opening
<b>Operculum – form (lid)</b>	markedly corrugated	barely corrugated	not corrugated	not corrugated, convex	barely corrugated
<b>Rhizome – form</b>	many branches, large compact mass	barely branched, small mass	barely branched	small fragile mass	-
<b>Flowering – order (cf local conditions)</b>	third	fourth	second	first	-
<b>Opening - position</b>	pointing downward	more or less horizontal	horizontal or slightly raised	variable	slightly turned downward
<b>Opening – mouth</b>	well-defined mouth, pointing downward	mouth absent or very small, pointing downward	barely developed mouth	developed mouth, pointing downward	mouth pointing downward at 45°
<b>Helix</b>	very marked in lower half; absent in upper half	almost absent	fully developed at summit, full	average	absent on the upper part of the trap
<b>Opening form</b>	oval, collapsed on the sides	rounded, curved in front	rounded, pointed in front		oval, flattened from back to front
<b>Veins – colour</b>	interior: brown exterior: nothing overall pale colour	interior and exterior: dark brown	interior and exterior: dark brown	interior only, sometimes visible from the exterior due to transparency	interior only, sometimes visible from the exterior due to transparency
* <i>S. alabamensis</i> forms two types of traps during the year: spring      small, rounded, hairless, brown veins at the base of the operculum summer     longer, straight, pubescent, corrugated operculum without brown veins					

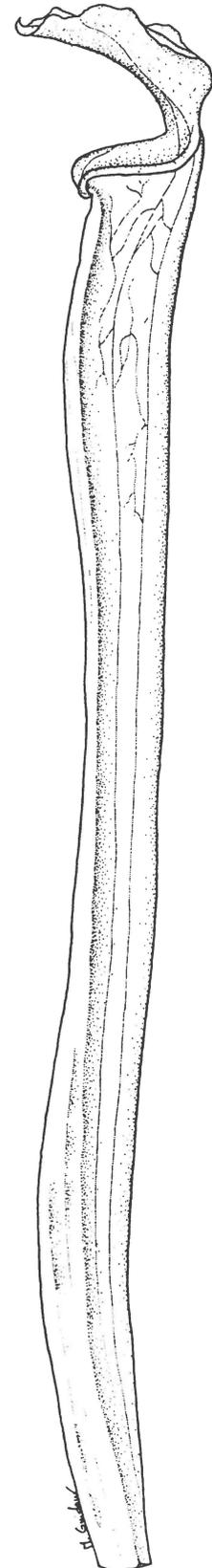
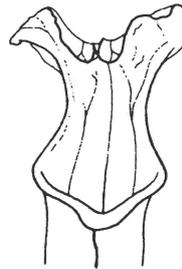


*Sarracenia rubra* Walt. spp. *alabamensis* (Case & Case) Schnell

Appendix I

Common names:      engl.: -  
                               esp.: -  
                               fr.: -

Scientific synonyms:    *S. alabamensis*



**Characteristics:**

Trap:                      Spring: curved form and dark veins.  
                               Summer: smoother texture, fine  
                               pubescence and pale yellowish-  
                               green colour.  
                               Differs in this respect from the *S.*  
                               *rubra* and *S. jonesii*.

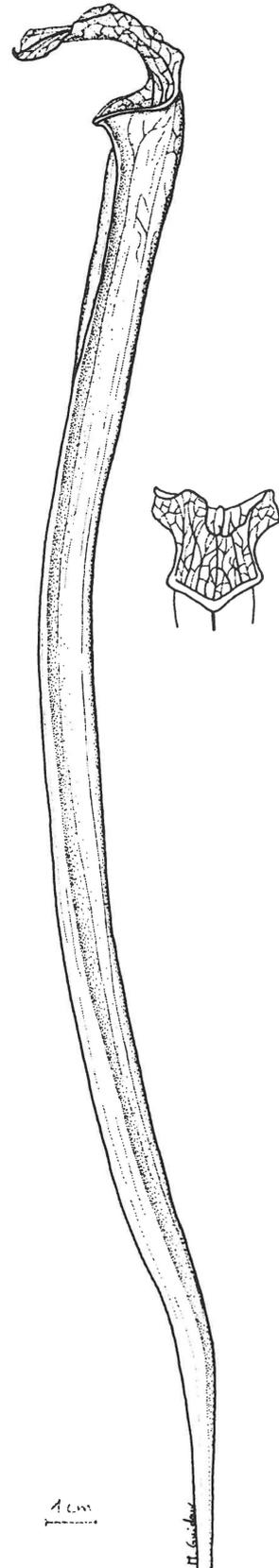
**Distribution:**            USA: Alabama.

**Habitat:**                 Marshes, humid gravel areas,  
                               slightly shaded.

**Threats:**                Transformation of habitat, collecting.

**Protection:**            Included in the red list of the U.S.  
                               Endangered Species List.

**Propagation:**         Easy using seeds and in vitro  
                               cultures. Few rhizomes available for  
                               large scale rhizome division.





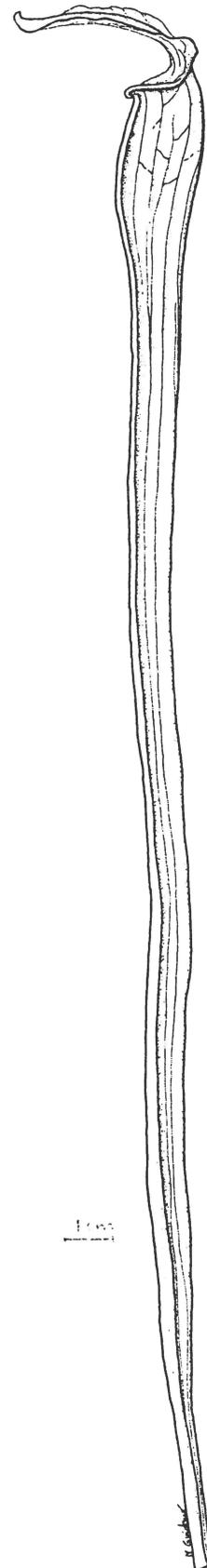
*Sarracenia rubra jonesii* (Wherry) Wherry      Appendix I

**Common names:**      engl.: -  
                                  esp.: -  
                                  fr.: -

**Scientific synonyms:**      *S. jonesii*



upper side of lid



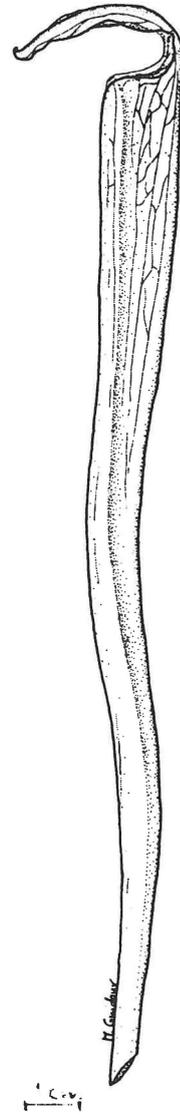
**Distribution:**      USA (North Carolina and South Carolina).

**Habitat:**      Swampy areas in the mountains, partially shaded.

**Threats:**      Transformation of the habitat (collecting).

**Protection:**      Included in the red list of the U.S. Endangered Species List.

**Propagation:**      Easy, using seeds and rhizomes.





**Family:** Asteraceae (Compositae)

**Synonyms:** *Saussurea lappa* (Decne.) C.B.Clarke  
*Aucklandia costus* Falc.  
*Aucklandia lappa* Decne.  
*Theodorea costus* (Falc.) Kuntze

**Vernacular names:**

english:	Aucklandia, costus
french:	
spanish:	
german:	Indische Kostuswurzel, Kostuspflanze
hindi:	Kuth
italian:	Costo

**Geographical range:** Himalayas; from Pakistan through Kashmir to Garhwal in north India.

**Distribution by country:** India, Pakistan.

**Protection:** CITES Appendix I;  
 Since 01.07.1975 included in Appendix II, 01.08.1985 uplisted to Appendix I;  
 All parts and derivatives are controlled.

**Use:** Medicinal and aromatic plant (also used in TEAM).

## Botanical drugs in trade

**Plant parts used:** Roots.

**Pharmaceutical names:**

latin:	Saussureae radix, Radix Saussureae, Radix Costus, Aucklandiae radix, Radix Aucklandiae lappae, Saussurea
english:	Costus root, saussurea root, aucklandia root
french:	
spanish:	
chinese:	Mu Xiang (Muxiang), Guangmuxiang, Yunmuxiang
german:	Costuswurzel, Himalayaschartenwurzel, Indische Kostuswurzel, Saussurea-costus-Wurzel
hindi:	Kuth
italian:	Radice di costo

**Countries of export:** **China**, India, Pakistan.  
 Re-export: Democratic People's Republic of Korea, France, China (Hong Kong SAR), Japan, Pakistan, Republic of Korea, Switzerland.

**Source:** Mainly cultivation (China, India), in addition some wild collection (Himalayas).

**Commodities in trade:** Mainly dried, sliced roots (cut drug), in addition also at most coarsely cut roots (crude drug); furthermore powdered roots and essential oil.

**Characteristics:**

**Crude drug:** (Fig. 1) Root pieces irregularly shaped, mainly 5-10(-20) cm long and 0.5-6 cm thick, strong, hard and firm, thick pieces hardly breakable, fusiform to cylindrical; external surface grey to dark brown, dull, with fine to coarse, distinctly reticulate depressions or wrinkles, thinner roots also longitudinally grooved; lateral roots mainly lacking; pieces often split longitudinally revealing the whitish-yellow to dark brown root wood; fracture short and horny;

**Cut drug:** (Fig. 2-4) Roots sliced transversely or longitudinally, root pieces very variable in size and shape; pieces to 5 mm thick and several cm long, and wide, horny; in transverse section the root is clearly divided into 3 parts: root bark very thin, the layer below the bark is light brown delimited by a dark circular marking; the inner part light brown, yellowish to white, radially striped; wood of thicker roots inside alveolate or porous, in particular seen in longitudinally or obliquely cut root pieces;

**Odour:** Characteristic, strong, unpleasant odour;

**Taste:** Slightly bitter;

**Essential oil:** The essential oil of the root is also traded. It is known as *Saussurea-costus-aetheroleum* (English: costus oil, costus root oil; German: Costus-Wurzelöl).

**Similar drugs/  
adulterations:**

Owing to the similarity of their trade names, the roots of *Saussurea costus* are often confused with the rootstocks of *Costus speciosus* (J.König) Sm., traded as *Costus speciosus rhizoma*. The latter species is distributed in south and southeast Asia and is also named costus, kust, kut and kushta.



Figure 1. Crude drug, Saussureae radix; species: *Saussurea costus*, (copyright BfN).



Figure 2. Cut drug, Saussureae radix; species: *Saussurea costus*, (copyright BfN).



Figure 3. Cut drug, *Sassureae radix*; species: *Saussurea costus*, (copyright BfN).



Figure 4. Cut drug, *Sassureae radix*; species: *Saussurea costus*, (copyright BfN).

# Sclerocactus brevihamatus ssp. tobuschii

(W. T. Marshall) N. P. Taylor 1995

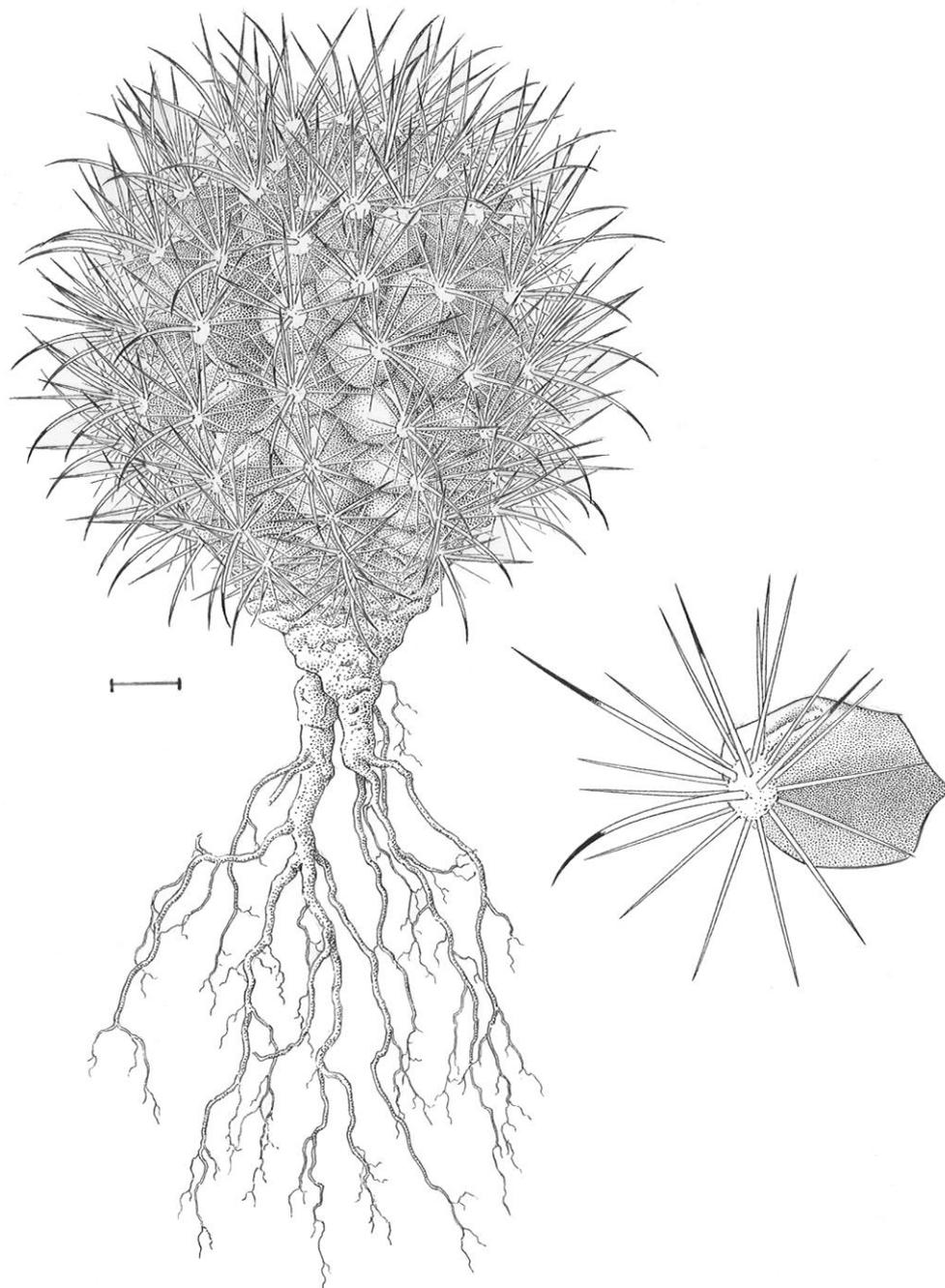


**Common names:** engl.: Tobusch's fishhook cactus

**Scientific synonyms:** *Mammillaria tobuschii* W. T. Marshall 1952  
= *Ancistrocactus tobuschii* (W. T. Marshall) Backeberg ex L. Benson 1966  
= *Echinocactus tobuschii* (W. T. Marshall) Weniger 1970 (nom. inval.)  
= *Ferocactus tobuschii* (W. T. Marshall) N. P. Taylor 1979  
= *Pediocactus brevihamatus* ssp. *tobuschii* (W. T. Marshall) Halda 1998  
= *Ancistrocactus scheeri* ssp. *tobuschii* (W. T. Marshall) Doweld 1999

**Excluded taxa** *Sclerocactus brevihamatus* ssp. *brevihamatus* (Engelmann) D. Hunt 1991  
= *Echinocactus brevihamatus* Engelmann 1856  
= *Ancistrocactus scheerii* fa. *brevihamatus* (Engelmann) Krainz 1967

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



bar = 1cm

- Characteristics:** Rather small sized, globose cactus, stem with tubercles, dark green with rather short, acicular, predominantly and distinctively golden yellow coloured spines. Spines rather thin, with 1 distinctive, porrect, curved to hooked central. Tubercles with a woolly furrow on the upper side.
- Roots:** Fibrous, from a slightly napiform stem base.
- Stem:** Solitary, globose, tuberculate, 4-5 cm high and  $\varnothing$ , dark green, partly obscured by the spines.
- Tubercles:** Conical, protruding 9-12 mm, base 6 mm broad x 6-9 mm long, confluent into ribs in old specimens, with a distinctive woolly furrow in mature specimens.
- Areoles:** Elliptic, 4.5 mm long, with little white wool, finally glabrate, conspicuously prolonged into a long, narrow furrow beyond the spines on the upper (adaxial) side of tubercles of mature specimens (furrow bearing nectar glands?).
- Spines:**
- Radial spines: 7-9, spreading somewhat irregularly, straight, acicular, rather thin (basally 0.2 mm  $\varnothing$ ), the longer to 12 mm long, yellow.
  - Central spines: 4, basally 0.4 mm  $\varnothing$ , acicular, light yellow with red tips, changing to grey in habitat, the upper 3 ascending, straight, acicular, to 2.2 cm long, the lower one porrect, curved to hooked, shorter.
- Flowers:** In april from the centre of the stem apex, 3-4 cm long and  $\varnothing$ , perianth yellowish white, outer perianth segments with brown midstripe, floral tube narrowly conical, scaly.
- Fruits:** 25-30 mm long, 9-15 mm  $\varnothing$ , with a few scales, green.
- Seeds:** 1.5 mm long, 1.5 mm broad, 1 mm thick, black, with finely papillate seed coat.

**Distribution:** State of Texas, USA



**Trade:** Local endemic, known from only two strongly disjunct localities in Texas. First collected in the field in 1951 by Herman Tobusch, on the Edwards Plateau near Vanderpool, along the Sabinal River. Only a few subsequent collections are reported. Flowering plants in habitat southwest of Kerrville have been documented by Bobby Crabb (in Doweld 2001). In the 1970s, the species has been found by Roland H. Wauer in the Big Bend National Park, some 400 km from the type locality. Reported in 1983 to be endangered by commercial collecting and water development projects (U.S. Endangered species 11/7/79). It has been collected in the type locality to some extent by cactus enthusiasts and subsequently introduced in cultivation. International trade in wild-collected specimens today is rather unlikely. It is not well represented in collections, although propagation from seeds is not too difficult. The plants are quite sensitive to overwatering. The species is in some demand mainly because of its reputation of being rare. Artificially propagated plants and seeds are in trade in USA and Europe usually under the older name "*Ancistrocactus tobuschii*". Often cultivated as grafted specimens. Nurseries registered for artificial propagation: Czech Republic P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** Could be mistaken for the quite common *Sclerocactus brevihamatus* ssp. *brevihamatus* (CITES App. II), better known under the synonym *Ancistrocactus scheerii*, occurring in Texas, New Mexico and northern Mexico, which grows to a cylindrical shape (-15 cm), has longer spines (-4.5 cm), a higher number of radials (12-20) and centrals (-6), the upper centrals whitish, flattened and ascending. Further, the plants of ssp. *brevihamatus* show an unusual, shaggy coloration, caused by multicoloured spines (vs. golden-yellow in ssp. *tobuschii*) and they have fleshy roots.

**Bibliography:**

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Doweld, A. B. (2001): The genus *Ancistrocactus* Britton & Rose. *Cactus & Co.* 5 (2): 60-102.

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# Sclerocactus erectocentrus

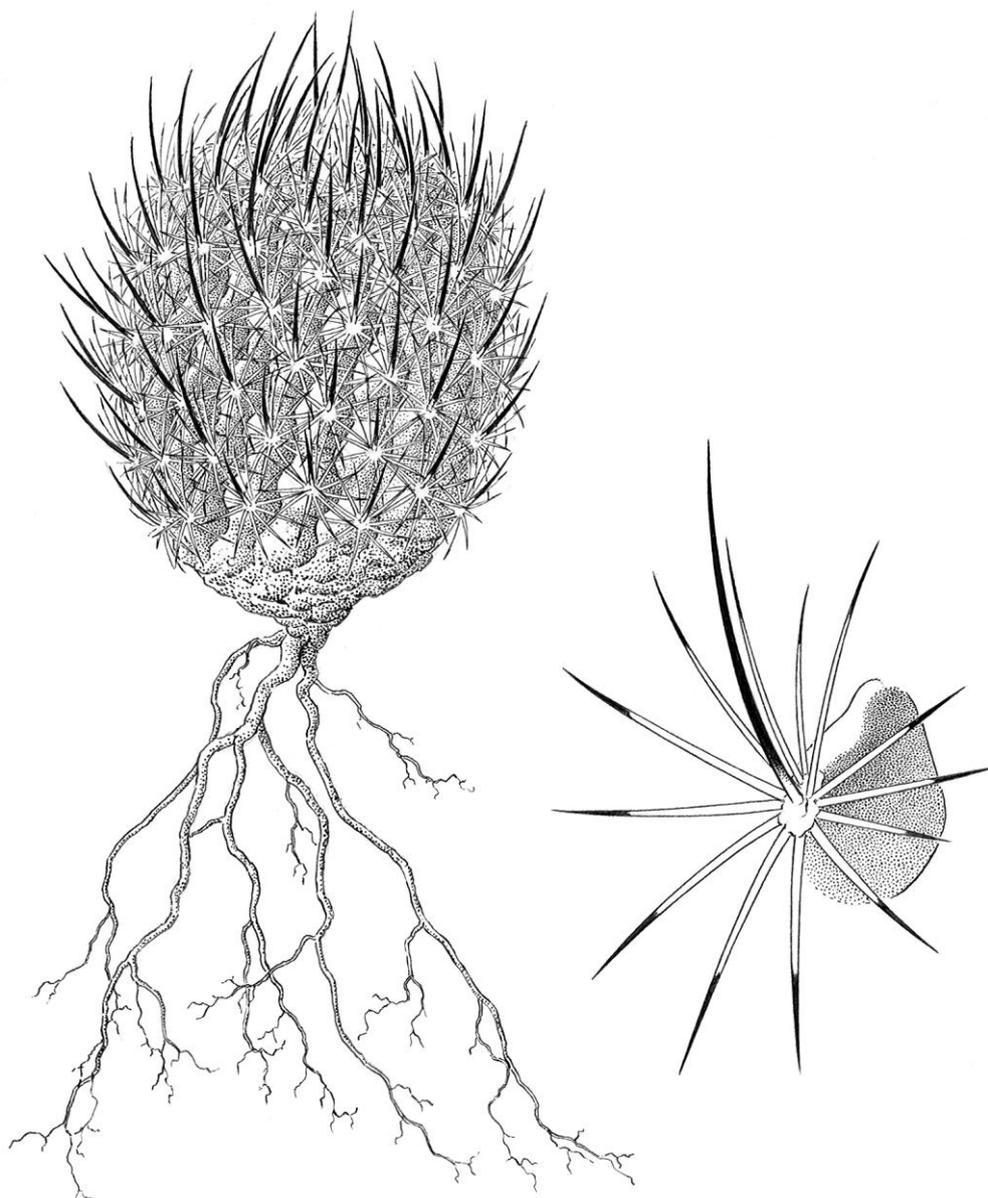
(J. Coulter) N. P. Taylor 1987

**Common names:** engl.: Needle-spined pineapple cactus (*S. erectocentrus*), Acuña Valley cactus, red pineapple cactus (*Echinomastus acunensis*)

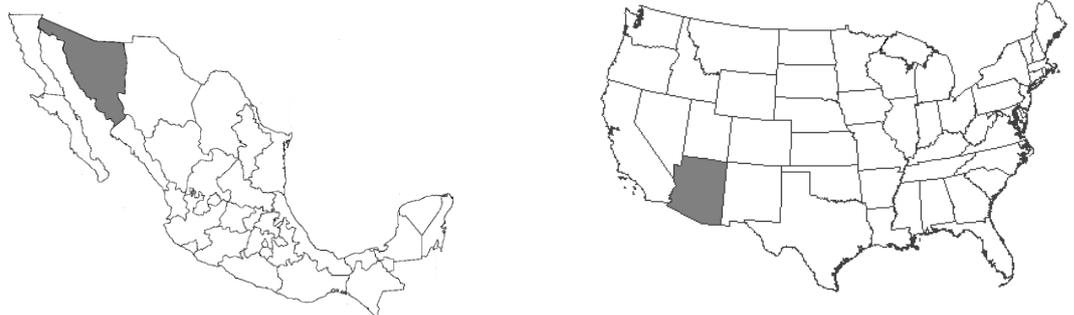
**Scientific synonyms:**

- = *Echinocactus erectocentrus* J. Coulter 1896
- = *Echinomastus erectocentrus* (J. Coulter) Britton & Rose 1922
- = *Neolloydia erectocentra* (J. Coulter) L. Benson 1969
- = *Pediocactus erectocentrus* (J. Coulter) Halda 1998
- *Echinocactus krausei* Hildmann 1989
- = *Echinomastus krausei* (Hildmann) Borg 1937
- *Echinocactus acunensis* W. T. Marshall 1953
- = *Echinomastus acunensis* W. T. Marshall 1953
- = *Neolloydia erectocentra* var. *acunensis* (W. T. Marshall) L. Benson 1969
- = *Echinomastus erectocentrus* var. *acunensis* (W. T. Marshall) Bravo 1980
- *Echinomastus pallidus* Backeberg 1960 (nom. inval.)
- = *Echinomastus erectocentrus* var. *pallidus* (Backeberg) Weniger 1970 (nom. inval.)

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



- Characteristics:** Medium sized, globular to cylindroid cactus with colourful spines, obscuring the stem, spines dense, very rigid, protruding, pungent, predominantly red coloured, with 1 ascending central, hence the species name "*erectocentrus*".
- Roots:** Fibrous from a rounded stem base.
- Stem:** Solitary, globose to elongated, 10-23 (-37) cm high, 7.5-10 (-12) cm Ø, whitish-green, completely obscured by the spines.
- Ribs:** 15-21, the mammillate tubercles protruding prominently above ribs, 6 mm high, base 6-12 mm long, 6 mm broad.
- Areoles:** Elliptic, 3-4.5 mm long, with little white wool, finally glabrate, little prolonged beyond the spines on the upper (adaxial) side of tubercles of flowering specimens into a short furrow.
- Spines:**
- Radial spines: 11-15, spreading, straight, acicular, 1.2-2.5 cm long, basally 0.5-0.8 mm Ø, chalky reddish, pink, purplish or straw-coloured.
  - Central spines: 1-4, basally 1 mm Ø, acicular, 1.2-3.5 cm long, reddish, pink or purplish, dark tipped, sometimes the lower half straw-coloured, arranged crosswise, if all 4 present; the upper, principal central, which is always present on adult specimens, ascending, protruding, straight or slightly curved, longer than the lower ones; the lower 0-3 centrals spreading, straight, one descending and 2 lateral.
- Flowers:** From apex of stem, 4-5 cm long and Ø, perianth pink, floral tube scaly.
- Fruits:** 10 mm long, 7.5 mm Ø, barrel-shaped, thin-walled, with a few scales, green, becoming dry at maturity, opening with 1-2 irregular longitudinal slits.
- Seeds:** 1.5 mm long, 2 mm broad, 1 mm thick, black, with papillate seed coat.
- Distribution:** States of Arizona, USA and Sonora, Mexico



- Trade:** Acclimatisation of adult, wild-collected specimens to cultivation is extremely difficult. The demand for the species is moderate. A rather small number of artificially propagated specimens can be observed in collections of specialists. They are usually grafted in seedling stage, as cultivation on own roots is difficult and losses are rather high. Flowers are seldom seen in cultivated specimens. A taxon from lower elevations (400-600m vs. 900-1300m) is described as var. *acunensis*, differing by longer spines. Seeds and plants are moderately reported in trade in USA and Europe. The more popular genus name in horticulture is still *Echinomastus*. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1002, Switzerland P-CH-1001.
- Similar species:** The very colourful, strong, pungent spination is quite distinctive. *Sclerocactus johnsonii* (CITES Appendix II) from the Mojave Desert comes very close in all characters and could easily be mistaken for *S. erectocentrus*. But its spination is even stronger, the centrals are distinctly curved and radiating in all directions and usually more numerous (4-9 vs. 1-4). Further, yellow flowers occur in *S. johnsonii* apart from pink ones and there is a less frequently observed, yellow spined phase (*S. johnsonii* is extremely difficult to successfully cultivate and very seldom seen in collections).
- Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.

# Sclerocactus glaucus (incl. *S. wetlandicus* & *S. brevispinus*)

(K. Schumann) L. Benson 1966

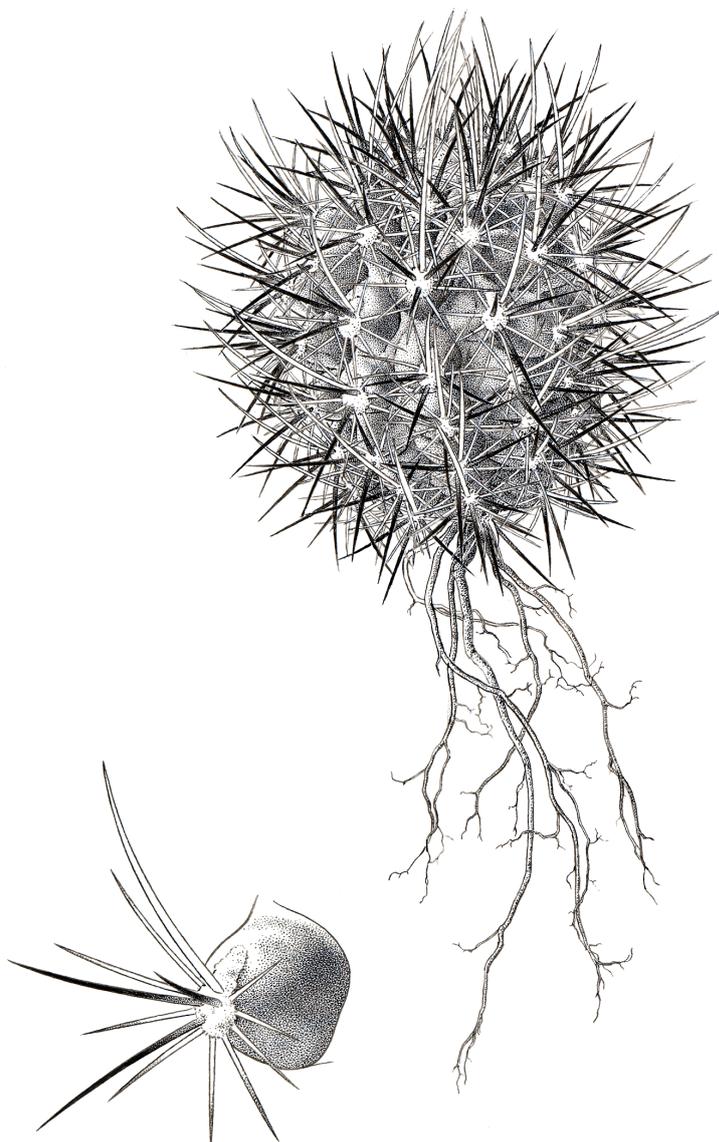


**Common names:** engl.: Uinta Basin Hookless Cactus

**Scientific synonyms:**

- = *Echinocactus glaucus* K. Schumann 1998
- = *Echinocactus whipplei* var. *glaucus* (K. Schumann) J. A. Purpus 1925
- = *Pediocactus glaucus* (K. Schumann) Arp 1972
- = *Ferocactus glaucus* (K. Schumann) N. P. Taylor 1979
- *Echinocactus glaucus* J. A. Purpus 1895 (nom. nud.)
- = *Sclerocactus whipplei* var. *glaucus* (J. A. Purpus) Welsh 1984 (nom. inval.)
- *Echinocactus subglaucus* Rydberg 1917
- *Sclerocactus franklinii* J. W. Evans 1939
- *Sclerocactus wetlandicus* Hochstätter 1989
- = *Pediocactus wetlandicus* (Hochstätter) Halda 1998
- *Sclerocactus brevispinus* K. D. Heil & J. M. Porter 1994 (nom. nov.)
- = *Sclerocactus wetlandicus* var. *ilseae* Hochstätter 1993
- = *Sclerocactus wetlandicus* ssp. *ilseae* (Hochstätter) Hochstätter 1995
- = *Pediocactus wetlandicus* f. *ilseae* (Hochstätter) Halda 1998

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



- Characteristics:** Rather small, globose, tuberculate to ribbed, typically distinctly bluish-green, soft-textured cactus with predominantly white spines, not obscuring the stem. Normally only straight central spines, but sometimes 1 lower hooked. Rather polymorph species. Found on clay hills.
- Roots:** Fibrous, much branched, from deep-seated, subterranean stem base.
- Stem:** Usually solitary (rarely branching from the base, 2-3 heads), depressed globose (*S. brevispinus*) to globose to cylindroidal, (3-) 4-6 (-12) cm high, (2-) 4-5 (-9) cm Ø, not obscured by the spines, bluish-green (green in *S. brevispinus*).
- Ribs:** 12-13 in adult individuals, tubercles protruding prominently above ribs (not quite obvious in *S. brevispinus*).
- Areoles:** 3 (-4.5) mm Ø, with little white wool, finally glabrate, little prolonged beyond the spines on the upper (adaxial) side of tubercles of mature specimens.
- Spines:**
- Radial spines: (2-) 6-8, spreading, nearly straight, acicular, 6-17 mm long, white (8-12 in *S. brevispinus*).
  - Central spines: 1-5, the upper 1-2 (if present) white, only partly flattened, 1.5-3.5 cm long, the lower 1-3 light brown to reddish-brown to dark brown to black, very rarely 1 hooked, 1.2-2.6 cm long (in *S. brevispinus* a single very short straight or hooked central, rarely up to 5, porrect, 0.2-0.5 (-3.1) cm long).
- Flowers:** April to may near apex of stem, fragrant, 3-4 cm long, 4-5 cm Ø, perianth pink, filaments of the stamens green, floral tube scaly (1.0-3.5 cm long, 1.2-3.0 cm Ø in *S. brevispinus*).
- Fruits:** 9-12 mm long, 9 mm Ø, barrel-shaped, with a few scales, thin-walled, green, turning pink, becoming dry at maturity, opening with 2-4 irregular longitudinal slits.
- Seeds:** 1.5 mm long, 2.5 mm broad, 1 mm thick, black, with tuberculate seed coat.

**Distribution:** States of Colorado and Utah, USA



**Trade:** The western population from Utah is taxonomically treated in various ways (*S. glaucus* or *S. wetlandicus*), especially the westernmost, depressed globose, extremely short-spined forms (*S. brevispinus* or *S. wetlandicus* ssp. *ilseae*), see synonyms. Cultivated and traded as grafted specimens, artificially propagated in USA and Europe. Cultivation on own roots is slow and extremely difficult, losses are high. Acclimatisation of wild collected, adult specimens to cultivation is virtually impossible outside the natural range with the exact climate and soil conditions required by the species. Trade in seeds is important, seeds are available from traders in USA and Europe. *S. brevispinus*, included here in *S. glaucus*, discovered in the early 1980s, is reported to having been a curiosity to US cactus horticulturists and collectors and being threatened in the wild. It is one of the geographically most restricted taxa of *Sclerocactus*. Nurseries registered for artificial propagation (*S. glaucus* s. str., from Colorado): Germany P-DE-1001, Czech Republic P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** The bluish-green stem and straight centrals of "typical" specimens are quite distinctive. However, *S. glaucus* is polymorphic and, when bearing a hooked central spine, could be confounded with *Sclerocactus whipplei* (Engelmann & Bigelow) Britton & Rose or *S. wrightiae* L. Benson, which have similar dimensions, but a distinctly flattened, ascending central spine. "Typical" *S. glaucus* could further be confounded with *Pediocactus sileri* (Engelmann) L. Benson for its similar shape, white radials and dark centrals, but the latter is lacking a bluish stem colour and has 11-15 radial spines, obscuring the stem. "Typical" *S. brevispinus* is quite distinctive for its short spines, it might be confounded with *S. mesae-verdae*.

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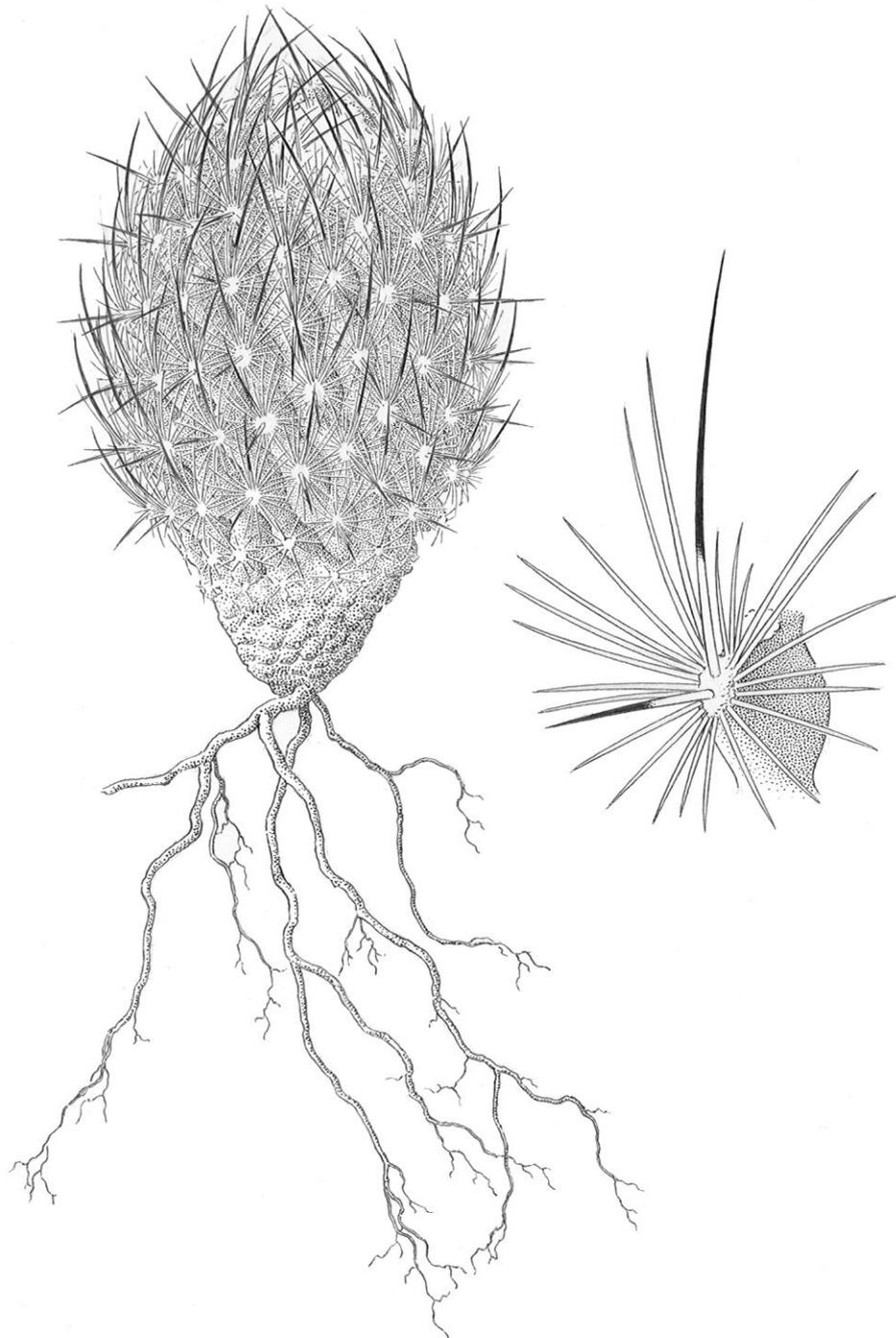
# Sclerocactus mariposensis

(Hester) N. P. Taylor 1987

**Common names:** esp.: Huevo de buey  
engl.: Mariposa cactus

**Scientific synonyms:** = *Echinomastus mariposensis* Hester 1945  
= *Neolloydia mariposensis* (Hester) L. Benson 1969  
= *Echinocactus mariposensis* (Hester) Weniger 1970  
= *Pediocactus mariposensis* (Hester) Halda 1998

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



- Characteristics:** Rather small to medium sized, globular to cylindrical, very densely and predominantly white spined cactus with contrasting dark tips of protruding central spines. Blending with the limestone gravel of its habitat. Growing on gentle hills and slopes of limestone gravel with sparse Chihuahuan desert vegetation.
- Roots:** Fibrous from a rounded stem base.
- Stem:** Solitary, globose to elongated, tuberculate, 6-10 cm high, 4-6 cm Ø, whitish-green, completely obscured by the radial spines.
- Tubercles:** Protruding 3 mm, base 6 mm Ø.
- Areoles:** Elliptic, 3 mm Ø, with little white wool, finally glabrate, little prolonged beyond the spines on the upper (adaxial) side of tubercles of flowering specimens.
- Spines:**
- Radial spines: 26-32, spreading evenly and parallel to stem, straight, acicular, up to 6 mm long, chalky white.
  - Central spines: 2-4, upper 1-3 ascending, straight, the longer 1.5-2 cm long; the lower central protruding, porrect, 0.7-1.4 cm long, straight, acicular, chalky white with chalky blue or brown tips.
- Flowers:** From apex of stem, 2.5 cm long and up to 4 cm Ø, perianth pink to pinkish- or yellowish-white, outer perianth segments with distinctive, darker midstripe, floral tube scaly.
- Fruits:** Undiscribed.
- Seeds:** 1.3 mm long, 1.5 mm broad, 1 mm thick, black, with papillate seed coat.

**Distribution:** States of Coahuila and Nuevo Leon, Mexico State of Texas, USA



**Trade:** The species has a range of at least 350 km with widely scattered populations. The species is not specifically endangered, but has been reported to be locally extensively exploited by commercial cactus collectors in SW Texas in 1983 (U. S. threatened species 11/6/79). Acclimatisation of adult, wild-collected specimens to cultivation is difficult. The demand for the species is moderate. A rather small number of artificially propagated specimens can be observed in collections of specialists. They are usually grafted in seedling stage, as cultivation on own roots is difficult and losses are rather high. Flowers are rather sparse in cultivated specimens. Seeds and plants are reported in trade in USA and Europe. The more popular genus name in horticulture is still *Echinomastus*. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** The dense spination, differentiated into radiating, chalky white radials and protruding, coloured-tipped centrals is quite characteristic and not exactly matched by any other species. Of all densely white spined, globular cacti, *Turbinicarpus mandragora* ssp. *beguinii* (N. P. Taylor) J. Lüthy (CITES Appendix I) comes closest, but it has not chalky white, but glassy, transparent radials and distinctly black tipped centrals. *Mammillaria pottsii* Engelm (CITES Appendix II) has a similar differentiation of dense, white, radiating radial spines and protruding, coloured central spines, but the species grows distinctly columnar with age and branches at the base and the number of centrals is 7-11, the strongest curving upwards, the remaining spreading at 30°-45°.

**Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.

# Sclerocactus mesae-verdae

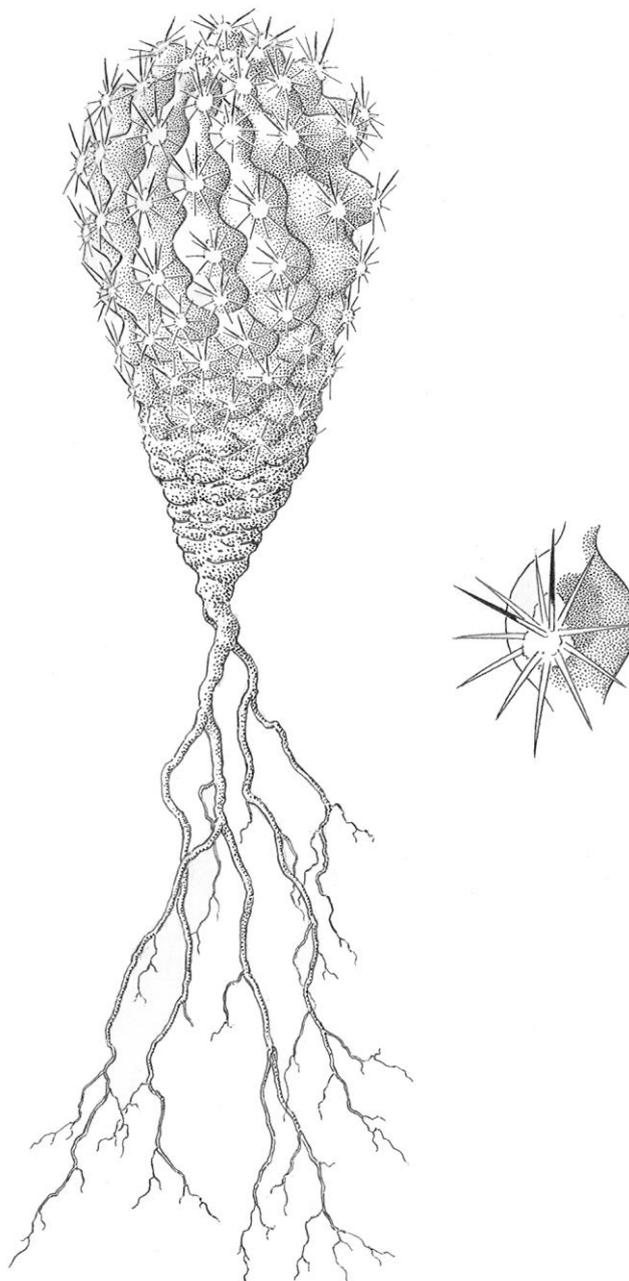
(Boissevain & Davidson) L. Benson 1966



**Common names:** engl.: Mesa Verde Cactus

**Scientific synonyms:** = *Coloradoa mesae-verdae* Boissevain & Davidson 1940  
= *Echinocactus mesae-verdae* (Boissevain & Davidson) L. Benson 1951  
= *Pediocactus mesae-verdae* (Boissevain & Davidson) Arp 1972  
= *Ferocactus mesae-verdae* (Boissevain & Davidson ) N. P. Taylor 1979

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



**Characteristics:** Rather small, depressed globose, ribbed, pale green to grey-green cactus, little protruding from the substrate, with short, white, spreading radial spines, often lacking central spines. One of the more distinctive and morphologically invariant species of the genus. Found on highly alkaline, bare clay hills.

- Roots:** Much branched taproot from deep-seated, subterranean stem base.
- Stem:** Solitary, (depressed) globose to ovoid, (3.2-) 4-6 (-18) cm high (including subterranean part), 3.8-6 (-8) cm  $\varnothing$ , pale green or grey-green, not obscured by the spines, retracting into the soil during winter dormancy (grafted specimens tend to grow into much elongated, cylindrical stem shape).
- Ribs:** 13-17 in adult individuals, tubercles of older individuals inconspicuous, only slightly protruding above ribs. Tubercles of juvenile specimens not confluent into ribs.
- Areoles:** 3-4.5 mm  $\varnothing$ , with conspicuous white wool, finally glabrate, little prolonged bend the spines on the upper (adaxial) side of tubercles of flowering specimens.
- Spines:**
- Radial spines:** (5-) 8-10 (-14), short, acicular, spreading irregularly, straight or slightly curving, 6-12 (-17) mm long, white to pale tannish or grey to straw coloured.
  - Central spines:** Often absent, rarely (and in single areoles), 1 single central, 7-15 mm long, straight or hooked, ascending.
- Flowers:** Near apex of stem in April or May, fragrant, (1-) 2-2.5 (-3.5) cm long and (1-) 2.5-3 cm  $\varnothing$ , perianth yellowish-cream, rarely pale pink, floral tube funnelform, scaly.
- Fruits:** 8-10 mm long and  $\varnothing$ , usually naked, thin-walled, green, becoming tan and dry at maturity, opening irregularly transversely above middle.
- Seeds:** 2.5-3 mm long, 3-4 mm broad, 1.5 mm thick, black, with papillate seed coat.
- Juvenile specimens:** Stem dissolved into tubercles.

**Distribution:** States of New Mexico and Colorado, USA



**Trade:** Cultivated and traded as grafted specimens, artificially propagated in USA and Europe. Usually propagated vegetatively by cutting off the apex of a grafted specimen and grafting it on another stock and subsequently cutting off offsets of the regenerating trunk and grafting them as well. Cultivation on own roots is slow and difficult and losses are high. Acclimatisation of wild collected, adult specimens to cultivation is virtually impossible outside the natural range with the exact climate and soil conditions required by the species. Trade in seeds is important, seeds are available from traders in USA and Europe. Continued illegal taking from the wild is reported. Nurseries registered for artificial propagation: Czech Republic P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** Adult or especially juvenile specimens of *S. mesae-verdae* closely resemble juvenile specimens of *Sclerocactus pubispinus* (Engelmann) Woodruff & L. Benson, *S. spinosior* (Engelmann) Woodruff & L. Benson or *S. blanei* Welsh & Thorne when the latter are still lacking central spines. Adult, flowering specimens of *S. mesae-verdae* are needed to allow correct identification. *S. mesae-verdae* could also be confounded with *S. brevispinus*, which is treated here under *S. glaucus*. Juvenile specimens of *S. mesae-verdae*, when not yet showing ribs, are even resembling *Pediocactus bradyi* L. Benson and its subspecies, which have a similar, pale green, tubercle-bearing stem with white, radiating spines. Fruits of the 2 genera however are very different.

**Bibliography:**

Benson, L. (1966): A revision of *Sclerocactus*. *Cact. Succ. J. (US)* (38): 50-57, 100-106.

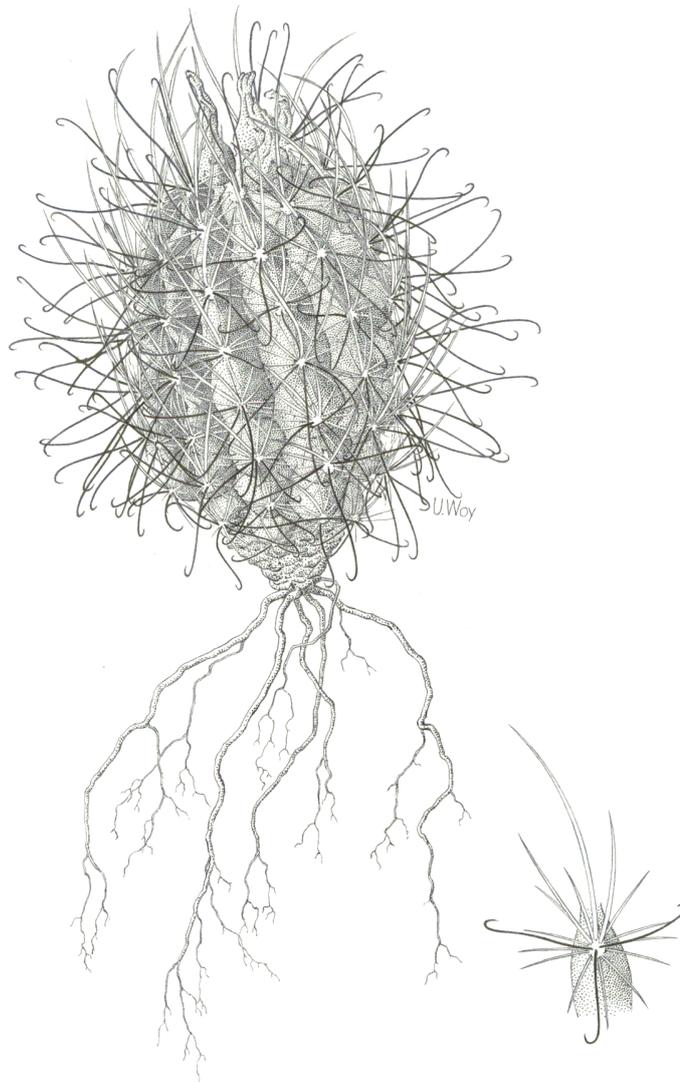
Benson, L. (1982): *The Cacti of the United States and Canada*. Stanford University Press, Stanford, California

Heil, K. D. & J. M. Porter (1994): *Sclerocactus* (Cactaceae): A revision. *Haseltonia* 2: 20.

Hunt, D. (1999): *CITES Cactaceae Checklist, 2<sup>nd</sup> Edition*. Royal Botanic Gardens, Kew, UK.



- Common names:** Tonopah Fishhook Cactus
- Scientific synonyms:** = *Pediocactus nyensis* (Hochstätter) J.J.Halda 1998
- CITES category:** Appendix II since 1.7.1975, Appendix I since 13.2.2003 (Prop. USA)



- Characteristics:** Rather small, globose, ribbed, soft-textured and rather densely and wildly spined cactus. Distinct contrast between white radial and dark central spines, various of the latter hooked; spination dense and obscuring the stem. Found on dry rocky soils and volcanic tuff, within the southern Great Basin vegetation zone.
- Roots:** Fibrous, much branched, from deep-seated, subterranean stem base.
- Stem:** Usually solitary (rarely branching into 2-3 from the base), globose to cylindrical or elongate-cylindrical, 5-12 cm high, 4-5 cm in diameter, obscured by the spines, mostly dark green.
- Ribs:** 12-15, quite well-developed in adult individuals, tubercles confluent at the base, 10-12 mm long, 10 mm wide.
- Areoles:** Elliptic, mostly 13 mm apart, young plants with fine white wool, glabrous at maturity extending little beyond the spines on the upper (adaxial) side of tubercles of mature specimens.

- 
- Spines:
- Radial spines: 12-17, whitish, 8-12 mm long, flat, straight.
  - Central spines: 4-7, the 3-5 lower and lateral centrals red or reddish-brown, 2-3.6 cm long, 0.75 mm in diameter, mostly hooked, upper centrals mostly 1-2 white, flat, mostly 2.5-4.5 cm long, 1.5-2 mm wide, rarely hooked.
- Flowers: Funnelform, near apex of stem, 3-4 cm long, 2-2.5 cm in diameter, perianth rose purple to magenta, filaments of the stamens, style and stigma green, floral tube scaly. Mid-May.
- Fruits: 15-20 mm long, 7.5-15 mm in diameter, barrel-shaped, green to tan, becoming dry at maturity.
- Seeds: 3 mm long, 2 mm broad, 1 mm thick, shiny black, irregularly furrowed.
- Juvenile specimens: Stems with tubercles instead of ribs. Radial spines short, strongly pubescent, white, central spines first lacking, later a single, descending short, white, hooked central spine and 3 ascending, straight to curved central spines and then gradually development of full spination and ribbed stem. Paedomorphosis: Specimens produce flowers while still showing juvenile stem and spine characters.

**Distribution:** State of Nevada, USA



**Comments:** *S. nyensis* is named after part of its distribution range, Nye County, Nevada, which contains the type locality. It is reported from only one additional locality in Esmeralda County, Nevada. *S. nyensis* is widely scattered in both localities. It was first discovered by Richard May in the early 1980s (Heil & Porter 1994), but only gained popularity after it was described and published as a new species in 1992. Because cultivation of *Sclerocactus* cacti is generally difficult, demand since publication has been high only among specialists. Today, the taxon is still quite uncommon in cultivation. Possibly illegal international trade in seeds is reported (CITES CoP 12, Prop. 12.46), and was the main reason for inclusion in Appendix I. Other threats to the species include removal of plants from the wild by collectors, habitat destruction through mining, off road vehicle use, and land conversion may have a more severe impact. *S. nyensis* is listed on the State of Nevada Rare Species List and is also listed as a Special Status Sensitive Species by the U. S. Bureau of Land Management. The species is also ranked as critically imperilled in the State of Nevada (S1) and globally (G1) by NatureServe (2002). *S. nyensis* is artificially propagated in Austria, Czech Republic, Germany, Malta, the Netherlands, Switzerland, the USA, and possibly other countries. Nurseries registered for artificial propagation: none.

**Similar species:** Obvious comparison is with the closely related *Sclerocactus spinosior* (Engelm.) Woodruff & Benson ssp. *spinosior* from the State of Utah, and even more with its geographical neighbour, the nearly overlapping *S. spinosior* ssp. *blainei* (Welsh & Thorne) Hochstätter, also from Nevada, and also *S. schlesseri* Heil & Welsh with narrower stems. A rather cryptic difference between *S. nyensis* and these other species is that the look-alikes have fewer radial spines, *S. spinosior* ssp. *spinosior* having 6-10 radial spines and ssp. *blainei* having 6-9 (occasionally up to 12). In addition, *S. spinosior* ssp. *blainei* has very persistent pubescence surrounding radial spines. Furthermore, juvenile specimens of *S. nyensis*, when still lacking the central spines, can be confused with *Sclerocactus pubispinus* (Engelm.) L. Benson, due to the pubescent radial spines and similar stem characteristics. Juvenile specimens of *S. nyensis*, however, relatively early produce hooked central spines, whereas in *S. pubispinus* they appear later, and are less numerous and mostly straight. The flower of *S. pubispinus* is yellow. All of these taxa belong to the *S. spinosior* complex and have a similar juvenile phase so that juvenile specimens are quite hard to distinguish. Similarity with *S. polyancistrus* (Engelm. & Bigelow) Britton & Rose, which overlaps geographically, is due to the various hooked lower and



flattened upper central spines and the contrast between white radial and mostly dark red central spines. *S. nyensis* is therefore compared with a dwarf *S. polyancistrus* (Heil & Porter 1994). However, this similarity is superficial because *S. polyancistrus* is unique within the genus in various, partly cryptic, but taxonomically important respects. *S. polyancistrus* has 9–11 central spines, 6 of them normally hooked, which are unique within the genus and allow reliable identification of this species.

The illustration in Heil & Porter (1994) under *S. nyensis* clearly shows *S. polyancistrus* and this is likely to have caused some confusion.

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# Sclerocactus papyracanthus (Engelmann) N. P. Taylor 1987

**Common names:** engl.: Grama grass cactus

**Scientific synonyms:**  
= *Mammillaria papyracantha* Engelmann 1849  
= *Echinocactus papyracanthus* (Engelmann) Engelmann 1863  
= *Toumeyia papyracantha* (Engelmann) Britton & Rose 1922  
= *Pediocactus papyracanthus* (Engelmann) L. Benson 1962

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



- Characteristics:** One of the most cryptic of all cacti, perfectly imitating a dry bunch of grass with its long, flattened, curved, papery spines, obscuring the small elongated, tuberculate stem. This masterpiece of camouflage is paralleled only by a few South American opuntoid cacti.
- Roots:** Much branched taproot from deep-seated, tapering, napiform, subterranean stem base.
- Stem:** Solitary, elongated, club-shaped with rounded apex, 2.5-8 cm high (excluding subterranean part), 1.2-2 (-3) cm  $\varnothing$ , grey-green, obscured by the spines, retracting into the soil during winter dormancy (grafted, cultivated specimens grow to considerably bigger dimensions than plants in the habitat and the much elongated stems usually branch with age).
- Tubercles:** Rounded, elongate-conical, 1.5 mm high, 3-4.5 mm  $\varnothing$ .
- Areoles:** 1-1.5 mm  $\varnothing$ , with some white wool, finally glabrate, little prolonged beyond the spines on the upper (adaxial) side of tubercles of flowering specimens.
- Spines:**
- Radial spines:** 6-9, spreading star-like, parallel to stem surface, straight, up to 3 mm long, 0.5 mm broad, flattened, very thin, non pungent, white.
  - Central spines:** 1-4, 2-3 cm long, strongly flattened, the lower one broadest, 1.2-1.3 mm broad, all ascending and curving or inwards or outwards (the two types are kept separate in horticulture), overarching the stem apex, papery, flexible, non pungent, with faint midrib, pale brown, turning grey.
- Flowers:** From apex of stem, 2.5 cm long and 2-2.5 cm  $\varnothing$ , perianth yellowish-white, floral tube narrowly funnelform, scaly.
- Fruits:** Globose, 4.5-6 mm long, 4.5 mm  $\varnothing$ , naked or with a few scales, thin-walled, green, becoming tan and dry at maturity, opening irregularly.
- Seeds:** 2.5 mm long, 3 mm broad, 1 mm thick, black, with papillate seed coat.
- Juvenile specimens:** Lacking central spines.

**Distribution:** States of Arizona, New Mexico and Texas, USA



**Trade:** Two morphological types are known from horticulture, one with central spines distinctly curved outwards and one with ascending central spines, rather curved inwards (as illustrated here). The species is cultivated and traded as grafted specimens, artificially propagated in USA and Europe. Usually propagated vegetatively by cutting off the apex of a grafted specimen and grafting it on another stock and subsequently cutting the offsets of the regenerating trunk and grafting them as well, which is fairly easy and allows for fast propagation. Flowers are readily produced, but pollination is rather difficult. Trade in seeds is less important, seeds are available from traders in USA and Europe. Cultivation on own roots is rather difficult. *S. papyracanthus* is the most popular and best represented species of the genus *Sclerocactus* in collections. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Morphology of seeds, seedlings and vascular bundles clearly show the affinity with the genus *Sclerocactus*, where it has been placed relatively recently. No North American cactus species is comparable with *S. papyracanthus*. *Pterocactus fischeri* and some *Tephrocactus* spp. (CITES Appendix II) from South America have strikingly similar papery spines and a comparable stem shape and size. However, their stems are multiply jointed and their areoles bear glochids (finely bristly, barbed, dehiscent spines), as they belong to Subfamily *Opuntioideae*. *P. fischeri* from Patagonia is a remarkably close (convergent) look-alike, with only the apical stem joint sticking out of the ground).

**Bibliography:** Benson, L. (1982): The Cacti of the United States and Canada. Stanford University Press, Stanford, California  
 Heil, K. D. & J. M. Porter (1994): *Sclerocactus* (Cactaceae): A revision. *Haseltonia* 2: 20.  
 Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.



# Sclerocactus pubispinus

(Engelmann) L. Benson 1966

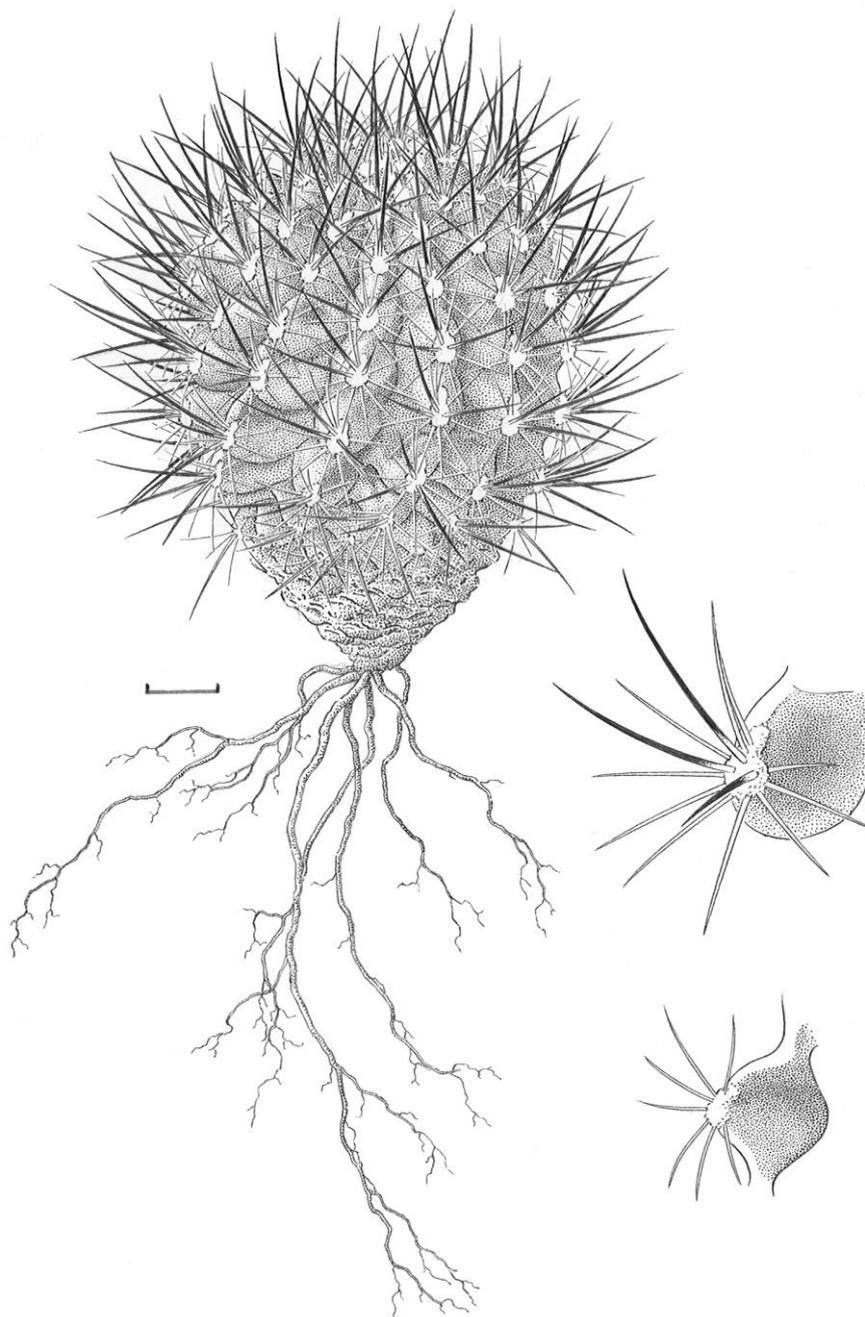
**Common names:** engl.: Great Basin fishhook cactus

**Scientific synonyms:**  
 = *Echinocactus pubispinus* Engelmann 1863  
 = *Pediocactus pubispinus* (Engelmann) Arp 1972  
 = *Ferocactus pubispinus* (Engelmann) N. P. Taylor 1979

**Excluded taxa**

1. *Sclerocactus pubispinus* var. *sileri* L. Benson 1969  
 = *Sclerocactus sileri* (L. Benson) K. D. Heil & J. M. Porter 1994  
 = *Pediocactus pubispinus* ssp. *sileri* (L. Benson) Halda 1998  
 → *Sclerocactus whipplei* ssp. *busekii* Hochstätter 1995
2. *Sclerocactus pubispinus* var. *spinosior* (Engelmann) Welsh 1984  
 = *Echinocactus whipplei* var. *spinosior* Engelmann 1863  
 = *Sclerocactus spinosior* (Engelmann) Woodruff & L. Benson 1976

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



bar = 1 cm

- Characteristics:** Dwarf, depressed globular, pale green, soft textured cactus, hardly emerging from the substrate. Strong dimorphism: Adult specimens ribbed and spination pungent, dense, typically 1 dark, hooked + 1 white, flattened central spine. Juvenile specimens tuberculate and spination strongly pubescent; only short radials, centrals lacking.
- Roots:** Fibrous, from deep-seated, subterranean stem base.
- Stem:** Solitary, depressed globose to shortly cylindrical, (1-) 6 (-15) cm high, 2-15 cm Ø, pale green, not obscured by the spines.
- Ribs:** Usually 13 in adult individuals, tubercles protruding prominently above ribs. Tubercles of juvenile specimens not confluent into ribs.
- Areoles:** Elliptic, 3-6 mm broad, with white wool, finally glabrate, little prolonged beyond the spines on the upper (adaxial) side of tubercles of flowering specimens.
- Spines:**
- Radial spines: (6-) 8-11 (-16), spreading, mostly 5-12 (-35) mm long, 0.3-1 mm Ø, white or with dark tips, acicular.
  - Central spines: (0-3) 4 (-6), the single, lower one porrect, tan to brown, reddish or black, often hooked, (1-) 3 (-5.5) cm long, the lateral (0-) 2 (-4) white, tan, red or reddish-brown, sometimes hooked, mostly 1-2 cm long, the upper one white or dark-tipped, flattened, (5-) 15-25 (-60) mm long, 0.7-2.2 mm wide, nearly straight.
- Flowers:** Near apex of stem, 2-4 cm long and Ø, yellow, with scaly, funnellform floral tube.
- Fruits:** (9-) 10 (-12) mm long and Ø, barrel-shaped, with a few scales, thin-walled, green, turning pink, becoming dry at maturity, opening with 2-4 irregular longitudinal slits.
- Seeds:** 2-2.5 mm long, 3-4 mm broad, 1-2 mm thick, black, with papillate seed coat.
- Juvenile specimens:** Stem dissolved into tubercles. Radial spines short, strongly pubescent, white, central spines lacking. Pedomorphosis: Specimens produce flowers while still showing juvenile stem and spine characters.

**Distribution:** States of Utah, and Nevada, USA



**Trade:** Populations are extremely scattered and hard to find. The species has been reported as potentially threatened through private and commercial collectors in 1983. Cultivated and traded as grafted specimens, artificially propagated in USA and Europe. Cultivation on own roots is slow and difficult and losses are high. Acclimatisation of wild collected, adult specimens to cultivation is virtually impossible outside the natural range with the exact climate and soil conditions required by the species. Trade in seeds is important, seeds are available from traders in USA and Europe. Nurseries registered for artificial propagation: Czech Republic P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** *Sclerocactus pubispinus* could be confounded with *S. spinosior* (Engelmann) Woodruff & L. Benson and *S. blanei* Welsh & Thorne. Mainly juvenile specimens are hard to tell apart, when still lacking the central spines (flower colour and central spines are important differentiating characters). Juvenile specimens also look quite similar to *Sclerocactus mesae-verdae* (Boissevain & Davidson) L. Benson, which also lacks central spines or even *Pediocactus bradyi* L. Benson and its subspecies, which have a similar, pale green, tubercle-bearing stem with white, radiating spines. Adult specimens of *S. pubispinus* are needed to allow correct identification.

**Bibliography:**

Benson, L. (1966): A revision of *Sclerocactus*. *Cact. Succ. J. (US)* (38): 50-57, 100-106.

Benson, L. (1982): *The Cacti of the United States and Canada*. Stanford University Press, Stanford, California

Heil, K. D. & J. M. Porter (1994): *Sclerocactus* (Cactaceae): A revision. *Haseltonia* 2: 20.

Hunt, D. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.



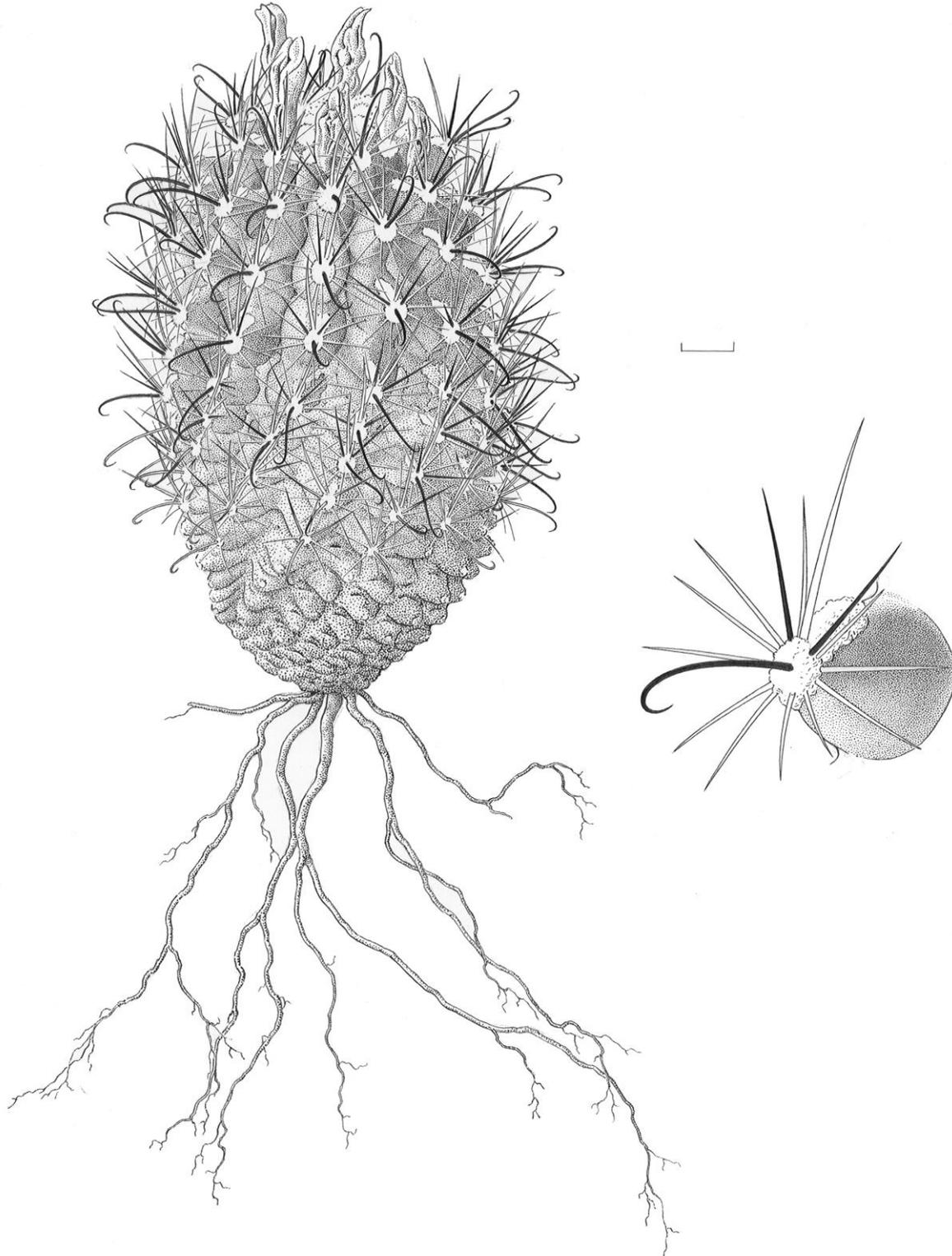
# Sclerocactus wrightiae

L. Benson 1966

**Common names:** engl.: Wright's fishhook cactus

**Scientific synonyms:** = *Pediocactus wrightiae* (Engelmann) Arp 1972  
= *Ferocactus wrightiae* (Engelmann) N. P. Taylor 1979

**CITES category:** Appendix II since 1.7.1975, Appendix I since 29.7.1983 (Prop. USA).



bar = 1 cm

- Characteristics:** Rather small globose, seldom elongated, soft textured, ribbed, pale green cactus. Spination strong but rather short, rigid, pungent. Typically 1 hooked, protruding and 1 flattened, ascending central spine. Whitish flowers with contrasting, magenta filaments. Found on highly alkaline, bare clay hills.
- Roots:** Much branched taproot from deep-seated, subterranean stem base.
- Stem:** Solitary, (depressed) globose to elongated with age, (1-) 5-5.5 (-9) cm high, (4-) 5-7.5 (-8) cm Ø, pale green, not obscured by the spines, retracting into the soil during winter dormancy.
- Ribs:** Usually 13 (-16) in adult individuals, tubercles protruding prominently above ribs.
- Areoles:** 3-4 mm Ø, with white wool, finally glabrate, little prolonged beyond the spines on the upper (adaxial) side of tubercles of flowering specimens.
- Spines:**
- Radial spines: 5-10 (-14), spreading, nearly straight, 6-12 (-17) mm long, white.
  - Central spines: 4, the principal, lower pale on upper side, dark brown on lower, hooked and somewhat curved, 12-15 (-30) mm long, the 2 lateral slightly curving, dark to light brown, to 12 (-21) mm long, the uppermost (median) pale straw or ashy, 6-20 (-27) mm long, to 1.5 mm broad, flattened.
- Flowers:** Near apex of stem in April or May, fragrant, short, barrel-shaped, 3-4 cm long and Ø, perianth pale pink to nearly white, contrasting with magenta filaments of the stamens and green style and stigma, floral tube scaly.
- Fruits:** 9-12 mm long and Ø, barrel-shaped, usually naked, thin-walled, green, turning pink, becoming dry at maturity, opening with 2-4 irregular longitudinal slits.
- Seeds:** 2 mm long, 3.5 mm broad, 1.5 mm thick, black, with papillate seed coat.

**Distribution:** Utah, USA



**Trade:** Regional endemic from east of Capitol Reef, Utah. Has been reported to be overcollected and also threatened by mineral resource exploration and development of off-road vehicles in 1983 (U. S. endangered species 10/11/79). Cultivated and traded as grafted specimens, artificially propagated in USA and Europe. Cultivation on own roots is slow and difficult and losses are high. Acclimatisation of wild collected, adult specimens to cultivation is virtually impossible outside the natural range with the exact climate and soil conditions required by the species. Trade in seeds is important, seeds are available from traders in USA and Europe. Nurseries registered for artificial propagation: Czech Republic P-CZ-1002, Switzerland P-CH-1001.

**Similar species:** Can be confounded with *Sclerocactus whipplei* (Engelmann & Bigelow) Britton & Rose, which has similar dimensions, a similar, ascending, flattened central spine, but usually longer spines, more obscuring the stem and flowers with yellow filaments of the stamens. Further *S. parviflorus* Clover & Jotter, which is extremely variable, can look quite similar. This species grows to much bigger dimensions and has a dense, much longer spination, obscuring the stem and pink or yellow flowers with according filament colour. Thus, flower characters are important to allow correct identification of *S. wrightiae*.

**Bibliography:**

Benson, L. (1966): A revision of *Sclerocactus*. *Cact. Succ. J. (US)* (38): 50-57, 100-106.

Benson, L. (1982): *The Cacti of the United States and Canada*. Stanford University Press, Stanford, California

Heil, K. D. & J. M. Porter (1994): *Sclerocactus* (Cactaceae): A revision. *Haseltonia* 2: 20.

Hunt, D. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens, Kew, UK.

# Strombocactus disciformis (incl. ssp. *esperanzae*)

(DC) Britton &amp; Rose 1922



**Common names:** esp.: Peyote  
engl.: Disk or Top cactus

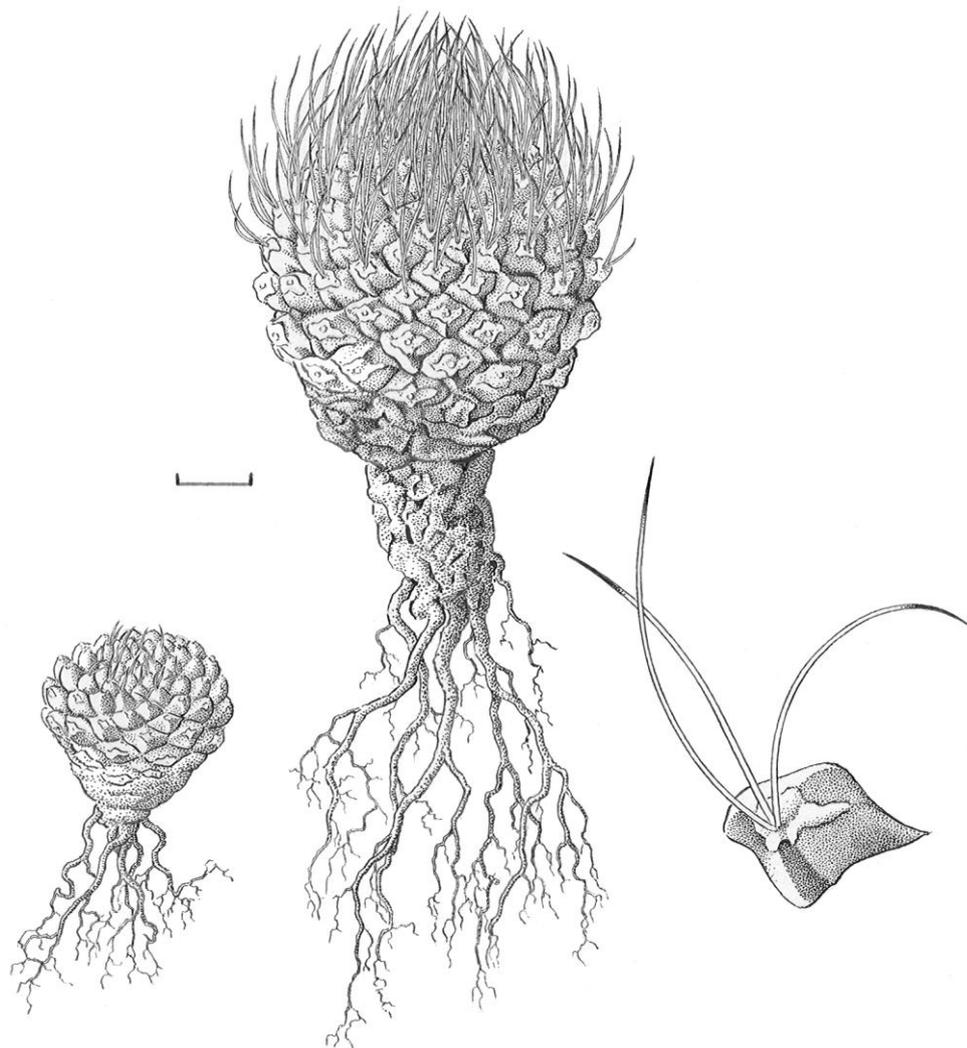
## Scientific synonyms:

- |   |  |
|---|--|
| = <i>Mammillaria disciformis</i> DC 1828                            | → <i>Mammillaria turbinata</i> Hooker 1843                                 |
| = <i>Cactus disciformis</i> (DC) Kuntze 1891                        | = <i>Cactus turbinatus</i> (Hooker) Kuntze 1891                            |
| = <i>Echinocactus disciformis</i> (DC) Schumann 1894                | → <i>Strombocactus jarmilae</i> Halda 1996                                 |
| = <i>Ariocarpus disciformis</i> (DC) W. T. Marshall 1946            | = <i>Strombocactus disciformis</i> ssp. <i>jarmilae</i> (Halda) Halda 1997 |
| = <i>Pediocactus disciformis</i> (DC) Halda 1998                    | = <i>Ariocarpus disciformis</i> ssp. <i>jarmilae</i> (Halda) Halda 1998    |
| → <i>Echinocactus turbiniformis</i> Pfeiffer 1838                   | = <i>Pediocactus jarmilae</i> (Halda) Halda 1998                           |
| = <i>Echinofossulocactus turbiniformis</i> (Pfeiffer) Lawrence 1841 | → <i>Strombocactus disciformis</i> f. <i>minimus</i> Don Pedro & Riha 1997 |
| = <i>Anhalonium turbiniforme</i> (Pfeiffer) F.A.C. Weber 1893       |  |

## ***Strombocactus disciformis* ssp. *esperanzae* Glass & Arias 1996**

- = *Strombocactus disciformis* var. *esperanzae* (Glass & Arias) Don Pedro & Riha 1997  
 → *Strombocactus pulcherrimus* Halda 1996  
 = *Ariocarpus pulcherrimus* (Halda) Halda 1998  
 = *Pediocactus pulcherrimus* (Halda) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



bar = 1 cm

<b>Characteristics:</b>	Small, few-spined, flattened, disc-shaped, extremely hard textured cactus, whitish-green, with rhomboidal tubercles, geometrically arranged in spirals. Spines non-pungent, erect, typically only present in the centre of the stem apex. Found in big colonies on steep walls of canyons, often in inaccessible places.
Roots:	Branched taproot from deep-seated, subterranean stem base.
Stem:	Depressed globose, often appearing disk-like, later cylindrical with flattened apex (wild collected specimens) or rather globose with rounded apex (cultivated specimens), 3-8 cm high and $\varnothing$ (up to 4.5 cm $\varnothing$ in ssp. <i>esperanzae</i> ), pale whitish-green or greyish with a slightly woolly apex (in cultivated specimens wool more persistent).
Tubercles:	Very hard, rhomboid in cross-section, arranged in spirals, becoming corky from the tip towards the base when ageing.
Areoles:	2 mm $\varnothing$ , at the tips of the tubercles, bearing some deciduous wool and deciduous spines.
Spines:	In adult specimens radial spines lacking, only central spines present, 1-5 (1-2 in ssp. <i>esperanzae</i> ), non pungent, slightly curved inwards, flexible (rather straight and slightly stouter in ssp. <i>esperanzae</i> ), 1.0-1.5 cm long (1.0-1.1 cm in ssp. <i>esperanzae</i> ), white to grey to brownish, soon dehiscent (in cultivated specimens sometimes rather persistent and covering the whole stem, as illustrated here).
Flowers:	2 cm $\varnothing$ , creamy white (magenta in ssp. <i>esperanzae</i> ), originating from the centre of the stem apex.
Fruits:	Barrel-shaped, 7 mm long, ca. 3 mm $\varnothing$ , with a few scales, brown, opening longitudinally.
Seeds:	Exceedingly fine, ca. 0.5 mm, dark honey-tan, with minutely wrinkled seedcoat and conspicuous corky aril.
Juvenile specimens:	With 5-7 short, white, radiating, appressed spines, lacking centrals.

**Distribution:**      ssp. *disciformis*: States of Hidalgo and Querétaro, Mexico.      ssp. *esperanzae*: States of Guanajuato and Querétaro, Mexico



**Trade:** Large amounts of wild collected specimens of ssp. *disciformis* have been observed in international trade (U. S. Fish and Wildlife Service 1983). Importation of 6'491 specimens from Mexico to USA between 1976 and 1982 has been reported. Large plants in nurseries and collections are often wild-collected. However, they may well be pre Convention specimens. The typical subspecies is still very abundant and rather widely distributed in habitat. It is classified as safe/low risk (Anderson & al. 1994). It is extremely slow growing and quite difficult to rise from seeds, because the seedlings are nearly microscopically small, corresponding to the size of the seeds. Ssp. *esperanzae* has a much more restricted distribution and is probably not very abundant. Described in 1996, it has already been reported in illegal trade in Czech Republic, Germany and Switzerland. Being an unexpected novelty, it is very highly in demand by collectors. Seedlings from artificial propagation are now slowly entering into trade, the motherplants and possibly seeds have been exported illegally from Mexico. The two subspecies are virtually impossible to tell apart with any certainty when not flowering. Nurseries registered for artificial propagation (ssp. *disciformis*): Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001 (also "*jarmilae*").

**Similar species:** *Turbinicarpus hoferi* J. Lüthy & Lau and *Turbinicarpus lophophoroides* (Werdermann) Buxbaum & Backeberg are similar with respect to the pale green stem colour and the flattened to disc-shaped stem, but their spines are spreading and not exclusively directed upwards and also more persistent. Furthermore, *T. lophophoroides* has flat and rounded rather than prominent tubercles.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): Las Cactáceas de México, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
 Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.



## How to use the determination keys

The identity of a plant is determined by a combination of several characters (features of stem, leaf, flower, fruit, size, colour, etc.). In a key each character is like a determination outline designed to facilitate a process of elimination of all but the taxon to which the plant belongs. Each key is made up of a series of pairs of opposed leads or, to be precise, of opposite characters (see hypothetical key). One feature only will fit and lead to the identified plant species or next key step (correct plant group), the other option will not fit and is therefore eliminated. For example, see hypothetical key: a globose cactus with fibrous roots (plant c) is a lead to key step 2 “*Plant globose*”, because the option - “*Plant cylindric, not globose*” is ruled out. At the next stage (key step 2), the plant object is determined and identified to be “*Plant with fibrous roots, (without a taproot)*”.

Hypothetical key (three characters)

- |    |  |          |
|----|--|----------|
| 1. | Plant globose .....                                | <b>2</b> |
| -  | Plant cylindric, not globose .....                 | Plant a  |
| 2. | Plant with taproot .....                           | Plant b  |
| -  | Plant with fibrous roots (without a taproot) ..... | Plant c  |

Keys must be used with caution, because they can reflect only the characters ordinarily present in a taxon, and these in turn may be only an approximation of those of any one plant. Because the combination of characters is complex, a successful use of a key requires the consideration of the whole set of characters described in each pair of leads.

## Key of stem succulent plant families and genera

The word “cactus” – which stands in botanical correct sense strictly for a member of the Cactaceae – is often ignorantly applied to succulent prickly plants of other stem succulent families.

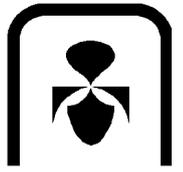
- |    |   |                               |
|----|---|-------------------------------|
| 1. | Sap storage (succulence) mainly in fleshy, persistent leaves (leaves more succulent than stems)<br>Leaf Succulents  |                               |
|    | NOTE: Succulent leaves not to be confused with leaf-like stems (phylloclades):<br>rosetted (rosulate), flattened, leaf-like or scale-like stems of some cacti<br>( <i>Ariocarpus</i> , <i>Obregonia</i> ) are look alike of some rosulate Leaf Succulents<br>(e.g. Agavaceae ( <i>Agave</i> ), Asphodelaceae ( <i>Aloe</i> , <i>Haworthia</i> ), Crassulaceae<br>( <i>Echeveria</i> , <i>Aeonium</i> ). |                               |
| -  | Sap storage (succulence) mainly in fleshy stems (stems more succulent than leaves) .....  | <b>2</b>                      |
| 2. | Plants with a swollen, stout basal stem (caudex) and slender,<br>scarcely succulent and often deciduous branches .....  | <b>Caudiciform Succulents</b> |
| -  | Plants with more or less regular thickened stems<br>(no swollen, stout basal caudex) .....  | <b>Stem Succulents 3</b>      |
| 3. | Stems with areoles often bearing clusters of spines,<br>bristles or hairs .....   | <b>Cactaceae</b>              |
| -  | Stems without areoles; spines may be present and even clustered<br>(e.g. <i>Euphorbia</i> , <i>Didierea</i> , <i>Fouquieria</i> ) .....   | <b>4</b>                      |
| 4. | Sap not milky .....   | <b>5</b>                      |
| -  | Sap milky. Spines on shield (solitary, two-paired or 3); rarely spines<br>apical dichotomous splitted; flowers in cyathias. ....  | <b>Euphorbiaceae</b>          |

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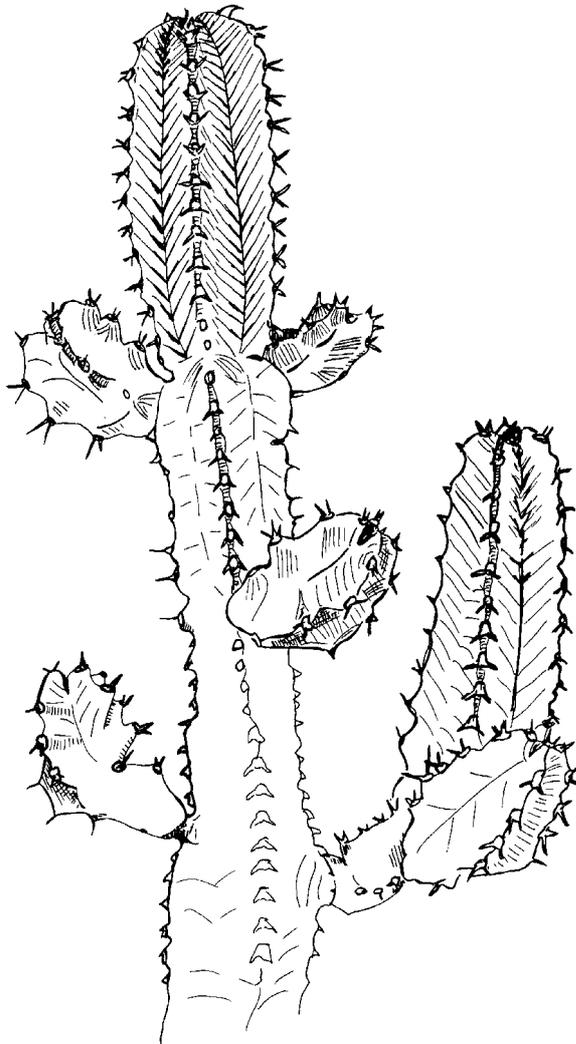
5.	Plants bearing spines or prickles as well as leaves (at least during the growing period) .....	6
-	Plants never with spines or prickles or leaves .....	12
6.	Spines 4 or more together at each node .....	<b>Didiereaceae (<i>Didierea</i>)</b>
-	Spines 3 or fewer together at each node .....	7
7.	Spines 2-3 .....	<b>Apocynaceae (<i>Pachypodium</i>)</b>
-	Spines in pairs or solitary .....	8
8.	Spines 2; branch system in zigzag .....	<b>Didiereaceae (<i>Decarya</i>)</b>
-	Spines solitary or setaceous rest of petiole .....	9
9.	Tall trees or shrubs (>2m) .....	10
-	Shrubs <1m .....	11
10.	Long stemmed shrubs or trees; hummingbird-pollinated; restricted to SW-USA, Mexico; spine = rest of petiole; stem base rarely stout .....	<b>Fouquieriaceae (<i>Fouquieria</i>)</b>
-	Long stemmed shrubs or trees; restricted to Madagascar .....	<b>Didiereaceae (<i>Alluaudia</i>, <i>Alluaudiopsis</i>)</b>
11.	More or less woody plants, with foliage, incised, deciduous leaves; distribution South Africa .....	<b>Geraniaceae</b> <b>(<i>Sarcocaulon</i> p.p., <i>Monsonia</i> p.p., <i>Pelargonium</i> p.p.)</b>
-	Fleshy plants, without foliage leaves; distribution South and East Africa .....	<b>Asclepiadaceae (e.g. <i>Hoodia</i>, <i>Edithcolea</i>)</b>
12.	Low growing shrubs (<0,5m); deciduous leaves lobed or incised .....	<b>Geraniaceae</b> <b>(<i>Sarcocaulon</i> p.p., <i>Monsonia</i> p.p., <i>Pelargonium</i> p.p.)</b>
-	Leaves entire, reduced or without leaves .....	13
13.	Individual flowers small, clustered into a capitula .....	<b>Asteraceae (e.g. <i>Othonna</i>, <i>Kleinia</i>)</b>
-	Individual flowers not clustered into a capitula; solitary flower larger, showy, mostly with unpleasant scent .....	<b>Asclepiadaceae</b> <b>(e.g. <i>Lavrania</i>, <i>Stapelia</i>, <i>Whitesloanea</i>, <i>Pseudolithos</i>)</b>

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# Artificially propagated versus wild-collected succulents



## The difference between artificially propagated and wild-collected succulent plants



## 1. Introduction

### 1.1 Collecting succulent plants

Succulent plants have been cultivated in private collections and Botanical Gardens for more than 150 years because of their fascinating forms, and large quantities of plants were taken for cultivation long before CITES existed. The collecting of succulent plants has had various great periods historically, mainly 1885-1910, 1925-1940 and 1965-1985. In these periods, large shipments of wild-collected succulent plants came into trade, mainly in Europe and the United States of America. In the past ten years, the size of these shipments has decreased because of better enforcement of regulations in the countries where succulents are collected in their habitats. On the other hand, private collecting trips have increased with the worldwide increase of individual tourism. Wild-collected plants are transported in hundreds in suitcases and hand luggage, as various recent confiscations confirm, but also by mail.

### 1.2 What are succulent plants?

The majority of succulent plants come from semi-arid regions of the world. The most important semi-arid regions lay in the Horse Latitudes (two circumglobal belts between 23 degrees north and 34 degrees south of the equator). Some succulent plants also live in humid regions of the world but there they grow on rocks, in trees and in other places where rainwater runs off quickly. To survive dry periods, succulents store water in their roots, stems or leaves. These parts of the plant are thickened to increase the volume available for water storage. Storage of water is the only character shared by all succulents. Succulent plants have developed various sophisticated mechanisms to protect themselves against herbivores. They can be covered with spines, or they look very much like the substrate in which they grow (e.g. "living rocks"). Succulents are often covered with hairs, wool or thick wax layer to reflect the sunlight and to reduce evaporation. Succulents have evolved in many plant families (ca. 50). In adapting to similar, strongly selective conditions of the environment in their habitats, even taxa that are systematically quite unrelated may look very similar (such look-alikes are called convergent forms). Identification of succulent plant taxa can be difficult even for experts, in particular when no flowers and fruits are available. This manual therefore is not designed to enable identification of individual plant taxa but to enable the reader to determine whether plants are artificially propagated or not.

### 1.3 How to use this information?

This manual should help the user to identify whether the plants in a shipment are artificially propagated succulent plants or not, and to treat commercial shipments efficiently. It cannot give a 100% guarantee about the identification of any individual wild-collected plant. If there are doubts, an expert on succulent plants should be called-in for assistance.

How to distinguish between a shipment of wild-collected succulent plants and a shipment of succulent plants grown in a nursery? To provide a general idea about shipments that may require closer inspection, the following pages contain lists of the most often traded and most often wild-collected succulent plant taxa and their countries of origin, as well as a list of countries from which are exported significant quantities of succulent plants that are artificially propagated in nurseries. This list helps if plants are labelled and documented correctly. But this is not always the case. Therefore, the manual also provides checklists of characteristics indicative of wild-collected plants. The most significant characteristics are illustrated with photos of typical examples.

The checklists have to be applied step-by-step, in particular the one on morphological characteristics. If characteristics are found that might indicate wild origin, the lists of critical taxa and countries can be consulted. The documents that accompany a shipment have to be checked, as well as labels and packing material.

# Artificially propagated versus wild-collected succulents



## 1.4 Plant names and labels

- Significance of the label

For non-experts, the label is the only means to identify a plant. If plants are labelled correctly, it is easy to compare the names on the labels with the names of the species included in the CITES appendices. But, unfortunately, information on labels is not always reliable - names on labels should be treated cautiously. In the context of this manual, plant names are much less important than the morphological characters listed in the chapters below.

- Problems with plant names

Often, there are various synonymous names for one and the same plant taxon. (*Taxon* is a term that is used for the various levels in the classification of plants and animals. A taxon can be a genus, a species or a subspecies etc.) Experts not always agree about the name that should be applied to a certain taxon. Some authors regard a particular taxon as a species, naming it, for example, *Euphorbia cap-saintemariensis*. Others, however, regard the same taxon as a variety only, naming it *E. decaryi* var. *cap-saintemariensis*. Both names refer to the same entity and, in this particular case, it is included in Appendix I under *E. decaryi* [meaning that this and all varieties of *E. decaryi* (var. *decaryi*, var. *ampanihyensis* and var. *spirosticha*) are included]. However, by using only the name *Euphorbia cap-saintemariensis* the impression can be given that this taxon is NOT included in Appendix I.

Also, recent research may have demonstrated that earlier conclusions about a taxon were not entirely correct. This may result in a re-grouping of the species, placing it in another genus. For example, *Lobeira macdougallii* was included in Appendix I under that name in 1983. A different opinion regarding the relationship of this species resulted in its name being changed to *Nopalxochia macdougallii* (1987). Currently, as a result of further investigations as part of the preparation of the CITES Cactaceae Checklist, the same species has, since 1992 been included in the appendices under the name *Disocactus macdougallii*.

But even if there is an agreement on the names that should be used, synonymous names are continuously applied by nurseries and enthusiasts, because they refuse to use the recent ones, or do not know them. In the nursery trade there is great reluctance to accept new names, since the older ones are well established. The International Organization for Succulent Plant Studies (IOS) is working on a worldwide consensus on nomenclature and taxonomy of succulent plant taxa. For the most important group of succulent plants in trade, the Cactaceae, there is a checklist of names generally accepted by experts and approved by the Conference of the Parties, the "CITES Cactaceae Checklist". Where possible, check the names using the CITES Cactaceae Checklist for wild-collected plant specimens. Another useful reference is the "List of Names of Succulent Plants other than Cacti". Both are published by the Royal Botanic Gardens, Kew, United Kingdom.

## 2. Trade in succulent plants

### 2.1 Countries and regions, where succulent plants are frequently collected in the wild

- Countries and regions of the Old World

Africa: Ethiopia, Kenya, Madagascar, Malawi, Morocco, Namibia, Somalia, South Africa (Cape Province, Natal, Transvaal), United Republic of Tanzania, Zimbabwe.

Asia: Arabian Peninsula.

- Countries and regions of the New World

Central America: Costa Rica, Guatemala, Honduras.

North America: Mexico, Southwestern states of United States of America (Arizona, California, Colorado, Nevada, New Mexico, Texas, Utah).

South America: Argentina, Brazil, Chile, Ecuador, Paraguay, Peru, Uruguay, Venezuela.

Caribbean Islands.

### 2.2 Countries and regions, where succulent plants are frequently produced in nurseries

- Commercial outdoor cultivation in semi-arid regions

Big nurseries that produce large numbers of plants under optimal climatic conditions are found in the following regions and countries:

Africa (excl. Mediterranean region): South Africa.

Mediterranean countries: Israel, Italy, Morocco, Spain (in particular the Canary Islands).

United States: Arizona, California, New Mexico.

- Commercial greenhouse cultivation

European countries with significant horticultural mass production: Denmark, Germany, Netherlands.

European countries with less significant horticultural production: Austria, Belgium, Czech Republic, France, Hungary.

- Plants propagated by enthusiasts

Succulent plants have been very popular in private collections for at least 150 years, particularly in Europe (Austria, Belgium, Czech Republic, France, Germany, Hungary, Italy, Malta, Switzerland, United Kingdom), and - more recently - also in Japan and the United States of America. In most of these countries there are cactus and succulent societies, some of them founded in the last century. Cactus and succulent enthusiasts often get very good results in cultivating and propagating rare and difficult-to-grow taxa. Small amounts of plant material propagated by enthusiasts are exchanged or traded at society meetings or offered or advertised in society journals. Sometimes, however, there are wild-collected plants among this material.

### 2.3 The most frequently traded succulent plants (artificially propagated and wild-collected)

The following list is based on information from the annual reports presented to the CITES Secretariat.

CITES taxa in bold.

Family	Species
Agavaceae	<b><i>Agave victoriae-reginae</i></b>
Aizoaceae (Mesembrantemaceae)	<b><i>Argyroderma</i> spp., <i>Cheiridopsis</i> spp., <i>Conophytum</i> spp., <i>Delosperma</i> spp., <i>Faucaria</i> spp., <i>Gibbaeum</i> spp., <i>Lampranthus</i> spp., <i>Lithops</i> spp., <i>Pleiospilos</i> spp., <i>Ruschia</i> spp., <i>Trichodiadema</i> spp.</b>
Apocynaceae	<b><i>Pachypodium bispinosum</i>, <i>P. brevicaule</i>, <i>P. lamerei</i></b>
Asclepiadaceae	<b><i>Ceropegia armandi</i>, <i>C. volubilis</i>, <i>C. woodii</i></b>
Cactaceae	<b><i>Ariocarpus fissuratus</i>, <i>A. kotschoubeyanus</i>, <i>A. retusus</i>, <i>Arthrocereus</i> spp., <i>Astrophytum asterias</i>, <i>A. capricorne</i>, <i>A. myriostigma</i>, <i>A. ornatum</i>, <i>Browningia</i> spp., <i>Cephalocereus senilis</i>, <i>Cereus peruvianus</i>, <i>C. jamacaru</i>, <i>Cleistocactus strausii</i>, <i>Coleocephalocereus</i> spp. (incl. <i>Buiningia</i>), <i>Copiapoa humilis</i>, <i>Coryphantha elephantidens</i>, <i>C. bumamma</i>, <i>Discocactus</i> spp., <i>Disocactus</i> species and hybrids, <i>Echinocactus grusonii</i>, <i>Echinocereus</i> spp., <i>Echinopsis chamaecereus</i> (= <i>Chamaecereus silvestrii</i>), <i>Epiphyllum</i> (species and hybrids), <i>Epithelantha micromeris</i>, <i>Espositoa</i></b>



# Artificially propagated versus wild-collected succulents

Family	Species
	<p><i>Ianata</i>, <i>Ferocactus</i> spp.,  <i>Gymnocalycium baldianum</i>, <i>G. mihanovichii</i> (mainly grafted coloured forms), <i>Haageocereus</i> spp., <i>Heliocereus</i> spp., <i>Hylocereus</i> (often used as root stock for grafts), <i>Mammillaria bocasana</i>, <i>M. elongata</i>, <i>M. hahniana</i>, <i>M. magnimamma</i>, <i>M. zeilmanniana</i>, <i>Melocactus bahiensis</i>, <i>M. oreas</i>, <i>Monvillea</i> species (see also <i>Cereus</i>), <i>Myrtillocactus geometricans</i>, <i>Neobuxbaumia polylopha</i>, <i>Neolloydia</i> spp., <i>Neoporteria</i> spp. (see also <i>Eriosyce</i>), <i>Notocactus</i> (see also <i>Parodia</i>): <i>N. haselbergii</i>, <i>N. leninghausii</i>, <i>N. magnificus</i>, <i>N. scopa</i>, <i>Opuntia leucotricha</i>, <i>O. microdasys</i>, <i>O. robusta</i>, <i>Oreocereus trollii</i>, <i>Pachycereus</i> spp., <i>Parodia</i> spp., <i>Pilosocereus</i> spp., <i>Polaskia chichipe</i>, <i>Rebutia minuscula</i>, <i>Rhipsalidopsis</i> (mainly hybrids), <i>Schlumbergera</i> (mainly hybrids), <i>Selenicereus grandiflorus</i>, <i>Stenocactus</i> (syn. <i>Echinofossulocactus</i>) spp., <i>Stetsonia coryne</i>, <i>Thelocactus bicolor</i>, <i>T. setispinus</i>, <i>Weberbauerocereus</i> spp.</p>
Crassulaceae	<p><i>Adromischus</i> spp., <i>Aeonium</i> spp., <i>Cotyledon</i> spp., <i>Crassula</i> spp., <i>Echeveria</i> species and hybrids, <i>Kalanchoe blossfeldiana</i>, <i>K. manginii</i>, <i>K. scapigera</i>, <i>K. tomentosa</i>, <i>Pachyphytum</i> spp., <i>Graptopetalum</i> spp. (incl. <i>Tacitus</i>), <i>Sedum</i> spp.</p>
Didiereaceae	<p><i>Alluaudia ascendens</i>, <i>A. procera</i>, <i>Didierea madagascariense</i>, <i>D. trollii</i></p>
Euphorbiaceae	<p><i>Euphorbia alluaudii</i>, <i>E. angustiflora</i>, <i>E. cap-saintemariensis</i>, <i>E. cylindrifolia</i>, <i>E. decaryi</i>, <i>E. grandicornis</i>, <i>E. ingens</i>, <i>E. lactea</i>, <i>E. lophogona</i>, <i>E. millii</i>, <i>E. trigona</i></p>
Liliaceae (Aloaceae)	<p><i>Aloe arborescens</i>, <i>A. ferox</i>, <i>A. variegata</i>, <i>A. vera</i> (<i>A. barbadensis</i>), <i>Haworthia</i> spp., <i>Gasteria</i> spp.</p>

## 2.4 Genera (and their origins) that are frequently wild-collected (legally and illegally)

Family	Genus	Origin
Asclepiadaceae	<i>Brachystelma</i>	South Africa, Zimbabwe
	<i>Trichocaulon (= Lavrania)</i>	Namibia, South Africa
Apocynaceae	<i>Pachypodium</i>	Madagascar, Namibia, South Africa
	<i>Adenium</i>	Arabian Peninsula, Kenya, Namibia, Somalia, South Africa
Anacardiaceae	<i>Operculicarya</i>	Madagascar
Burseraceae	<i>Commiphora</i>	Madagascar, Namibia, South Africa
Cactaceae (names in accordance with C I T E S C a c	<i>Ariocarpus</i>	Mexico

Text: Jonas Lüthy, Berne, and Dieter Supthut, Zurich

Illustrations: H.-F. Haage, Kakteen (1993)

Submitted by the Management Authority of the Management Authority and Scientific Authority of Switzerland, with financial support from the Management Authority of the Netherlands

# Artificially propagated versus wild-collected succulents



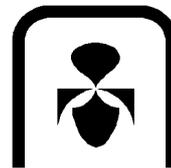
Family	Genus	Origin
t a c e a e C h e c k l i s t)	<i>Copiapoa</i>	Chile
	<i>Coryphantha</i>	Mexico
	<i>Discocactus</i>	Bolivia, Brazil
	<i>Echinocereus</i>	Mexico, USA
	<i>Escobaria</i>	Mexico, USA
	<i>Lobivia</i>	Argentina, Bolivia
	<i>Mammillaria</i>	Mexico
	<i>Melocactus</i>	Brazil, Caribbean Islands, V e n e z u e l a
	<i>Neolloydia</i>	Mexico
	<i>Neoporteria</i>	Chile
	<i>Notocactus</i>	Argentina, Brazil, Uruguay
	<i>Parodia</i>	Argentina, Bolivia
	<i>Pediocactus</i>	USA
	<i>Rebutia</i>	Argentina, Bolivia
	<i>Sulcorebutia</i>	Bolivia
	<i>Sclerocactus</i>	Mexico, USA
<i>Thelocactus</i>	Mexico	
<i>Turbincarpus</i>	Mexico	
<i>Uebelmannia</i>	Brazil	
Cucurbitaceae	<i>Xerosicyos</i>	Madagascar
Euphorbiaceae	<i>Euphorbia</i>	Arabian Peninsula, M

Family	Genus	Origin
		Madagascar, South Africa
	<i>Monadenium</i>	Kenya, Malawi, United Rep. of Tanzania, Zimbabwe
	<i>Jatropha</i>	Madagascar, Mexico
Geraniaceae	<i>Pelargonium</i>	Namibia, South Africa
	<i>Sarcocaulon</i>	Namibia, South Africa
Liliaceae (Aloaceae)	<i>Aloe</i>	Arabian Peninsula, Madag

Text: Jonas Lüthy, Berne, and Dieter Supthut, Zurich

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# Artificially propagated versus wild-collected succulents

Family	Genus	Origin
		g a s c a r, S o u t h a n d E a s t A f r i c a
	<i>Gasteria</i>	South Africa
	<i>Haworthia</i>	South Africa
Passifloraceae	<i>Adenia</i>	Madagascar
Pedaliaceae	<i>Uncarina</i>	Madagascar
Portulacaceae	<i>Anacampseros</i> incl. <i>Avonia</i>	Namibia, South Africa, Z i m b a b w e
Vitaceae	<i>Cyphostemma</i>	Madagascar, Namibia, South A f r i c a

## 2.5 Succulent plants in shipments

Succulent plants are traded for various purposes. Most often, they are shipped to be sold to plant traders or enthusiasts for cultivation. But there are also shipments of living or dead samples for scientific research. They must be accompanied by the same documents as commercially traded plants (permits and/or phytosanitary certificates) unless they bear the appropriate labels in case of exchange between two registered scientific institution. International trade in wild-collected plant material is legal only with appropriate CITES documents, except for some parts and derivatives specified in the Interpretations of the CITES Appendices I, II and III.

**Potted plants:** mass production of young, small plants in peaty substrate in pots or bowls of clay or plastic.

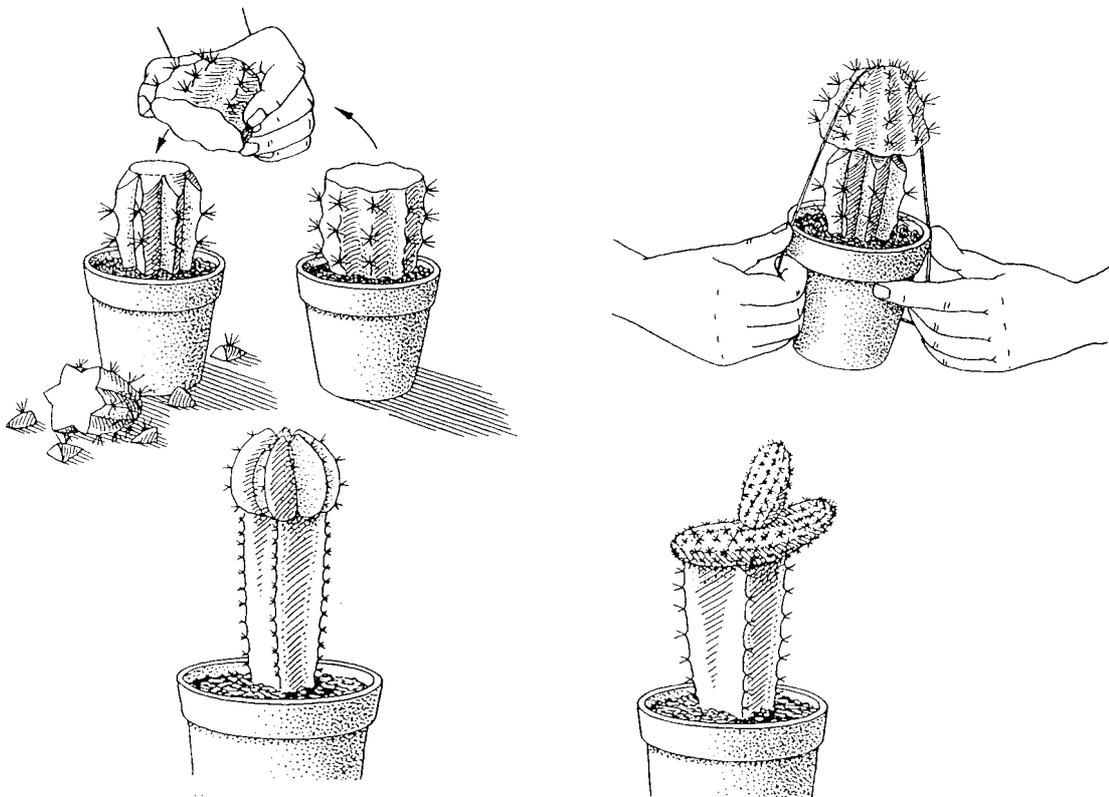
**Non-potted plants:** shipment mostly by air-freight or by post, but also by boat or road in container loads. The stems have bare roots, the root system is usually reduced (cut back or damaged). Big plants may originate from nurseries that cultivate plants outdoors in a semi-arid climate or from the wild in countries that permit the export of wild specimens (e.g. United States of America).

**Plant cuttings without roots:** apical stem parts of tree-like and big shrubby species (see Photo 9).



# Artificially propagated versus wild-collected succulents

**Grafted plants** (potted or non-potted): mostly cacti, but sometimes other succulents such as *Pachypodium*. Cacti: mutants that have lost the ability to produce chlorophyll that provides the green colour to all plants (non-green cacti, e.g. the red "strawberry cactus") or species that are rare and difficult to cultivate and that are grafted on root-stocks of selected more robust, well-growing species (see figures below). The species most often used for grafting of "strawberry cactus" and similar mutants are from the genera *Hylocereus* (a cactus with a triangular green stem with a few soft spines) or *Selenicereus* (a cactus with slender, stems with 4-5 angles and with a few soft spines); rare cacti are more often grafted on *Eriocereus* or *Echinopsis* (cacti with stems with 4 or more angles and with many short but strong spines).



This technique is used for specimens of species that are difficult to grow, for the hybrid varieties that can not grow on their own because of lack of chlorophyll, or to boost growth of slow growing species.

The top of the rootstock is cut off to obtain a smooth surface of exposed plant tissue. A similar treatment is given to the bottom part of the scion (the part to be grafted on to the root stock). The two parts are tight together (rubber band or sometimes sellotape) with the freshly cut surfaces touching each other. After one to several weeks, depending on the species used, the tissues of the graft and the scion have grown together and the ties can be removed.

**Seeds and fruits:** there are many companies worldwide that trade in seeds of succulent plants only. Seeds are often shipped in small quantities in envelopes, usually with a catalogue number or sometimes with a label with a scientific name. Note that seeds of species included in Appendices II and III are not subject to CITES controls, although collecting may be prohibited in their countries of origin (e.g. Mexico).

In-vitro cultures: the propagation of meristem material, especially of rare species, is becoming more and more popular for succulent plants (as it is for orchids). Small plants are grown in sterile containers.

Herbarium specimens: dried plants or parts of plants, e.g. fruits and seeds mounted on sheets and labelled or containers with plants conserved in alcohol.

**Succulent plants that are most certainly artificially propagated:** grafted plants of equal size, shipped in large quantities, such as those with non-green grafts (e.g. "strawberry cactus"); horticultural mass production, in-vitro cultures.

### 3. Checklist of differences between artificially propagated and wild-collected succulent plants

#### 3.1 Introduction

Plants grown under controlled conditions show characteristics different from those plants that grow in their natural habitat.

In natural habitats, plants grow under conditions of stress. They have to struggle for water and nutrients and are attacked by diseases, herbivores and parasites. They grow under individual, unique conditions, very often in special microhabitats, such as rock fissures, etc. Therefore, these plants show very individual characteristics, even if they come from the same locality and belong to the same taxon. Invariably they have widespread root systems that have to be cut off when they are dug out of the substrate. Illegal shipments of wild-collected plants are very varied. They usually contain plants of many different sizes and shapes and they contain specimens of many different taxa.

Nursery-grown plants are uniform and healthy. Such plants in a single shipment usually are of about the same age and size within a taxon. They are carefully grown and carefully prepared for shipment.

To know these differences helps in identifying wild-collected plants. In the following checklists, the most important characters are listed and illustrated.

#### 3.2 "What the hell is that?"

In a shipment, plant specimens may be found that can not be identified easily, such as bulbs, rhizomes or cuttings that show no characteristics that could help with identification. If there are problems or doubts, a trained botanist or an expert in succulent plants should be called. Botanical institutes of universities may help to find specialists. In many countries, there are resident members of the IOS (International Organization for Succulent Plant Studies) who may be able to help. IOS members are often associated with botanical institutes. To find the nearest specialist, the national CITES Management or Scientific Authority should be contacted.

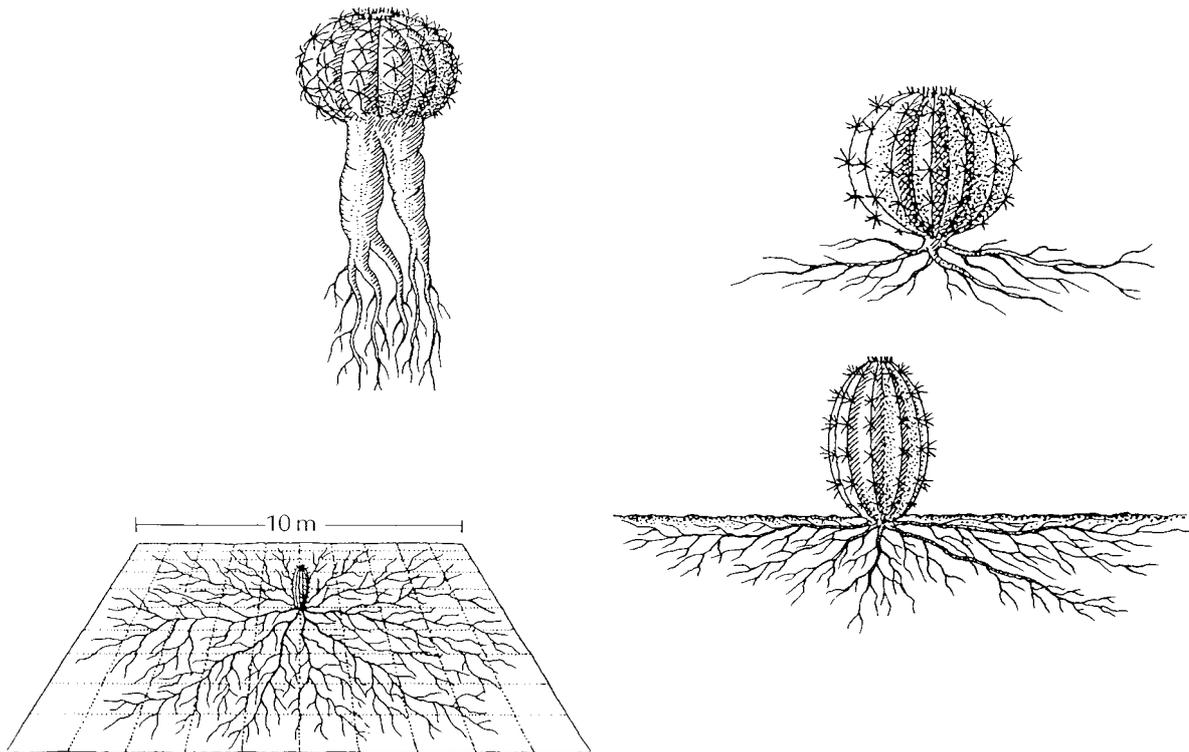


# Artificially propagated versus wild-collected succulents

## 3.3 Checklist of morphological characteristics

### ROOTS

The shape and size of roots is determined by the substrate in which they grow. Cultivated plants do not have to struggle for water and nutrients. They grow in soft, gravelly or peaty substrate of a uniform consistency and are supplied by plenty of water and fertilizer. They form relatively small, compact roots systems of a regular shape, which fill the container in which the plant grows. If the plants are taken out of a soft substrate, not much damage is done to the root system. Only minor roots break.



Top left: Taproots

Others: Example of superficial root systems, that may reach a diameter of 10 m or more.

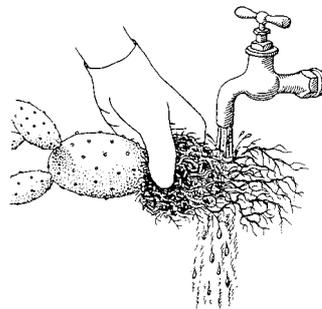
In natural habitats, succulents normally grow in hard substrate. Often, they form only one main root, which reaches deep into the soil. If plants grow in rock fissures or in rocky soil, the development of their root system is limited by the space available, that means the roots are laterally compressed or irregularly bent. In gravelly substrate, roots stretch out over considerable distances to collect water, mostly near the soil surface. When wild plants are collected, these root systems can never be taken out of the substrate without major damage. Usually, some, if not all, of the roots brake or are simply cut off. If the substrate is clay, traces of substrate usually stick to the roots and the lower parts of the plants. If the substrate is gravelly, some pieces of gravel often stay on the plant base. Some succulents grow in shallow humus layers in tufts of moss and small ferns on rocks and cliffs. Their root system therefore stretches out only horizontally, quite unlike a root system that develops in a pot. Plants with simple taproots most often send one or several roots upwards to the soil surface to collect moisture from dew and from short rainfalls that do not penetrate deeply into the soil.

*Indicators of wild-collected plants are:*

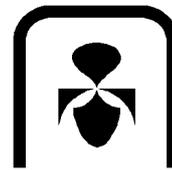
- Broken roots, roughly cut roots, or missing or damaged root systems (attention: big plants from outdoor cultivation may have *cut-back* roots, but the remaining root system has a regular shape)
- Only one or few main roots
- Lateral compression of root systems, mainly visible in taproots and at the base of the main root
- Only horizontally spreading roots
- Traces of clay, laterite soil or gravel
- Taproots with one main secondary root directed towards the soil surface

*Indicators of nursery-grown plants are:*

- Root systems with a regular shape
- Compact, small but complete root system
- Several main roots of similar size
- Damage only in small roots, main roots intact (but sometimes cut back)
- Traces of peaty/sandy *homogeneous* substrate mixtures



Roots of artificially propagated succulents are frequently cleaned from soil before they are exported.



# Artificially propagated versus wild-collected succulents

## STEMS AND LEAVES

The stems and/or the leaves (if they have any) of succulents plant growing in their natural habitat are confronted with many unfavourable habitat conditions, each of which leave its traces. Wounds caused by herbivores, fire, rock slides, frost and diseases leave corky scars or corky spots on stems and leaves. Wax layers are especially sensitive. They get scratched or damaged by natural factors in the habitat and also when plants are taken from their habitat. Especially in Crassulaceae, leaves are very fragile. Wild-collected plants often have dry leaves or show traces of attacks by herbivores. Leaf-rosettes are often of irregular form because they have grown on perpendicular rocks or in shaded places, where they turn towards the sunlight. In rocky habitats, imprints of rock edges can be found on the base of stem succulents, or the plants are compressed laterally because they grow in rock fissures. If plants get burned by the sun or damaged in another manner, the formerly green epidermis of stems and leaves turns into a layer of cork. Many cacti grow with part of the plant body into the soil. Small ones even withdraw almost all of the plant body in the soil in dry periods by contraction of the main root. Consequently the lower stem base is frequently corky and does not bear any spines. In areas with a sandy surface, the wind may blow sand to one side of the plant, partly burying it and thus causing unequal cork formation. If columnar plants fall, their new growth grows upwards at an angle. If the plant apex gets damaged, plants that are normally single-stemmed sprout unnaturally (many shoots of the same size develop on the stem apex or at the edge of a wound or hole). If plants collected in the wild are grown for a while in controlled conditions (i.e. cultivated) before being traded, their new growth looks different from the old growth. In greenhouses, the ultraviolet radiation is much weaker than in the natural habitats of succulent plants. Also, under nursery conditions, there is no shortage of water and nutrients. Consequently the plants may grow faster, and the distance between the spines will be greater. The plant body may be greener or, owing to a thinner cuticle or wax layer, less grey. Contrary to this, old wild-collected specimens suffer from transplantation. They often do not grow well in cultivation. Old cacti most often produce weaker spines and have a smaller stem diameter in their new growth. In spiny plants or in clustering plants, traces of vegetation, e.g. dry grass, often stay on the plant.

### *Indicators of wild-collected plants are:*

- Corky spots and scars, holes
- Damaged/scratched, relatively thick wax layer giving the plants a greyish hue
- Dry leaves
- Irregular, asymmetrical shape of leaf-rosettes (growing to one side)
- Imprints of rocks on stem base, compressed stems
- Unnatural sprouting
- New growth looks different from old growth (not applicable in cacti with a cephalium, e.g. *Melocactus*, *Discocactus*; see plate 21)
- Traces of vegetation, e.g. dry grass, in plants that grow in clusters

### *Indicators of nursery grown plants are:*

- Uniformly green epidermis
- Undamaged, thin wax layer
- No dry or dead plant parts
- Regular stem or rosette shape
- Uniform growth

## THORNS AND SPINES

The thorns or spines on plants growing in natural habitats get withered by sunlight and wind. They can get a fibrous surface and are sometimes strongly bleached. Often they break because of natural factors or especially when plants are taken out of their habitat and are wrapped in paper. If plants collected in the wild are cultivated before entering trade, the thorns or spines of their new growth tend to be thinner and softer than on the old growth (not applicable in cacti with a cephalium, e.g. *Melocactus*, *Discocactus*; see plate 21). This is in particular evident for species that, in the natural habitat, are densely covered with spines.

*Indicators of wild-collected plants are:*

- Bleached, withered (fibrous) thorns/spines
- Broken thorns/spines
- Notably weaker thorns/spines in new growth

*Indicators of nursery grown plants are:*

- Unwithered, colourful, undamaged thorns/pines
- Spines all of equal size and structure

### FRUITS OR FLOWERS

Fruits or remnants of flowers can be found sometimes on plants in shipments. They have some diagnostic value for the identification of wild-collected plants. Generally, nursery grown plants are shipped without flowers. Flowers and fruits, squeezed or damaged during shipping may cause fungal infection and loss of the plant. Also, a nurseryman would harvest the seeds and use them himself rather than shipping them to his clients.

#### 3.4 Checklist for shipment characters

Documents: when possible, and applicable, one should check the consistency between the CITES documents and the delivery note or invoice with the shipment (in particular with regard to the plant names and the number of specimens).

Country of origin: plant shipments from countries where succulent plants are often wild-collected (see list), have to be given special attention. Some senders are collectors of wild plants and plant traders at the same time. In case of doubt, an expert must be consulted. Special attention should be given to shipments from sources (persons, nurseries) from which it is believed or proven that illegally wild-collected plants have originated.

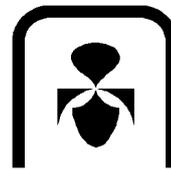
Packaging: normally the packaging does not provide clues about the legality of origin of the specimens. Both highly qualified nurseries, producing only artificially propagated plants, and smugglers wrap plants in newspaper to avoid sharp spines damaging other plants. Normally, artificially propagated specimens are shipped in boxes with the name of the nursery printed on them, and with the plants packed tightly together and frequently with a name label attached. Shipments of illegally collected wild plants normally contain plants of different sizes.

Sometimes the labels attached to wild-collected plants, contain interesting information such as collection numbers, sites and dates, mostly marked by hand on leaflets or card labels. This is rarely found with artificially propagated plants. Wild-collected plants are often not identified to species level but only to genus level. Names on labels consist of the genus name in combination with "spec.", "sp." or "spp."

Shipment composition: shipments of wild-collected plants usually consist of small samples of many different taxa. Enthusiasts who want to propagate wild-collected specimens in cultivation need at least two individual clones for cross-pollination and seed production. The collected specimens are not necessarily young or small individuals. It is more interesting for a succulent enthusiast to collect specimens of as many different taxa as possible during one field trip than to collect big specimens of a few taxa only. Shipments of wild-collected plants therefore often contain a high number of different taxa. Within one taxon, there are specimens of very different sizes. Some taxa are rare and quite difficult to find in their natural habitat. Therefore, also damaged plants are collected. Wild-collected plants are often sent in small shipments. Frequently several small parcels (less than 1 kilogram) are sent by post. The probability, that all or a great proportion of a series of such small parcels reaches the destination is higher than shipping all plants in one single consignment. Wild-collected succulents are also frequently carried in personal luggage.

Note: The fact that there are small quantities of specimens of several species in a mail parcel does not automatically mean that the specimens are wild-collected. There are a number of highly specialized nurseries that produce cacti of species that are of no or little interest to the wholesale market. Those who

# Artificially propagated versus wild-collected succulents



buy from these nurseries normally purchase small quantities of several species. These are also sent by mail. In most instances these parcels contain all the required CITES and phytosanitary documentation.

*Indicators of wild-collected plants are:*

- Missing documents, incorrect documents
- Shipment from country where succulent plants are often collected in the wild (see list)
- Sender known to trade or to have traded in wild-collected plants
- Information on sender missing
- Unprofessional package, such as toilet paper, etc.
- Handwritten labels or tags with collection numbers, dates, sites
- Small samples of many different taxa within a shipment
- Plants of very different sizes within the same taxon
- Damaged plants

*Indicators of nursery-grown plants are:*

- Correct documents
- Nursery name included on all packages
- Professional package
- Potted or grafted plants
- High numbers of plants of one taxon, of uniform size
- Only healthy plants
- Printed labels

1. Wild-collected cactus (*Echinomastus*) with traces of soil and vegetation. Usually, plants are cleaned more cautiously before shipment than is shown in this illustration. (Photo J. Lüthy)



2. A specimen of the same species (Fig. 1) in habitat, with the stem base buried in clayey substrate and grasses growing in the protection of the spines.



- )
3. Wild-collected cactus (*Echinocereus*) with damaged root system. The main roots are missing, most roots are broken. (Photo J. Lüthy)





# Artificially propagated versus wild-collected succulents



4 Wild-collected cactus (*Astrophytum*). The roots are almost completely dead.



5. Wild-collected cactus (*Uebelmannia*). Clustering plant with only one single stem. Especially in rare species plants are broken from transport, the stem are collected even if they are badly, base is strongly withered and corky, damaged. (Photo J. Lüthy)
6. Wild-collected cactus (*Echinocereus*). only the stump of the main root remains (Photo AID; Netherlands)



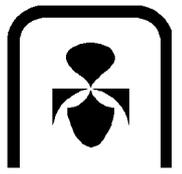
7. Wild-collected cactus (*Echinocereus*) with corky epidermis on old growth. Such a plant would not be in trade but thrown away if it were an artificially propagated specimen. (Photo J. Lüthy)



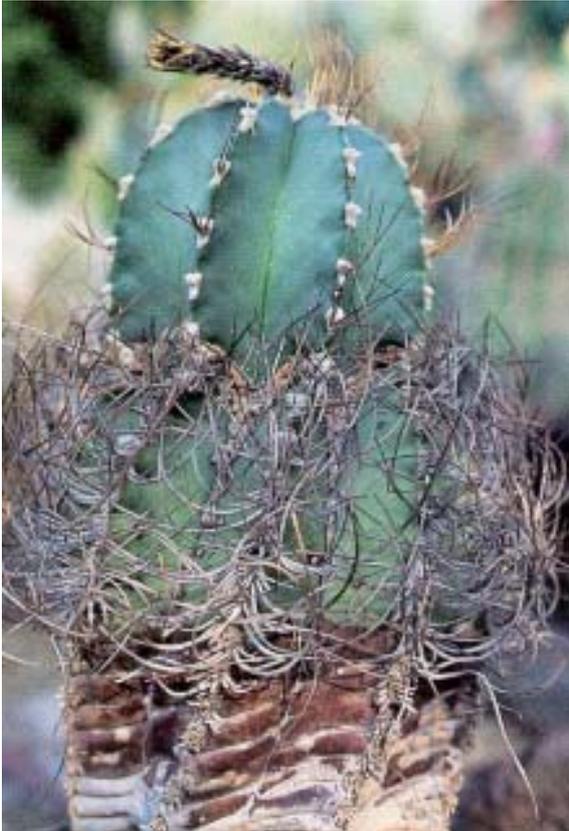
8. Wild-collected cacti (*Turbinicarpus*) with collection number on label. Taproots with irregular shape, one big secondary root typically directed upwards (toward the soil surface). (Photo AID, Netherlands)



9. Wild-collected cactus (*Pilosocereus*) cutting. Artificially propagated specimens of this taxon are normally traded as rooted seedlings. (Photo BLW)



# Artificially propagated versus wild-collected succulents

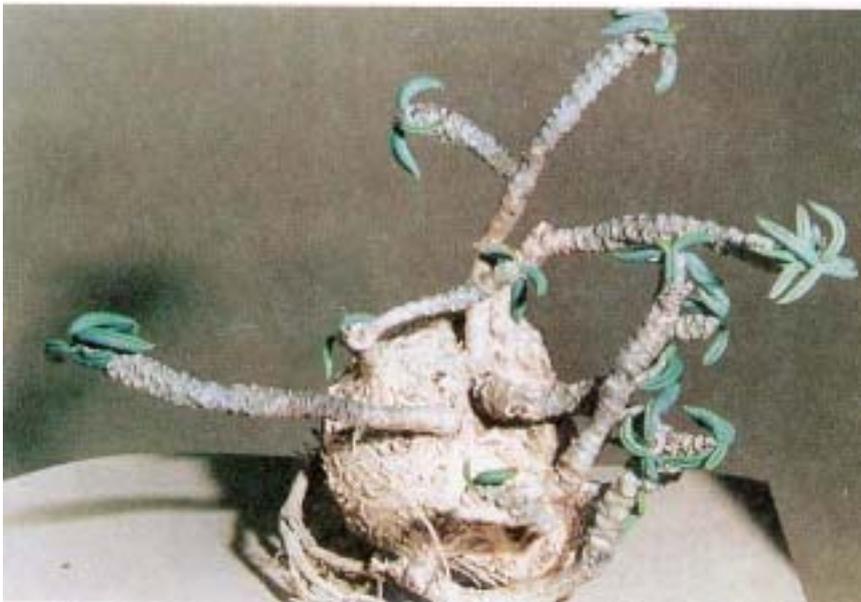


10. Wild-collected cactus (*Astrophytum*)

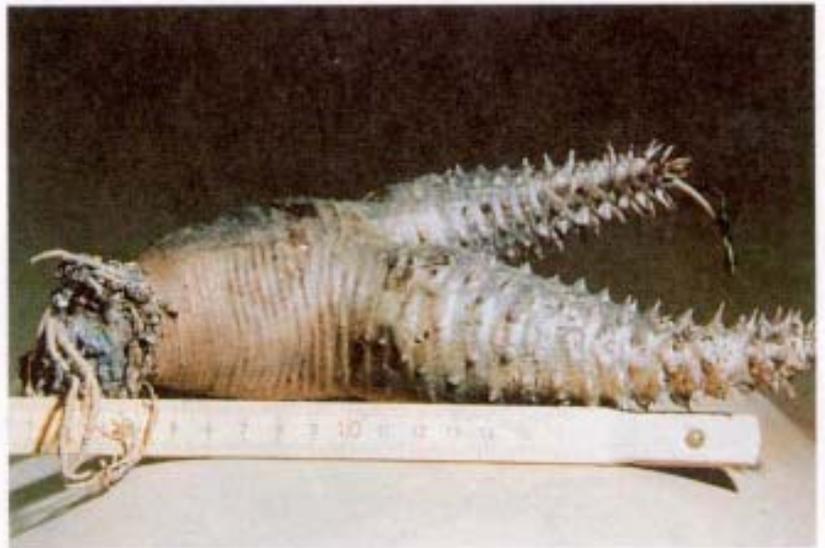
with new growth from cultivation.  
Weaker spines and smaller stem diameter  
in new growth. (Photo J. Lüthy)



11. Wild-collected cactus (*Thelocactus*), showing the difference between the withered spines on the old growth on the stem base and unwithered spines on the new growth (produced after the plant has been collected from the wild and cultivated) on the same plant. (Photo J. Lüthy)



12. Wild-collected caudiciform (Euphorbia)



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Text: Jonas Lüthy, Berne, and Dieter Supthut, Zurich

Illustrations: H.-F. Haage, Kakteen (1993)

Submitted by the Management Authority of the Management Authority and Scientific Authority of Switzerland, with financial support from the Management Authority of the Netherlands

# Artificially propagated versus wild-collected succulents

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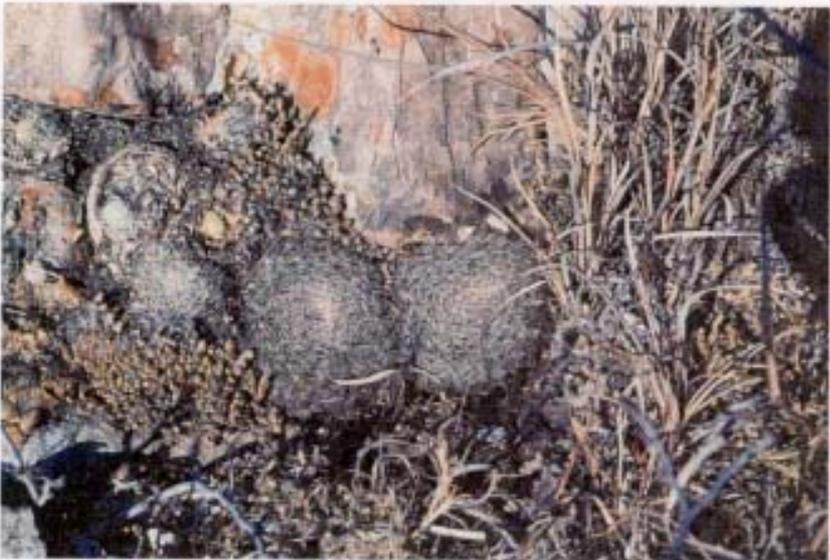
13. Wild-collected stem-succulent (*Pachypodium*). Leaves dried off, most roots missing, remaining roots bent by wrapping for shipment. (Photo BLW)

14. Wild-collected rosette of leaf-succulent (*Echeveria*; not in the CITES appendices) with damaged leaves and irregular, asymmetrical growth. (Photo J. Lüthy)

15. Wild-collected rosette of leaf-succulent (*Agave*) with many dry leaves and traces of moss at the base. (Photo J. Lüthy)



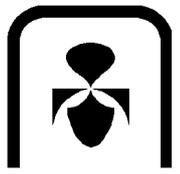
16. Confiscated shipment of wild-collected



17. Cacti (*Mammillaria*) in habitat. Squeezed into a small space between rocks, retreated deeply into the soil and hidden in surround vegetation. (Photo J. Lüthy)



18. Cactus (*Encephalocarpus*) in habitat. Plant



# Artificially propagated versus wild-collected succulents



20. Artificially propagated stem-succulent

19. Artificially propagated cactus (*Pachypodium*) three years old, from outdoor cultivation. Healthy plant without corky scars, no broken spines, root system regularly shaped, small and compact, undamaged. (Photo D. Supthut)
- (*Feroactus*) from outdoor cultivation in Madagascar. Undamaged, regularly shaped root system. (Photo CITES Secretariat)

21. Cacti (*Melocactus*) growing in outdoor cultivation under controlled conditions on the Canary Islands.



Healthy plants of uniform size and appearance. The reddish hairy 'crown' on top of the plant body is called 'cephalium' and carries the flowers. Once the cephalium is formed, the green plant body will no longer increase in size. (Photo D. Supthut)



22. Two-year old cactus seedlings (*Echinocactus*) growing in outdoor cultivation under controlled conditions on the Canary Islands. Plants of uniform size and appearance. (Photo D. Supthut)



23. Cactus seedlings (*Notocactus*) growing in outdoor cultivation under controlled conditions in California. Plants of uniform size and appearance. (Photo D. Supthut)



24. Artificially propagated cacti (grafted "strawberry cactus" and others) from mass production in greenhouses, for sale in a supermarket (Switzerland). (Photo J. Lüthy)

Text: Jonas Lüthy, Berne, and Dieter Supthut, Zurich

Illustrations: H.-F. Haage, Kakteen (1993)

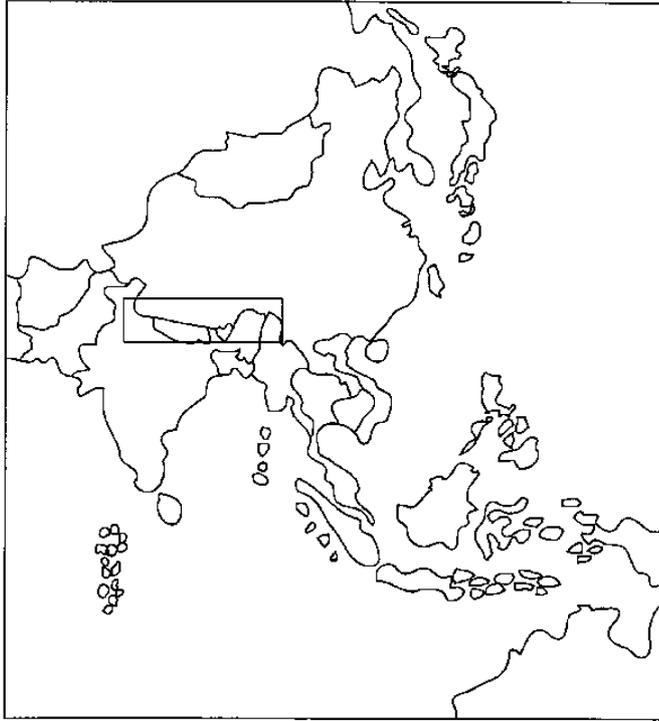
Submitted by the Management Authority of the Management Authority and Scientific Authority of Switzerland, with financial support from the Management Authority of the Netherlands



<b>Commercial names:</b>	engl.: Himalayan yew esp.: Tejo del Himalaya, Tejo de Asia fr.: If de l'Himalaya
<b>Common names:</b>	Beng.: Burmie, Bhirmie, lichujhau Hindi: Thuno, Thuner, Birmi, Zirnupbirmi Kashmir: Birmi, Postil Kashi: Basmi, Birmi chogam, Dhunu, Dingsableh Kumaon: Thaner, Thuner, Brahmi, Gallu Lepcha: Cheongbu, Tunki Nepal: Talis patra, Barme salle, Dhengra salla, Teheiraysulah, Tcheiraygulab Sans: Manduparni
<b>Scientific synonyms:</b>	<i>Taxus baccata sensu</i> Hook. f. 1888, auct non L. <i>Taxus baccata</i> L. ssp. <i>wallichiana</i> (Zucc.) Pilger
<b>Subject to CITES regulations:</b>	All parts and derivatives, except seeds, pollen, seedling or tissue cultures obtained in vitro, in solid or liquid media, transported in sterile containers and cut flowers of artificially propagated plants and chemical derivatives and finished pharmaceutical products.
<b>Macroscopic characteristics of the wood:</b>	Wood: brown, non porous, growth rings distinct. Clear difference between the sapwood and heartwood. The sapwood is light brown, the heartwood is pinkish brown or purple. Fibres straight. Hardness: semisoft Grain: fine Specific weight: 0.50 – 0.60 g/cm <sup>3</sup>
<b>Microscopic characteristics of the wood:</b>	Growth rings distinct. Non-porous. Resin canals absent. Tracheids, square to polygonal in transversal section and arranged in radial lines. All tracheids have spiral thickenings. Bordered pits uniseriate, 11 – 13 µm in diameter, smaller, 5 – 6 µm in diameter on the tangential surface. Axial parenchyma absent. Very short uniseriate wood rays, (1 –) (5 – 6) (– 15) cells high, 280 – 290 per mm <sup>2</sup> . Cross fields pits cupresoid, in groups of 1 – 3, 5 – 6 µm in diameter. No radial tracheids. Traumatic canals occasionally present.
<b>Characteristic of the trees:</b>	A large tree, about 30 metres high and 1.5 – 1.8 metres in diameter. Occurs in the subtemperate Himalaya, between 1500 and 3500 metres altitude.
<b>Characteristics of trade:</b>	The leaves, the buds and the bark are used for medicines, and are exported as leaves, roots, bark and derivatives.

**Distribution:**

Along the Himalayas to Burma

**Use:**

Medicinal uses. The leaves are sought after for the extraction of taxol. The wood is valuable and used to manufacture ornaments, sculptures and encrustations.

**Similar species:**

Some authors recognize seven species in the genus *Taxus* but some are very similar. *Cephalotaxus griffithii* Hook. f. is a tree with linear leaves that has an aspect similar to the Himalayan yew, with female cones and scales arranged in a spiral and two or more ovules per scale, while *Taxus wallichiana* Zucc. has feminine cones with imbricate scales, few in number and a single ovule.



**Family:** Taxaceae

**Synonyms:** *Taxus baccata* L. subsp. *wallichiana* (Zucc.) Pilger  
*Taxus contorta* Griff  
*Taxus orientalis* Bertol  
*Taxus yunnanensis* W.C.Ceng & L.K.Fu (sometimes considered to be a separate species)

**Vernacular names:**

english:	Himalayan yew
french:	If d'Himalaya
spanish:	Tejo del Himalaya, tejo de Asia
german:	Himalaya-Eibe
hindi:	Barmi, Thuno
italian:	Tasso dell'Himalaia

**Geographical range:** From Afghanistan and Pakistan through the Himalayas to south-west Tibet and in south-east Asia to Indonesia and the Philippines.

**Distribution by country:** Afghanistan, Bhutan, China, India, Nepal.

**Protection:** CITES Appendix II (#2), since 16.02.1995

**Use:** Medicinal plant, timber (carvings, furniture, floorboards, fences, roofs, etc.).

## Botanical drugs in trade

**Plant parts used:** Young twigs and needles, formerly also bark.

**Pharmaceutical names:**

latin:	Taxi folium, Folia Taxi
english:	Himalayan yew leaves
french:	Feuilles d'if d'Himalaya
spanish:	Hoyas de Tejo del Himalaya
german:	Taxus-wallichiana-Blätter
hindi:	Barmi, Thuno
italian:	Foglie di tasso dell'Himalaia

**Countries of export:** China, India, Nepal.

**Source:** Wild collection and cultivation.

**Commodities in trade:** Mainly dried young twigs and needles, often chopped (crude drug); in addition bark and extract (Taxol, Paclitaxel).

**Characteristics:**

Crude drug:	(Fig. 1-3) Bark reddish-brown, thin, scaly; twigs irregularly alternate; leaves spirally arranged or distichous, linear (needles!), flattened, leathery, glabrous, 20-40 mm long and 2-3 mm wide, gradually tapering to the cuspidate apex, margin revolute, narrowed at base and decurrent along twigs; upper surface domed, dark greenish, shiny, with distinct midrib; lower surface mainly paler than upper surface; buds at the ends of the twigs and in the axils of the needles 3-4 mm long, bud scales ovoid to rounded, strongly appressed;
Cut drug:	–
Odour:	–
Taste:	Caution: the drug is <b>toxic!</b>

**Remark:**

Besides the leaves, the shoots and the extract made thereof are in trade; the wood was traded, but whether it is still in trade is unknown.

**Similar drugs/  
adulterations:**

***Taxus baccata*** L. (English: common yew; German: Gewöhnliche Eibe) supplies also the drug *Taxi folium*;

Geographical range: Europe, Caucasus, Asia Minor, north Iran, north-west Africa (Atlas), Madeira;

Characteristics: Leaves 10-30 mm long, to 2 mm wide, dark, shiny, the upper surface greenish, the lower surface pale greenish.

***Taxus spp.***: Some further species are also used as a source of the drug and are known in trade as well as *Taxi folium*: the needles of the north American species *Taxus brevifolia* Nutt. (English: Californian yew, Oregon yew, Pacific yew, western yew; German: kurzblättrige Elbe, pazifische Eibe) and *Taxus canadensis* Marsh. (English: Canada yew; German: Kanadische Eibe) are very short and narrow, at most 2 cm long. The east Asian species *Taxus cuspidata* Siebold & Zucc. (English: Japanese yew; German: Japanische Eibe) and *Taxus chinensis* (Pilg.) Rehder shows needles up to 25 mm long and 2-3 mm wide, which are abruptly cuspidate. Furthermore, the needles of *Taxus cuspidata* have greenish yellow strips on lower surface.



Figure 1. Crude drug of twigs and needles, *Taxi folium*; species: *Taxus wallichiana*, (copyright BfN).



Figure 2. Comparison of crude drug of twigs and needles, *Taxi folium*; species: *Taxus wallichiana* (left), *T. baccata* (centre), *T. cf. cuspidate* (right), (copyright BfN).

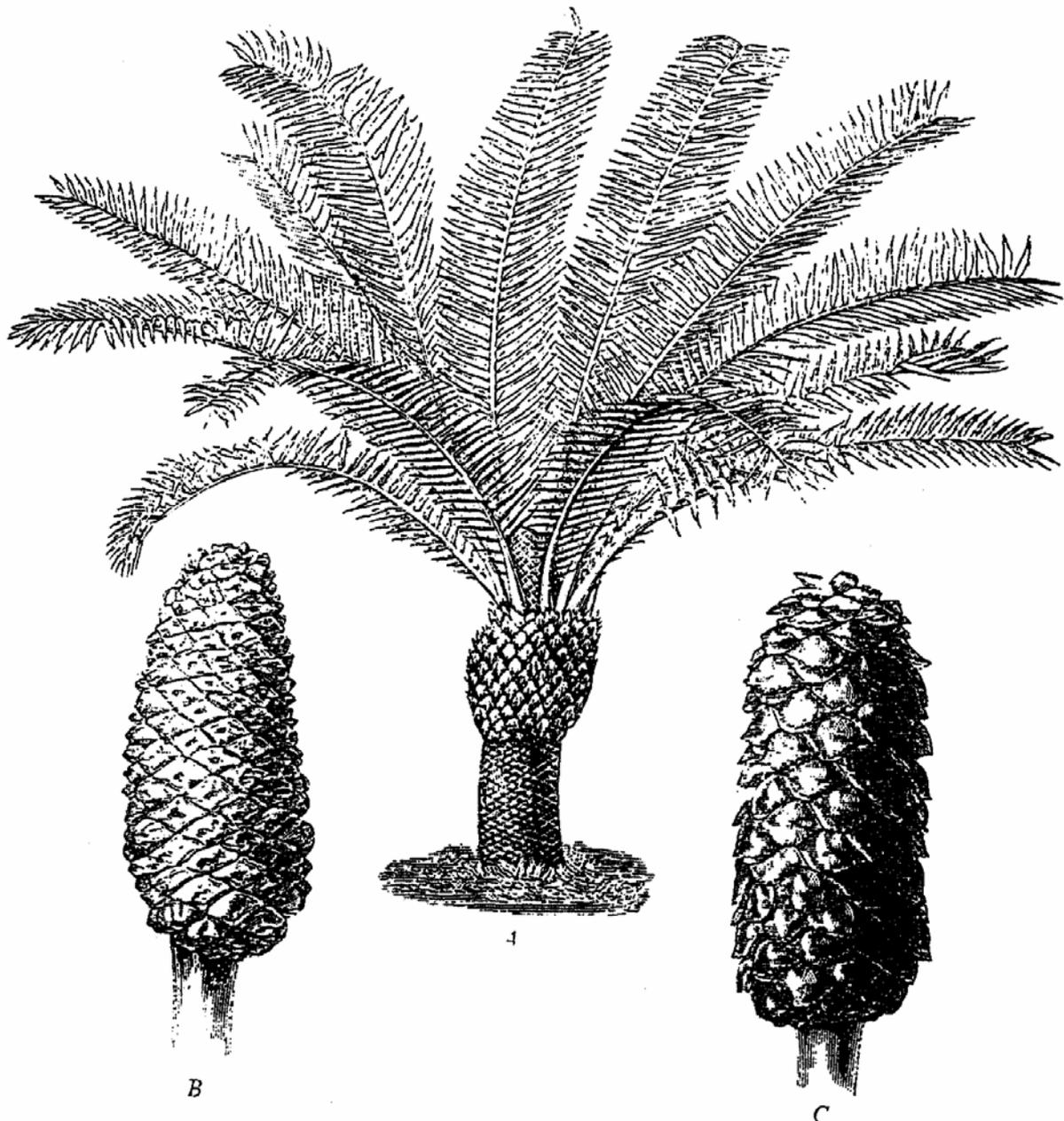


Figure 3. Crude drug of twigs and needles, *Taxi folium*; species: *Taxus wallichiana*, (copyright BfN).

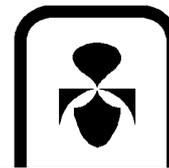


## The genera of Cycads

### How to identify them by their fronds







### Conservation of Cycads and international trade

Cycads play an important role in the international trade in ornamental plants. They are attractive for specialized collectors, but also more generally for tropical and subtropical gardening and landscaping. Their very slow growth rate makes them highly expensive items. This is an important reason, why some species of Cycads are in danger of extinction today. Therefore, all Cycads are included in the Appendices of the Washington Convention on International Trade in Endangered Species of Wild fauna and Flora (CITES or Washington Convention).

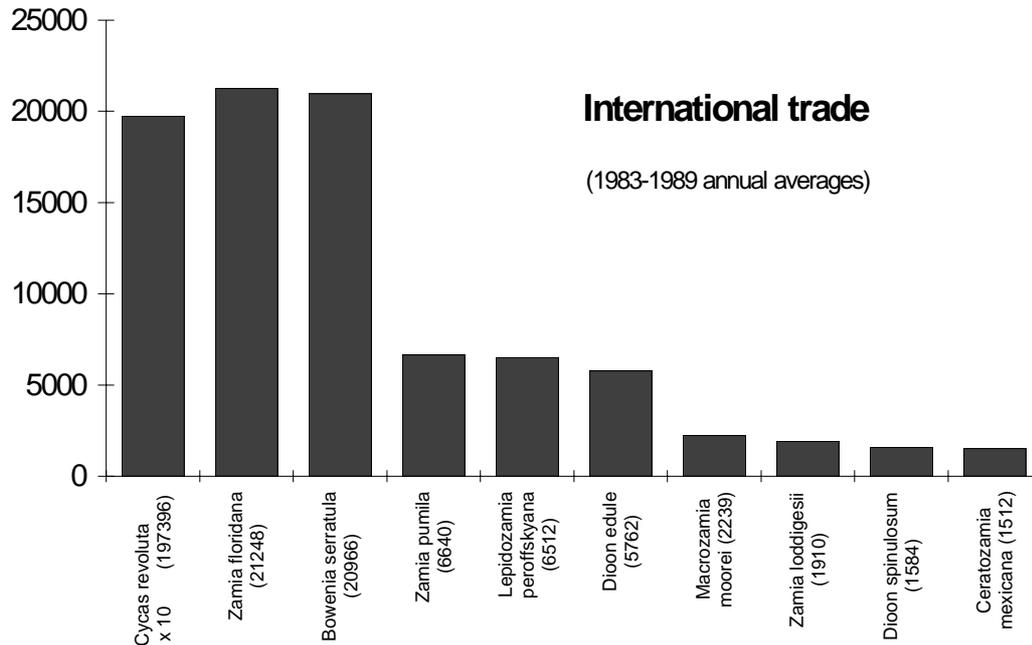
Listing Cycads in the Appendices means control over their fairly wide-spread international trade through export permits and customs inspection. Control over trade in any merchandise requires simple means of identification. Therefore, the ability to identify Cycads is an important factor in their conservation.

### What are Cycads?

Cycads, because of their unique pollination and fertilization methods, form quite an isolated evolutionary group amongst seed reproducing plants (Spermatophyta). The production of motile sperm cells, known as spermatozoids, is most noteworthy. Although their trunks and crowns of fronds make them look similar to treeferns or palms, they are not closely related to either of them. Rather, they are related to conifers, because they similarly grow male and female cones with exposed seeds and consequently are classified in the same taxonomical group (Gymnospermae). Their greatest period was 150 million years ago, during the Mesozoic era. However, they have existed for 250 million years. They lived with the dinosaurs and therefore they are considered as the dinosaurs among today's higher, seed producing plants. Their scattered distribution in the world's tropical and subtropical zones is a relic of a past continuous, global abundance. Eleven genera with a total of 185 species or more are known today. These are divided into three families. The family Cycadaceae only consists of the genus *Cycas*, distributed in Australia and parts of tropical Asia and Africa. This genus is unique in that it does not produce female cones, but only loose individual fertile fronds (megasporophylls). The family Stangeriaceae does not have very obvious characteristics and includes two geographically separated, small genera: *Stangeria*, native to Africa and *Bowenia*, native to Australia. All the other genera belong to the family Zamiaceae.

### International trade

Trade statistics are impressive: According to CITES data, in 1983-1989 there was an annual trade of 197.396 specimens of *Cycas revoluta*, a species native to Japan but widely cultivated elsewhere, 21.248 specimens of *Zamia floridana*, native to the Caribbean, 20.966 specimens of *Bowenia serratula*, a species native to Australia, 6.640 specimens of *Zamia pumila*, native to the Caribbean, 6.512 specimens of the Australian species *Lepidozamia peroffskyana*, 5.762 specimens of the Mexican species *Dioon edule*, 2.239 specimens of the Australian Cycad *Macrozamia moorei*, 1.910 specimens of *Zamia loddigesii*, from Central America, 1.584 specimens of *Dioon spinulosum*, another Mexican species, and 1.512 specimens of *Ceratozamia mexicana*, also native to Mexico. These figures represent the annual average of registered trade for that period.



Of course, international trade is not the only factor that endangers Cycads and other plant groups. Loss of habitat due to human development also has considerable impact. However, especially in the case of Cycads, trade has a fatal effect and is the main cause for their reduced numbers.

### Endangered Cycads

As shown above, Cycads are traded on a large scale. Not only artificially propagated nursery specimens are traded but also wild-collected specimens. From an evolutionary point of view, Cycads are very persistent but their reproduction is extremely slow. An individual may not only take years but decades to produce its first cone. On the other hand, the individual will live for many decades and produce a large amount of pollen or seeds, according to its sex. This strategy of slow propagation is not successful in an environment rapidly modified by Man. Changes occur in less than a generation of individual Cycads, which does not allow for adaptation of any kind nor counterbalances losses due to trade. For that reason, some species have already disappeared from their habitat, others have seen their numbers greatly reduced and cannot recover. Let us take some examples:

One well-known species is *Zamia furfuracea*, which thrived in its natural range in Mexico. In 1980, for example, one American trader alone imported from Mexico 30,000 specimens of this species per month. At Miami airport, 20,000 specimens were discovered in only one shipment in 1984, declared as palms of the genus *Chamaedorea*. Today, the species can no longer be found in most places where it used to thrive. Fortunately, an artificial propagation programme is now in place in its range. At the same time, there is an attempt to protect the plants that survived in their habitat, in order to collect their seeds.

Once discovered and described as a new species in Africa in 1988, *Encephalartos dolomiticus* was reduced by trade from hundreds of specimens to less than twenty individuals in their habitat. As dioecious plants that produce cones at intervals of several years, those few individuals are no longer capable of



producing male and female cones simultaneously. The species is condemned to slow extinction in its natural habitat without human help.

Of the genus *Encephalartos*, native only to Africa, principally the female plants are collected for their ornamental cones. This has led to a 10 to 1 relation between male and female *Encephalartos middelburgensis*, which has inhibited seed production. Another possible impact may be that certain pollinating insects (which feed on the cones or lay their eggs in them) on the surface from the lack of cones and can even disappear.

It is easy to see how the intensive trade, being the only or main threatening factor, can be highly detrimental to a species.

### Cycads included in the Appendices

The genera and species included in **Appendix I** of the Washington Convention can be traded for commercial purposes only if they are artificially propagated. This includes seeds and other parts, such as fronds, which are also used. It must be admitted that it is difficult to identify the seeds of the genera concerned.

The genera included in **Appendix II** of the Convention can be exported or imported, either as artificially propagated specimens or as wild-collected ones. Seeds and seedlings in sterile containers are exempted from the CITES provisions.

	<b>Appendix I</b>	<b>Appendix II</b>
CYCADACEAE	<i>Cycas beddomei</i>	<b>CYCADACEAE spp.</b> <i>Cycas</i> spp.
STANGERIACEAE	<b><i>Stangeria eriopus</i></b> = <i>S. paradoxa</i>	<i>Bowenia</i> spp.
ZAMIACEAE	<b><i>Ceratozamia</i> spp.</b> <b><i>Chigua</i> spp.</b> <b><i>Encephalartos</i> spp.</b> <b><i>Microcycas calocoma</i></b>	<b>ZAMIACEAE spp.</b> <i>Dioon</i> spp. <i>Lepidozamia</i> spp. <i>Macrozamia</i> spp. <i>Zamia</i> spp.

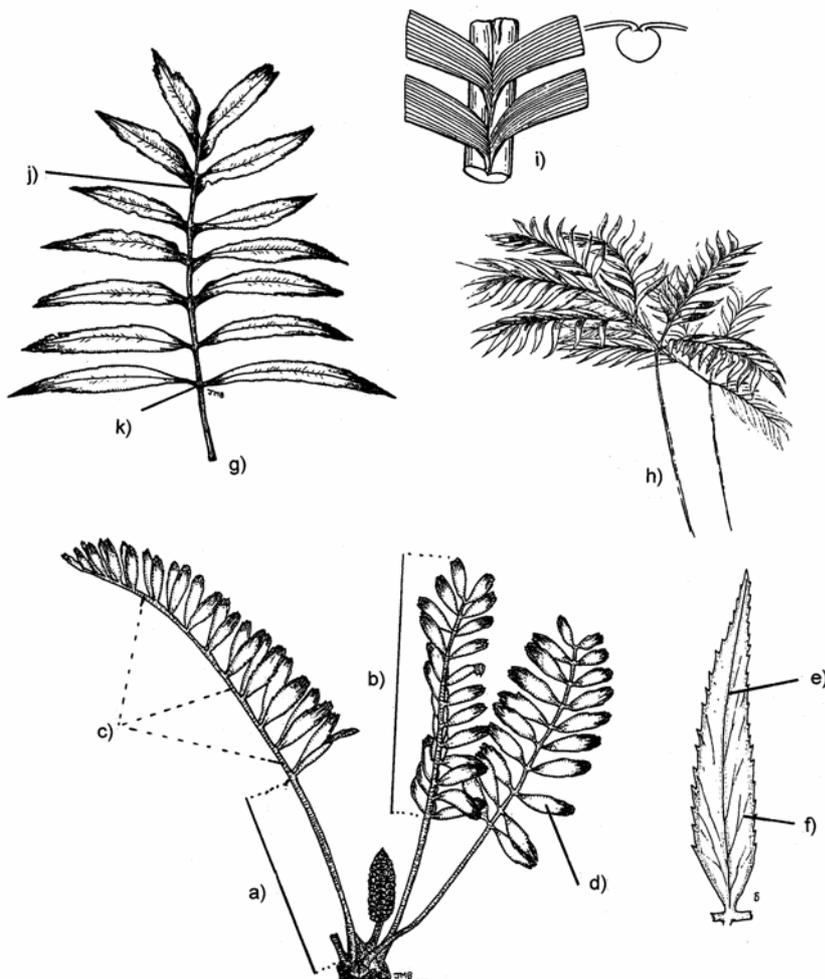
### Identifying genera

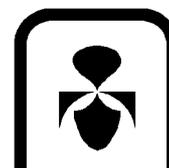
At genus level, the fronds alone usually allow the identification of Cycads. These have to be well developed however. In order to use the identification key given below, it is necessary to learn the general morphology and terminology of a frond (see also illustrations in page 5). A Cycad's frond consists of a petiole and a lamina. The lamina consists of a rachis and of leaflets, since the leaves are pinnately divided. Nerves are an important feature of the leaflets. They can be sunken or prominent, simple or branched. They can branch out from the midrib at different angles. The base of a leaflet may or may not be decurrent on the rachis. Also, the base of the leaflet can show a specific swelling, more or less prominent, either reddish or yellowish or it may end in a small petiole. Another important feature is the position of the leaflets on the rachis. Furthermore, the leaflets may or may not be caduceous. The petiole may have thorns, arranged in

lines or prickles without a specific order. It is easy to see, that only a few characters are needed in order to unmistakably identify most of the genera.

### Cycad fronds, morphological terms

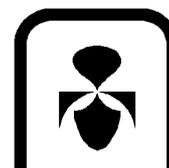
- a) petiole
- b) limb (or lamina)
- c) rhachis
- d) leaflet
- e) mid (or central) veins (or midribs)
- f) lateral veins (or ribs)
- g) leaf pinnate (= once pinnately divided)
- h) leaf bipinnate (= twice divided)
- i) leaflet emerging from the centre line of the rhachis
- j) leaflet decurrent on the rhachis
- k) leaflet not decurrent





- 1 leaves bipinnate (=twice divided) [Photo 1] ..... **Bowenia**  
 1\* leaves pinnate (=pinnately divided) ..... 2
- 2 leaflets with prominent veins ..... 3  
 2\* leaflets with sunken veins ..... 5
- 3 unbranched midrib [Photos 4 - 6] ..... **Cycas**  
 3\* branched midrib, lateral veins present ..... 4
- 4 lateral veins arising at almost right angle to midrib [Photos 2 and 3] ..... **Stangeria**  
 4\* lateral veins arising at acute angle to midrib..... **Chigua**
- 5 leaflets attached to upper surface of rhachis, slightly canaliculate  
 [Photos 7 and 8] ..... **Lepidozamia**  
 5\* leaflets attached to the margins of the rhachis, flat ..... 6
- 6 base of leaflets swollen, reddish or yellowish [Photos 9 - 11] ..... **Macrozamia**  
 6\* colourful swelling at base of leaflets absent ..... 7
- 7 leaflets not tapering towards the base, decurrent on the rhachis ("shark's teeth")  
 [Photos 12 and 13] ..... **Dioon**  
 7\* leaflets tapering towards the base, lanceolate or obovate, not decurrent ..... 8
- 8 leaflets noticeably smaller towards the petiole until almost rudimentary;  
 thornless rhachis [Photos 14 - 16] ..... **Encephalartos**  
 8\* leaflets only slightly smaller towards the petiole; rhachis often with a few short,  
 irregularly distributed prickles ..... 9
- 9 leaflets hanging from the rhachis in the form of a roof (reflexed), only slightly  
 smaller towards the apex of the leaf (leaf almost with "cut apex")  
 [Photos 20 and 21] ..... **Microcycas**  
 9\* leaflets spreading horizontally or ascending v-shaped; frond lamina lanceolate  
 (leaf with acute apex) ..... 10
- 10 individual leaflets caduceus in old or dehydrated fronds, leaflets often with  
 marginal teeth or serrate, sometimes with tomentum or translucent veins  
 [Photos 22 - 24] ..... **Zamia**  
 10\* individual leaflets not caduceus, margin entire [Photos 17 - 19] ..... **Ceratozamia**




**Distribution of some important characteristics (exclusive characteristics in grey)**

	Bo	Cy	St	Ch	Le	Ma	Di	En	Mi	Za	Ce
twice divided (bipinnate) leaf	x										
young leaflets spiralled		x									
petiole with paired thorns, forming two lines		x									
prominent midrib		x	x	x							
prominent lateral veins			x	x							
lateral veins at right angle			x								
lateral veins at acute angle				x							
leaflets attached to the upper surface of the rachis					x						
leaflets canaliculated					x						
base of leaflets swollen, reddish or yellowish						x					
leaflets noticeably smaller towards the petiole						x	x	x			
leaflets with marginal teeth or serrate				x		x	x	x		x	
leaflets decurrent ("shark's teeth")							x				
prickly petiole and rachis				x					x	x	x
leaflets hanging from rachis (reflexed)									x		
frond with "cut apex"									x		
leaflets caduceus				?					x	x	

***Bowenia***

*Bowenia* is the only Cycad genus with bipinnate leaves that makes it very easy to identify. It is native to the coastal region of Northeast Australia. Leaves emerge from a subterranean trunk and reach a height of two meters. Laminas grow horizontally. Its light green fronds are used in bouquets and ornamental displays, as backing material for cut flowers, because cut leaves survive for a very long time. They used to be collected from the wild for these purposes. The genus belongs to the family Stangeriaceae and is included in Appendix II.

***Cycas***

Adult plants often arborescent, similar to palms, with a simple trunk and a dense crown of glossy, coriaceous fronds. Leaflets not much smaller towards the petiole but abruptly replaced by paired thorns. Young leaflets on fresh fronds spiralled. Bases of fallen fronds remain on the trunk, like stubbles. Fertile female leaves pinnate, not joined to a cone but free, forming a crown at the apex of the plant, each leaf producing up to eight seeds. Distributed in Southeast Asia, from China and Japan to Australia and India, also in Madagascar and east Africa. The genus *Cycas* is included in Appendix II with the exception of *Cycas beddomei*, an Indian species included in Appendix I. Unfortunately, according to the literature *Cycas beddomei* resembles *Cycas revoluta*. Although it has lighter green leaves, it cannot be easily differentiated. Fortunately, *Cycas beddomei* is practically absent from international trade.

### ***Stangeria***

The genus *Stangeria* consists of only one species, *Stangeria eriopus*, which is included in Appendix I. These plants have a branched subterranean trunk, from which few fronds emerge, very similar to the fronds of certain ferns. They can be 2 meters tall. The base of the petiole is tomentose, covered with white wool. The species is native to the coastal region of southeast Africa, where the trunk and seeds are used as medicine.

### ***Chigua***

This genus has only two species, both native to Columbia and is included in Appendix I. It is very similar to certain species of the genus *Zamia*, but it can be differentiated by the prominent veins of its leaflets. It is practically absent from collections and trade and therefore little known.

### ***Lepidozamia***

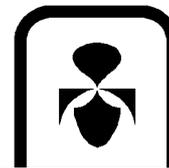
Both species of the genus form trunks up to 20 meters and up to 50 cm diameter, very similar to palms. They trunks terminate in a dense crown of glossy fronds of up to 3 meters long, with thornless, fairly long petioles. Numerous leaflets, inserted along the upper midline of the rhachis, not on the sides. Leaflets canaliculated, without visible veins and looking a little succulent or coriaceous. Not notably reduced in size towards the petiole. Bases of fallen fronds remain on the trunk, like stubbles. The genus is further characterised by female cones which have scales with a sharp tip, pointing downwards. *Lepidozamia* could be mistaken for *Cycas*, but the leaflets lack a prominent midrib and the petiole is thornless. *Lepidozamia* grows in eastern Australia and is included in Appendix II.

### ***Macrozamia***

The genus consists of two very distinct groups. The section ***Macrozamia*** consists of large plants with tall trunks (up to 2 meters high) with dense crowns of numerous long (up to 2 m), hard and coriaceous fronds with a high number of prickly leaflets. Bases of fallen fronds remain on the trunk, like stubbles. The leaflets are not divided and reduced in size towards the petiole, the lowest being rudimentary. The section ***Parozamia*** consists of small plants with subterranean trunks and only a few fronds. The fronds have a twisted rhachis and sometimes rather few narrow, grass-like, long leaflets with split tips. Both sections of the genus are restricted to Australia, most species occur along the eastern coast. The genus *Macrozamia* is included in Appendix II. It could be mistaken for *Dioon* or *Encephalartos* because of the hard, prickly fronds, but *Macrozamia* is characterized for the swollen, colourful base of its leaflets, although sometimes the swelling is not very prominent.

### ***Dioon***

Plants with short to fairly tall trunks. Dense crown of numerous hard, prickly fronds with coriaceous leaflets. Leaflets with a broad base, decurrent on the rhachis, like shark's teeth. Noticeably smaller towards the petiole, sometimes with denticulate margin, lacking visible veins. Thornless petiole. The cones are very characteristic, covered with white hairs. The genus could be mistaken for *Encephalartos* or *Macrozamia* due to their hard, prickly fronds but can be differentiated by the decurrent base of their leaflets.



Distribution: Mexico and Honduras. Some species grow in very restricted areas limited to only a few individuals. This makes them very sensitive for fires, changes in their habitat and collecting. They are included in Appendix II.

### ***Encephalartos***

Plants with strong trunks (varying from subterranean or low to rather tall) sometimes branched at the base, with a dense crown of numerous, very hard, prickly fronds with coriaceous leaflets. Bases of fallen fronds remains on the trunk, like stubbles. Leaflets narrow with entire or denticulate margins to very broad with strong spines, always quite wide at the base, lacking visible veins. Noticeably reduced in size towards the petiole. Petiole thornless. The genus could be mistaken for *Dioon* or *Macrozamia* due to their hard, prickly fronds but the leaflets lack a decurrent or swollen base respectively. Geographic distribution: Eastern South Africa, where diversity of species is highest, and around the Congo basin, to Nigeria. The genus is included in Appendix I.

### ***Microcycas***

Monotypic genus whose single species is *Microcycas calocoma*, originating in western Cuba. It is found in very few gardens outside of Cuba. There, it is protected and administrated by specific *in situ* and *ex situ* measures. Plants have slender, very tall trunks that can reach 12 meters, with a comparatively very small crown of relatively short fronds. *Microcycas* is similar to *Zamia* in many aspects but its cones are gigantic compared to the small cones of *Zamia*. *Microcycas* is well recognizable for its hanging leaflets, which form a roof, and the “cut apex” of its fronds. Young plants however have to be observed closely because these features are not always very obvious. It is included in Appendix I and practically absent from trade.

### ***Zamia* and *Ceratozamia***

These two genera are easily differentiated by their cones. *Ceratozamia* has cones with scales that end in two horns. Otherwise, *Zamia* and *Ceratozamia* closely resemble each other. *Ceratozamia* is more uniform. It has a short, partially buried and sometimes branched trunk, fronds with a prickly petiole and rachis, and much elongated leaflets with entire margins. The leaflets have a specific, but rather weakly developed character. Their profile is slightly w-shaped, with the margins slightly turning upwards. *Ceratozamia* can be found in Mexico, Guatemala and Belize. It is included in Appendix I. *Zamia* is a large, polymorphic genus, widely distributed in northern South America, southwards to Bolivia, further in Central America, Mexico and the southeast of the United States and in the Caribbean. Its trunk can measure from a few centimetres to 2 m and it sometimes branches from the base. The genus is terrestrial with the exception of a single species, which is an epiphyte. Fronds from sparse to numerous, with prickly petioles and rachis. Leaflets usually with denticulate margins, rarely tomentous. Old or dehydrated fronds have a specific character: their individual leaflets may be caduceus. This character differentiates it from *Ceratozamia*. *Zamia* is included in Appendix II.





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- Donaldson J. & Winter, J. (1998): *Grow Cycads*. - Kirstenbosch Gardening Series. Trident Press, Cape Town.
- Giddy, C. (1974): *Cycads of South Africa*. Purnell & Sons, Cape Town.
- Jones, D. L. (1993): *Cycads of the world*. Reed Books, Australia.





1. Leaves bipinnate or twice divided  
(*Bowenia serratula*)



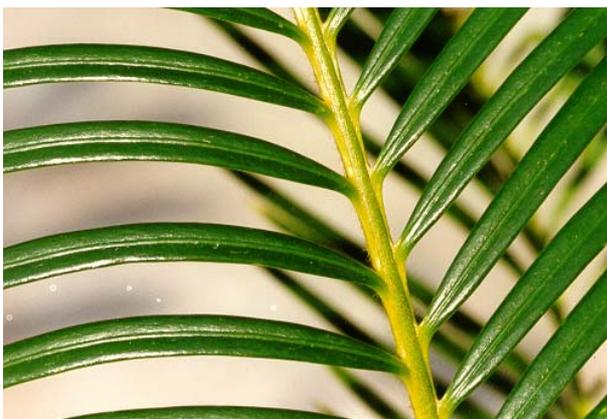
2. Leaflets with prominent veins, lateral veins arising at almost right angle to midrib  
(*Stangeria eriopus*)



3. Detail of veins on underside of leaflet  
(*Stangeria eriopus*)



4. Leaflets with undivided, prominent midrib  
(*Cycas rumphii*)



5. Leaflets with undivided, prominent midrib  
(*Cycas kennedyana*)



6. Petiole with thorns arranged in pairs  
(*Cycas kennedyana*)



7. Leaflets attached to the upper surface of the rachis, not lateral; leaflets canaliculated, without visible veins and looking a little succulent or coriaceous (*Lepidozamia hopei*)



8. Leaflets attached to the upper surface of the rachis, not lateral; leaflets canaliculated, without visible veins and looking a little succulent or coriaceous (*Lepidozamia hopei*)



9. Leaflets with a coloured swelling at the base (*Macrozamia spiralis*)



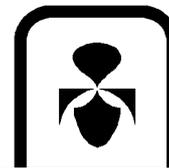
10. Leaflets with a coloured swelling at the base (*Macrozamia macdonnellii*)



11. Leaflets with a coloured swelling at the base and rachis spirally twisted, leaflets grass-like [*Macrozamia (Parazamia) fearnsidei*]



12. Leaflets not tapering towards the base, decurrent on rachis like "shark's teeth" margin slightly denticulated (*Dioon mejiae*)



13. Leaflets not tapering towards the base, margin of leaflets entire (*Dioon edule*)



14. Leaflets not decurrent, but tapering towards the base, with prickly spines on the margins (*Encephalartos horridus*)



15. Leaflets not decurrent, but tapering towards the base, with prickly spines on the margins (*Encephalartos sclavoi*)



16. Leaflets not decurrent, but tapering towards the base, with prickly spines on the margins (*Encephalartos ferox*)



17. Leaflets much elongated, notably tapering towards the base, with a slightly w-shaped profile and the margins slightly turning upwards, entire (*Ceratozamia mexicana*)



18. Petiole and rachis slightly prickly (*Ceratozamia mexicana*)



19. Cones with scales that end in two horns (*Ceratozamia mexicana*)



20. Leaflets reflexed, hanging from the rachis in the form of a roof, frond with "cut apex" (*Microcycas calocoma*)



21. Detail of the apex of the frond (*Microcycas calocoma*)



22. Leaflets notably tapering towards the base, spreading horizontally or ascending, rarely tomentous (*Zamia furfuracea*)



23. Leaflets notably tapering towards the base, spreading horizontally or ascending, but not tomentous, individual leaflets may be caduceous on old or dehydrated fronds (*Zamia integrifolia*)



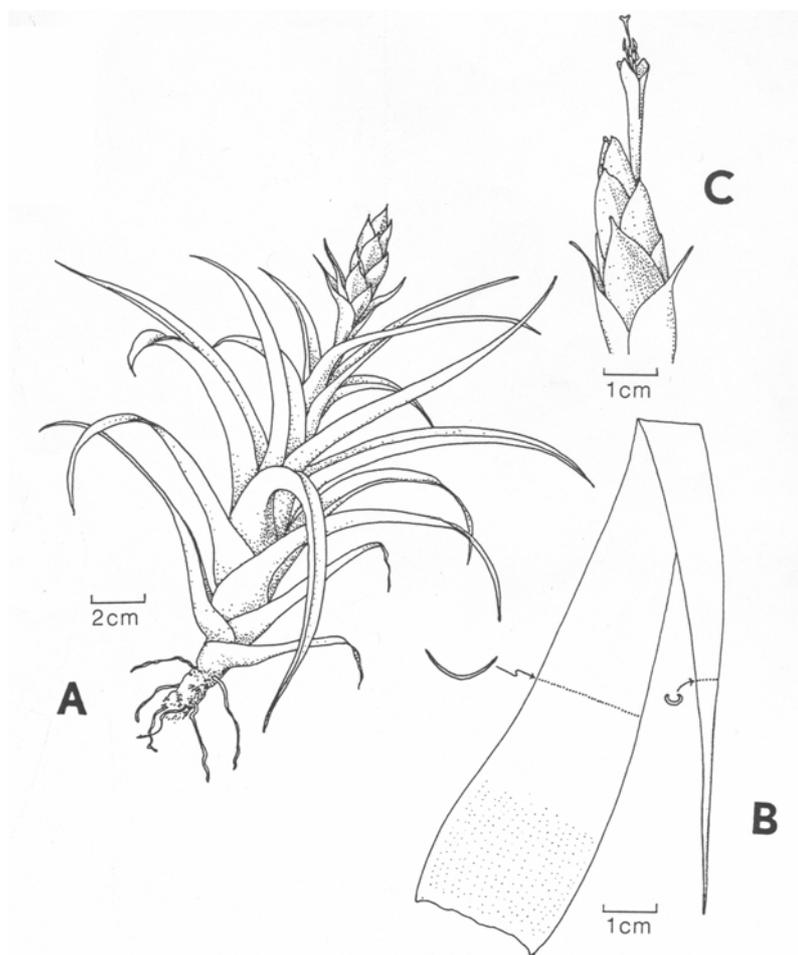
24. Leaflets notably tapering towards the base, spreading horizontally or ascending, striate, with denticulate margins (*Zamia skinneri*)



# Tillandsia harrisii

R. Ehlers, 1987

Scientific synonyms: None



A: habit, B: leaf, C: inflorescence

## Characteristics:

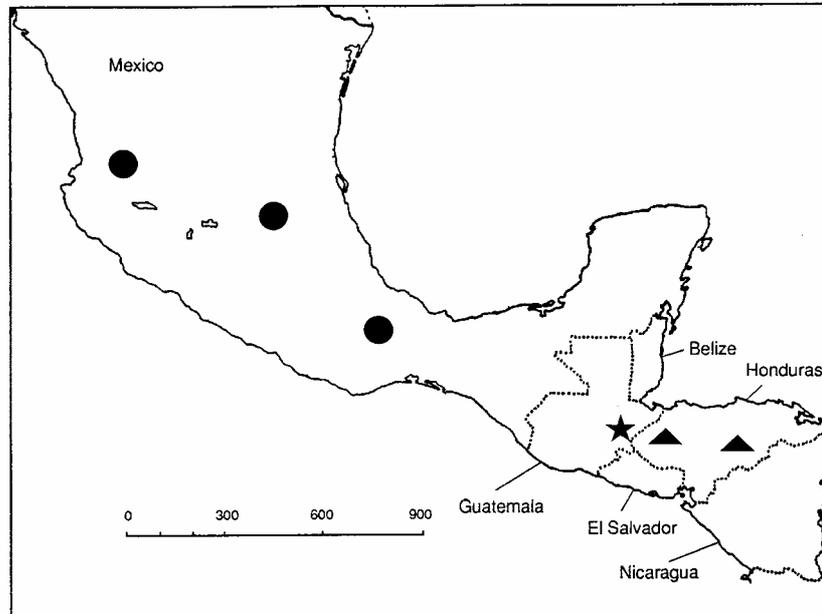
### Vegetative:

Plants with stems, usually 6-30 cm, rarely up to 80 cm tall. Leaves spirally arranged, numerous, spreading to recurved, more or less directed to one side, forming a dense rosette (diameter of rosette: 18-35cm). Leaf-sheaths 2.0-4.5x2-3cm, broad-elliptic, merging into the blade. Leaf-blades 10-15cm long, up to 1.5cm broad at base, narrowly triangular, acute, recurved, channeled. Densely covered with silvery-white scales (fig. 4). Scales roundish to elliptic (diameter: 0.4-0.5mm).

**Inflorescence:** Scape erect, 7-12cm long, glabrous, densely covered with white to rose coloured bracts, with very narrowly triangular blades up to several cm long. Inflorescence 7-13cm long, simple, lanceolate in outline, compact, with 5-9 spirally arranged flowers, densely appressed to the inflorescence-axis. Floral bracts 3-4.5cm long (longer than the sepals), thin, orange to red, more or less glabrous, acute or with a minute apex. Sepals ca. 3cm long, roundish, glabrous, the inner ones inconspicuously keeled. Petals to 5cm long, blue-violet, forming a narrow tube. Stamens and style exserted

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**Distribution:** Guatemala (Zacapa, Piedra del Galapago); known from cliffs along the Rio Teculután at 500 m altitude.



*T. harrisii* ★, *T. kammii* ▲, *T. mauryana* ●

**Similar species:**

*Tillandsia hondurensis* Rauh: In vegetative stage, *T. hondurensis* cannot be separated from *T. harrisii* with certainty. The former species has a more compact inflorescence (about 3 times as long as the diameter), floral bracts and sepals that are densely covered with scales, and much shorter and narrower straighter leaves. *T. hondurensis* seems to have become nearly extinct in its natural habitat (pers. comm. Renate Ehlers).

**Remarks:**

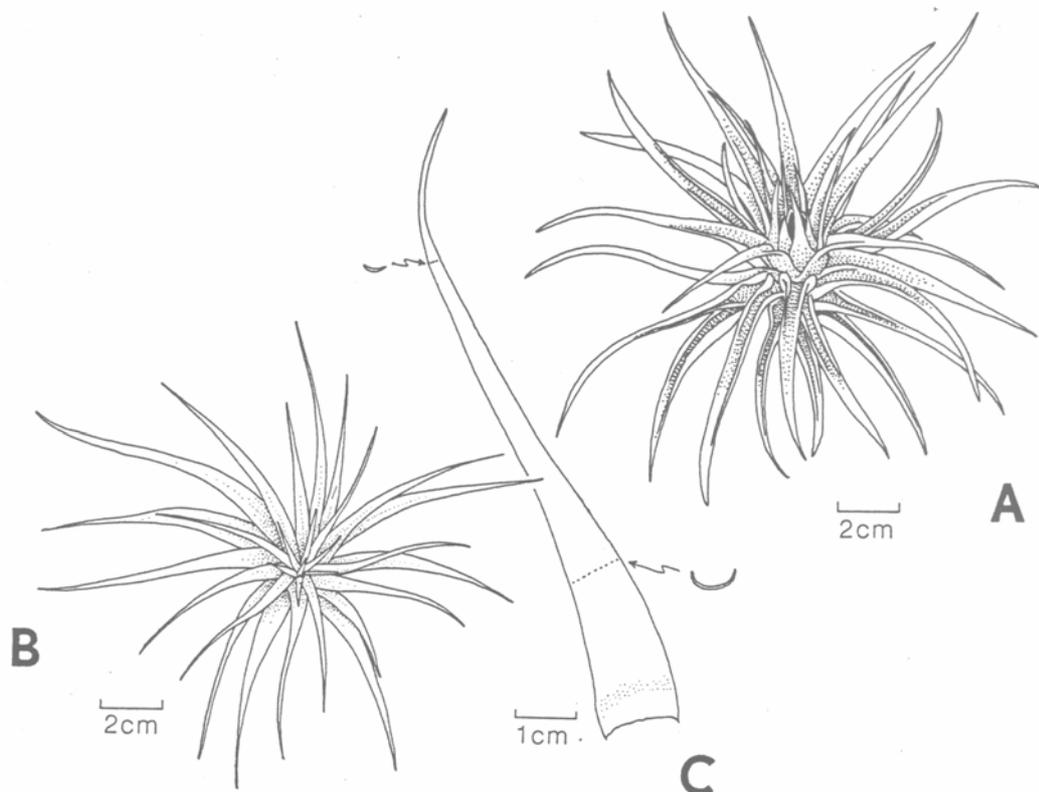
According to Luther (1984) *T. harrisii* is sometimes labelled by nurserymen as *T. "Blanca"*, *T. "Sphaerocephala Alba"*, *T. "Himnorum"* or *T. "Capitata White"*. It is propagated in large quantities in nurseries in Guatemala.



# Tillandsia kammii

Rauh, 1977

Scientific synonyms: None



A: habit, B: habit of flowering plant, C: leaf

## Characteristics:

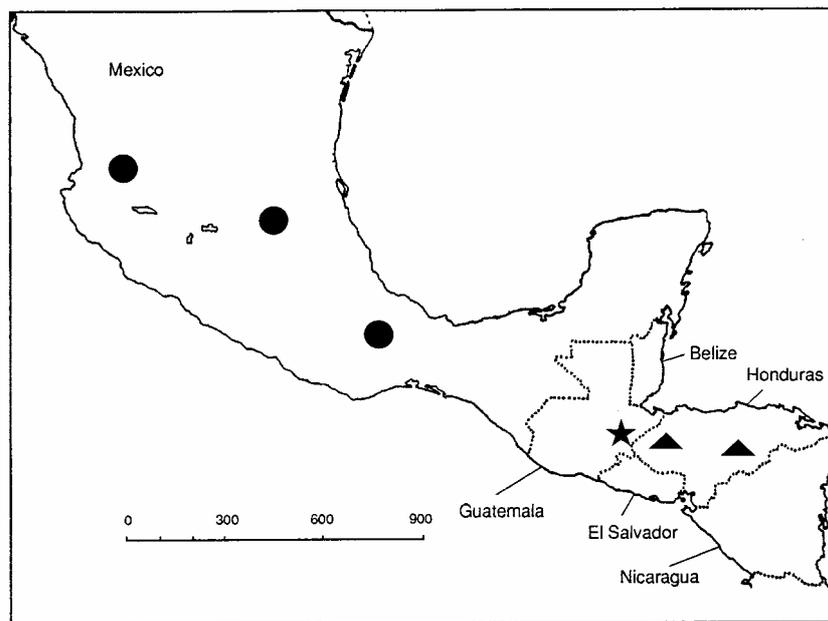
### Vegetative:

Plants stemless, 6-10cm tall. Leaves spirally arranged, numerous, spreading to recurved, forming a dense rosette (diameter of rosette: 15cm). Leaf-sheaths 1.2-1.5x1-1.4cm, broad-elliptic, merging into the blades. Leaf-blades 3-7cm long and up to 1cm broad at base, narrowly triangular, acute, channeled, soft, densely covered with silvery-white scales (fig. 5). Scales more or less irregular in outline, slightly spreading (diameter: 0.2-0.3mm).

**Inflorescence:** Scape very short, not exceeding the leaves, inflorescence simple, cone-shaped, 3-8-flowered, spirally arranged, 2-3cm long. Floral bracts ca. 2cm long, brownish-red at apex, densely covered with white scales, exceeding the sepals. Sepals ca. 1.5cm long, glabrous, the ones towards the axis slightly keeled. Petals ca. 4cm long, pale blue-violet, forming a curved tube. Stamens and style included.

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**Distribution:** Honduras (Juticalpa, Gracias and Catacanas near Juticalpa). Epiphytic, between 500-1200m altitude.



*T. harrisii* ★, *T. kammii* ▲, *T. mauryana* ●

**Similar species:**

*Tillandsia plagiotropica* has broader, usually shorter leaves that are stiffer and brittle and appear nearly white. Uncommon in cultivation (Luther, 1994).

The horticultural form *T. "Brachycaulos var. Multiflora"* has fewer, broader, darker grey leaves, and less densely arranged silvery scales. This form is common in cultivation and frequently exported from Guatemala (Luther, 1994).

**Remarks:**

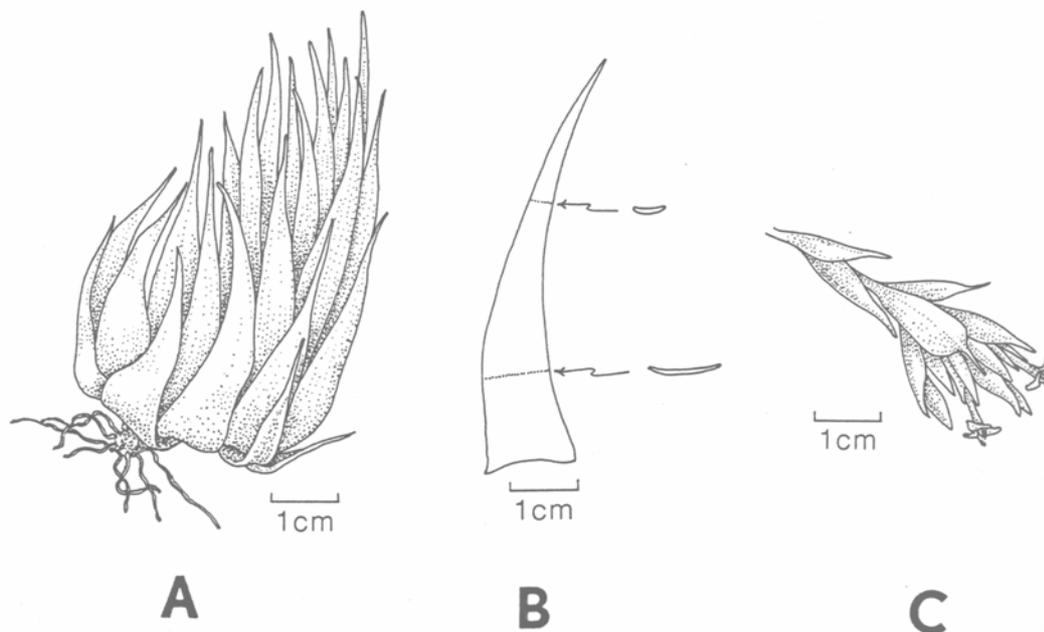
*T. kammii* is rare in cultivation.



# Tillandsia kautskyi

E. Pereira, 1974

Scientific synonyms: None



A: habit, B: leaf, C: inflorescence

## Characteristics:

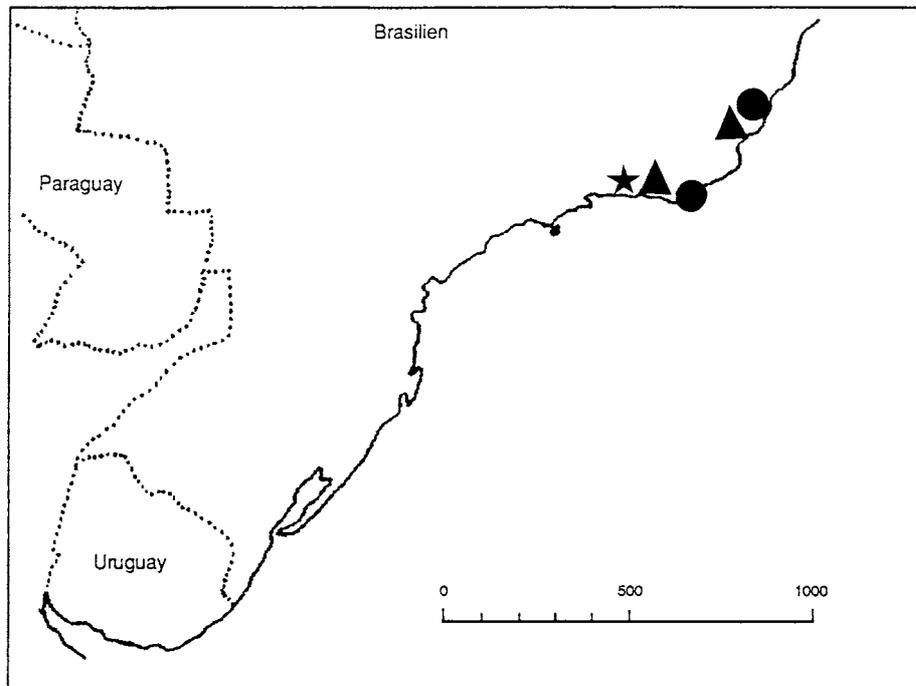
### Vegetative:

Plants stemless, 3-8cm tall (flowering: up to 8cm). Leaves spirally arranged, numerous, erect, more or less directed to one side, spreading only at part, forming a dense, more or less strict rosette (diameter: 4-8cm). Leaf-sheaths 1.2-1.8x0.6-1.3cm, broad elliptic, merging into the blades. Leaf-blades 3-5cm long and up to 1.3cm wide, narrowly triangular, acute to attenuate, slightly channeled (fig. 7), thin and soft, densely covered with greyish scales. Scales irregularly shaped, more or less spreading, not easily detachable (diameter 0.6-0.7mm).

### Inflorescence:

Scape erect, short, 2-4cm long, glabrous, covered by rose to red scape bracts that are densely covered with scales. Inflorescence slightly exceeding the leaves, simple or compound with 3-6 branches each with 2 flowers. Primary bracts exceeding the spikes, pale red to rose, covered with scales. Floral bracts ca. 1cm long, rose or greenish-white, equaling the sepals, inconspicuously keeled. Sepals 1cm long, acute, glabrous. Petals ca. 2cm long, lilac, the plate reflexed at anthesis. Stamens and style included.

**Distribution:** Brazil (Espírito Santo); wet mountain forests near Domingo Martins at 800-1000m altitude.



*T. kautskyi* ▲, *T. sprengeliana* ●, *T. sucrei* ★

**Similar species:** *Tillandsia sprengeliana* Klotzsch ex Mez has scales with spreading margins, more or less easily detachable and not densely crowded in apical part of leaf.

*Tillandsia brachyphylla* Baker has broader leaves that are densely covered with coarse scales and are more conspicuously channeled.

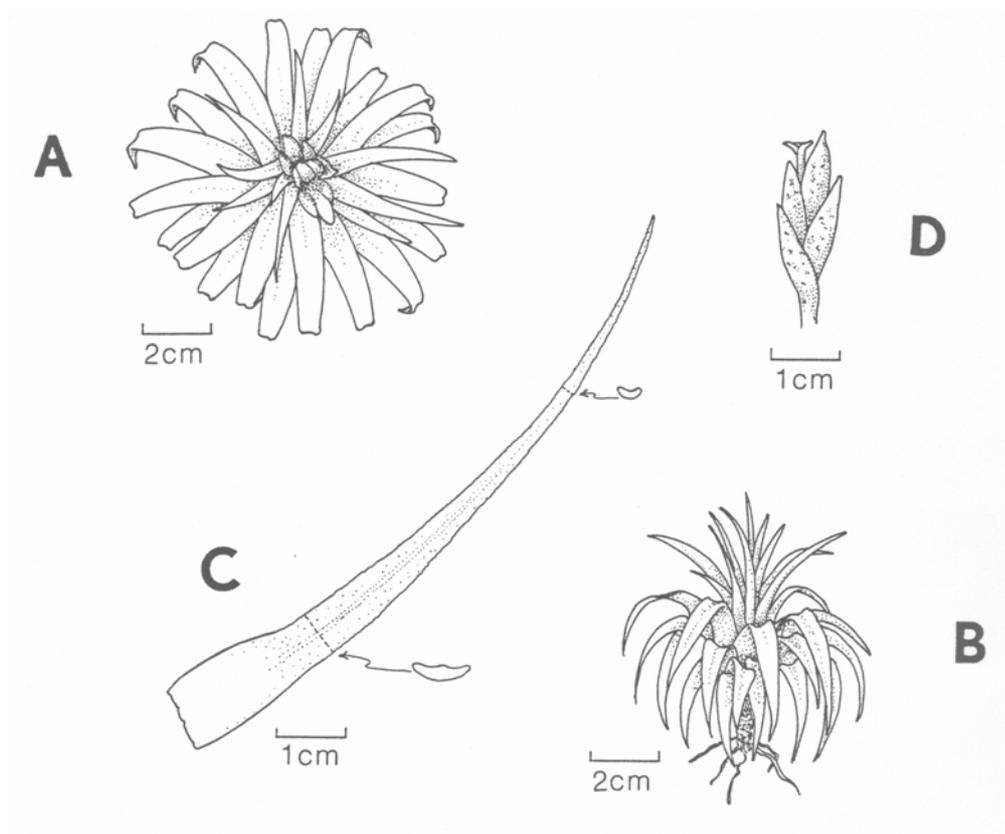
**Remarks:** Uncommon in cultivation (Luther, 1994).



# Tillandsia mauryana

L.B. Smith, 1937

**Scientific synonyms:** *Tillandsia atroviridipetala* sensu L.B. Smith, non Matuda



A: habit of flowering plant, B: habit, C: leaf, D: branch of inflorescence

## Characteristics:

### Vegetative:

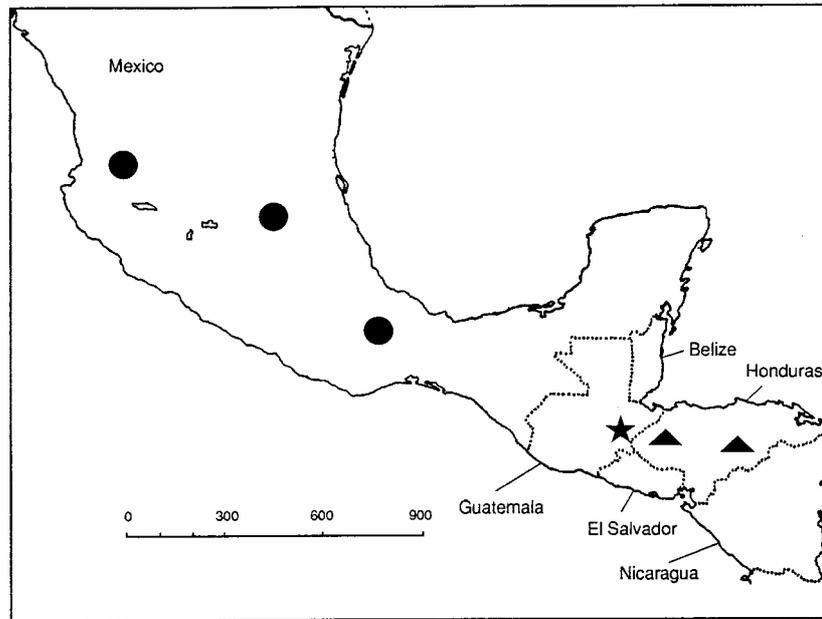
Plants stemless, 5-8cm tall (flowering plants 10-12cm). Leaves spirally arranged, recurved to spreading, forming a dense rosette (up to 12cm diameter). Leaf-sheaths 1.2-1.5x1-1.2cm, broad-elliptic, densely covered with white scales pale green to tan, except for the extreme base, merging into the blades. Leaf-blades 5-9cm long, 0.5-0.7cm wide at base, narrowly triangular, acute, flat, slightly succulent, brittle, slightly keeled beneath, densely covered with scales. Scales roundish to elliptic in outline, margins hardly spreading (diameter: 0.4-0.5mm).

### Inflorescence:

Scape very short (ca. 2-4cm). Inflorescence not exceeding the leaves. Lower scape bracts leaf-like. Inflorescence up to about 3.5cm long, more or less digitate with 2-6 spikes. Primary bracts 2-3cm long, white to rose, membranous, densely covered with scales, shorter than the spikes. Spikes 2.5-3.5cm long, flattened, dense, distichously 2-6-flowered. Floral bracts 1.5-2cm long, equaling or slightly exceeding the sepals, keeled, green, yellow or orange, covered with whitish scales. Sepals 1.2-1.5cm long, acute, covered with white scales. Petals ca. 2cm long, green, yellowish-green or white at base. Stamens and style included.

**Distribution:**

Mexico (Puebla, Hidalgo, Jalisco). Epiphytic in dry forests or lithophytic on steep slopes at 1500-2700m altitude.



*T. harrisii* ★, *T. kammii* ▲, *T. mauryana* ●

**Similar species:**

*T. ionantha* has fewer, more erect and narrower leaves, less silver-coloured and the central ones frequently tinged red. This species is very common in cultivation.

*T. atroviridipetala* Matuda has smaller, nearly filiform (thread-like) leaves with more hair-like scales.

**Remarks:**

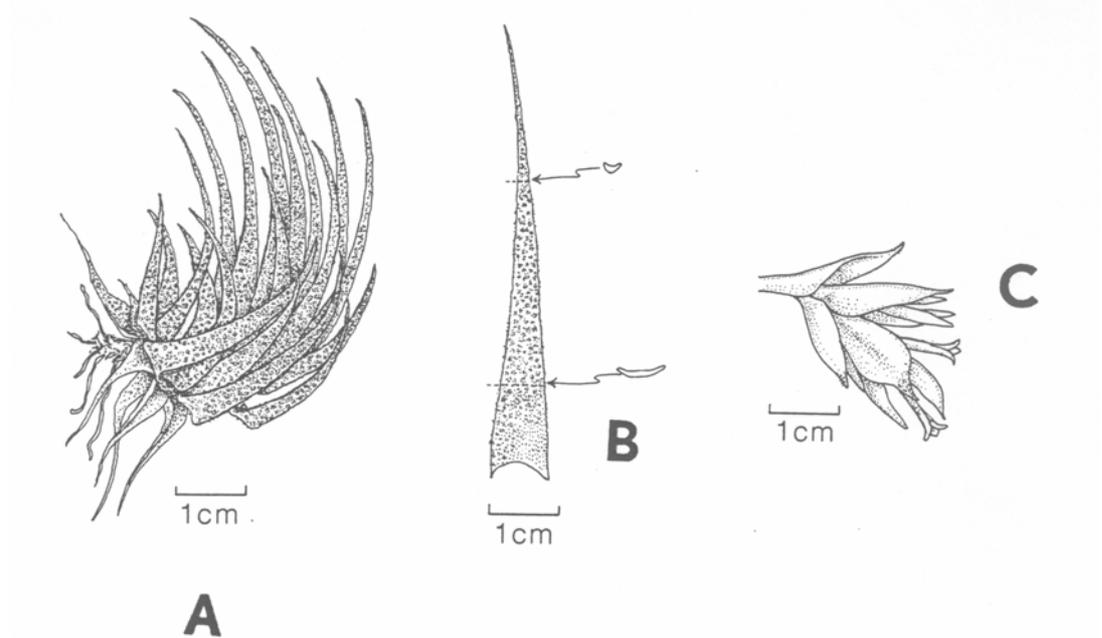
Not common in cultivation (Luther, 1994); only rarely found in trade (pers. comm. Renate Ehlers).



# Tillandsia sprengeliana

Klotzsch ex Mez, 1894

**Scientific synonyms:** *Anoplophytum sprengelianum* Beer  
*Tillandsia purpurea* sensu Sprengel  
*Tillandsia brachyphylla* Baker pro parte



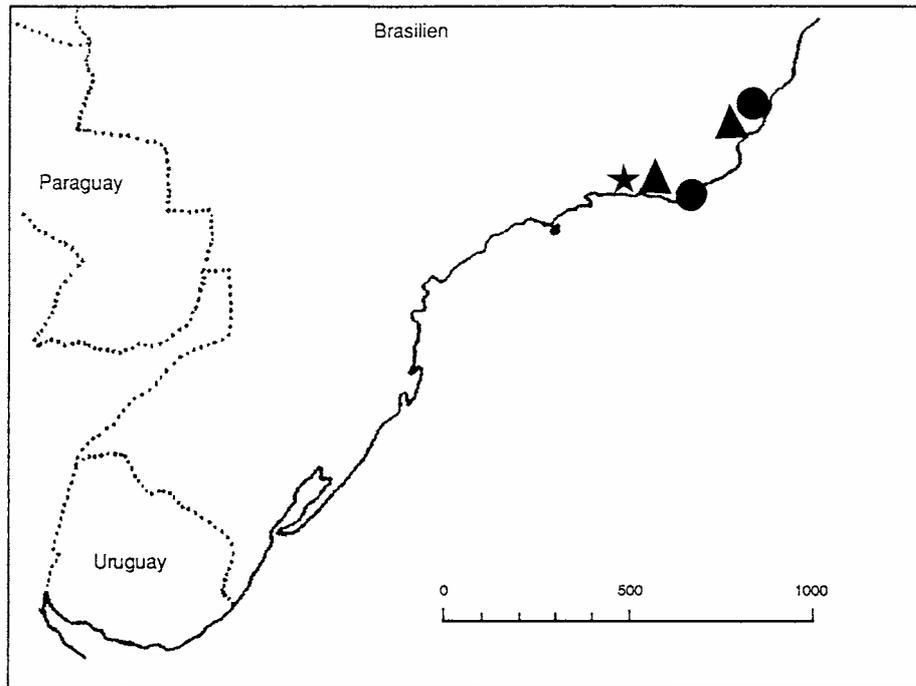
A: habit, B: leaf, C: inflorescence

## Characteristics:

- Vegetative:** Plants stemless, 4-8cm tall (flowering plants up to 6-9cm). Leaves numerous, spirally arranged, erect, directed to one side, forming a dense rosette (diameter: 3-5cm). Leaf-sheaths 0.5-0.8cm wide, broad elliptic, merging into the blades. Leaf-blades 3-8cm long, 0.4-0.8cm wide at base, narrowly triangular, acute, slightly channeled, soft. Scales roundish to irregular in outline, spreading (diameter: 0.5-0.8mm). Indumentum of scales only subdense on the abaxial surface of the upper third of the leaf-blade, scales individually recognizable; remaining parts of leaves more or less densely covered with scales.
- Inflorescence:** Scape more or less erect, glabrous, Scape bracts with linear blades, reddish tinged, scale covering less dense than on leaves. Inflorescence to 3cm long, simple, densely 6-8-flowered, the flowers spirally arranged, glabrous. Floral bracts 1.7cm long, thin, rose-red, exceeding the sepals. Sepals 1.1cm long, acute, pale green. Petals to 1.9cm long, rose. Stamens and style included.

**Distribution:**

Brazil (Espírito Santo, Rio de Janeiro). Epiphytic at sea level.



*T. kautskyi* ▲, *T. sprengeliana* ●, *T. sucrei* ★

**Similar species:**

*Tillandsia kautskyi* E. Pereira: Scales not spreading, dense, not easily detachable; leaves slightly pseudobulbous.

*Tillandsia brachyphylla* Baker: Leaf-sheaths obscure, leaf-blades to 9cm long, broader and more conspicuously channeled.

*Tillandsia thiekenii* R. Ehlers: Leaf-blades not directed to one side, more channeled to folded, succulent.

**Remarks:**

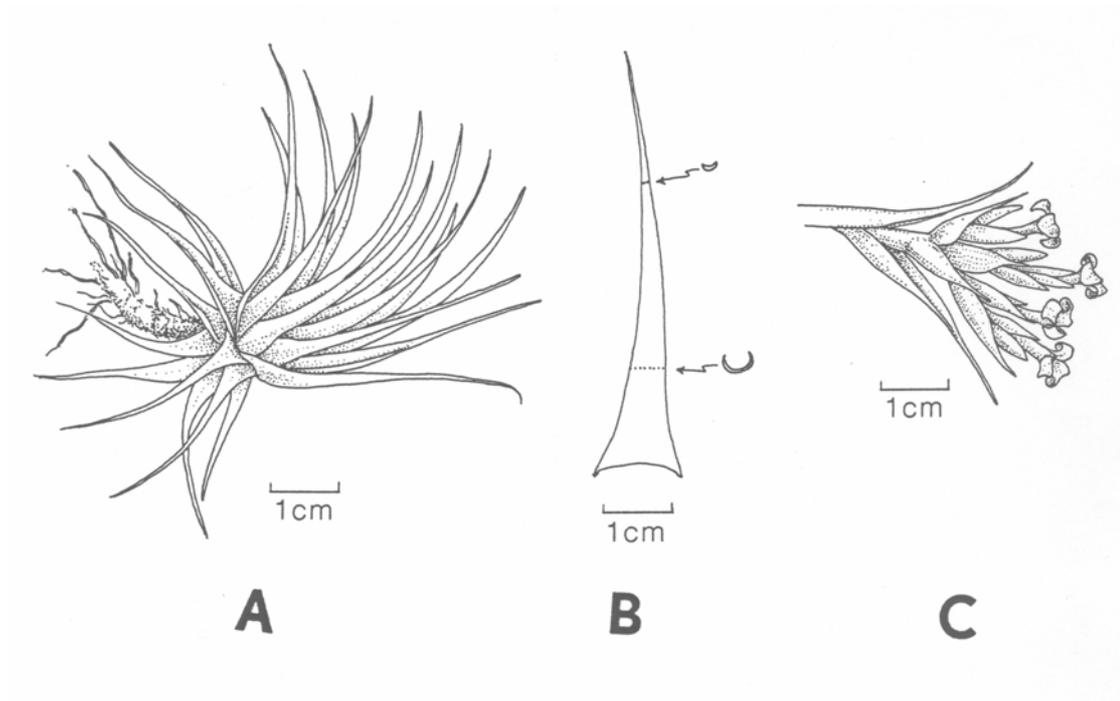
The species seems to have nearly become extinct in the wild and is hardly of importance in the *Tillandsia*-trade (pers. comm. Renate Ehlers); rare in cultivation (Luther, 1994).



# Tillandsia sucrei

E. Pereira, 1971

Scientific synonyms: None



A: habit, B: leaf, C: inflorescence

## Characteristics:

### Vegetative:

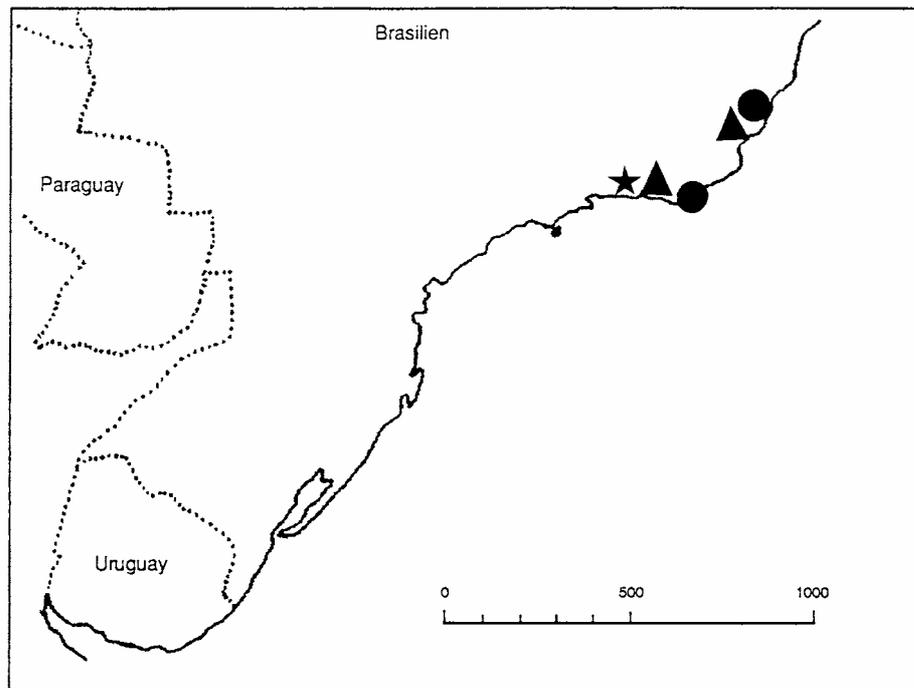
Plants nearly stemless or with short stems, 5-7cm tall. Leaves numerous, erect, directed to one side, crowded at the stem apex and forming a dense rosette (diameter: 4-6cm). Leaf-sheaths 0.8-1x0.7-0.9cm, broadly triangular, distinct from the channeled leaf-blade. Leaf-blades 3-5cm long and 0.5-0.8cm wide (when spread) at base, narrowly triangular, acute to acuminate, thin, more or less softish, deeply channeled to folded, densely covered with scales. Scales roundish to elliptic in outline (diameter: 0.3-0.5mm), slightly spreading.

### Inflorescence:

Scape more or less erect, equaling the leaves. Scape bracts like the leaves, but rose and with linear blades. Inflorescence compound, with 3-6 branches, the spikes 2-3-flowered. Primary bracts ovate, acute, keeled, rose, densely covered with white scales. Floral bracts 1-1.5cm long, about equaling the sepals, thin, rose, acute, densely covered with scales. Sepals 1.3-1.5cm long, acute, pale rose, with white scales, the inner ones keeled. Petals 1.5-1.8cm long, rose to lilac. Stamens with folded filaments; stamens and style included.

**Distribution:**

Brazil (Rio de Janeiro); lithophytic on steep slopes at 100-500m altitude.



*T. kautskyi* ▲, *T. sprengeliana* ●, *T. sucrei* ★

**Similar species:**

*Tillandsia brachyphylla* Baker has more broader, more densely arranged, erected leaves.  
*Tillandsia geminiflora* Brongniart is several times larger with nearly plane, not channeled, leaf blades.

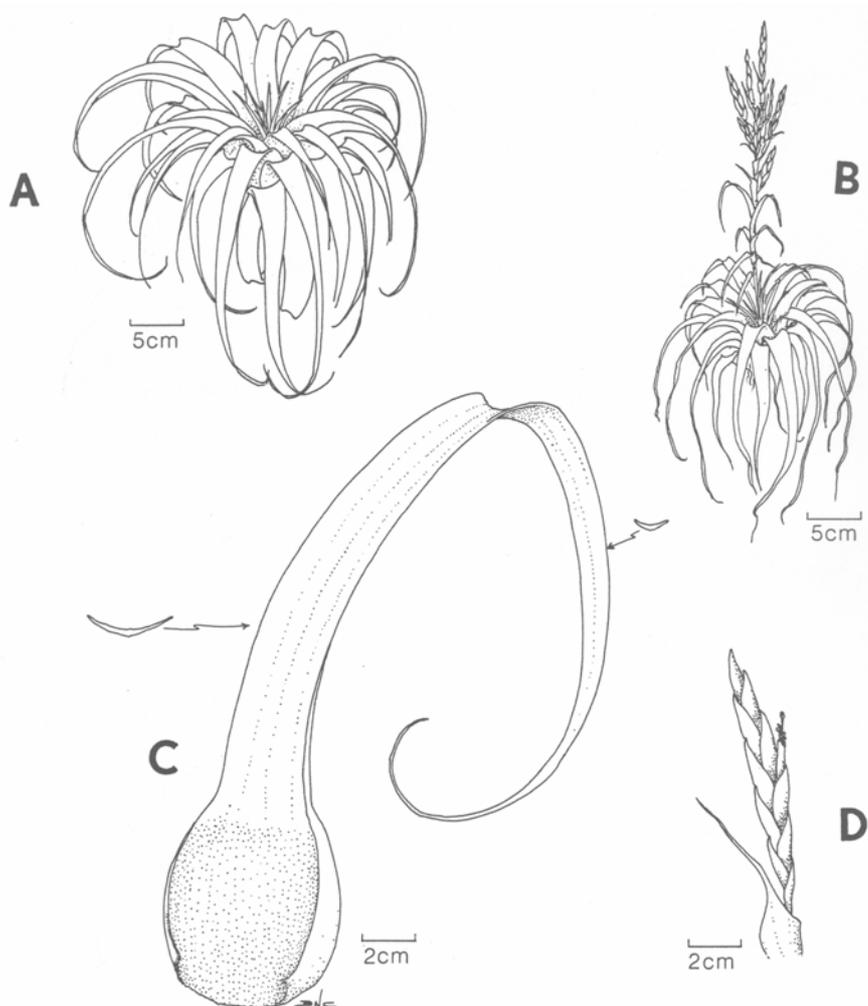
**Remarks:**

*T. sucrei* seems to be restricted to very few localities that are difficult to access and is infrequently found in the trade (pers. comm. Renate Ehlers); not common in cultivation (Luther, 1994).



# Tillandsia xerographica

Rohweder, 1953

**Scientific synonyms:**
*Tillandsia kruseana* Matuda*Tillandsia tomasellii* DeLuca, Sabato & Balduzzi

A: habit of flowering plant, B: habit, C: leaf, D: branch of inflorescence

**Characteristics:**
**Vegetative:**

Plants stemless, 20-60cm tall (flowering plants 35-100cm). Leaves spirally arranged, numerous, forming a dense rosette (diameter: 60-90cm) with more or less pseudobulbous base. Leaf-sheaths 4.5-9x4-7cm, broadly elliptic to suborbicular, more or less inflated, distinct from the blades. Leaf-blades 15-75cm long and to 6cm wide at base, narrowly triangular, acute to tapered, recurved and more or less twisted, slightly channeled, densely silvery-white, sometimes tinged pink. Scales roundish in outline (diameter: 0.3-0.5mm).

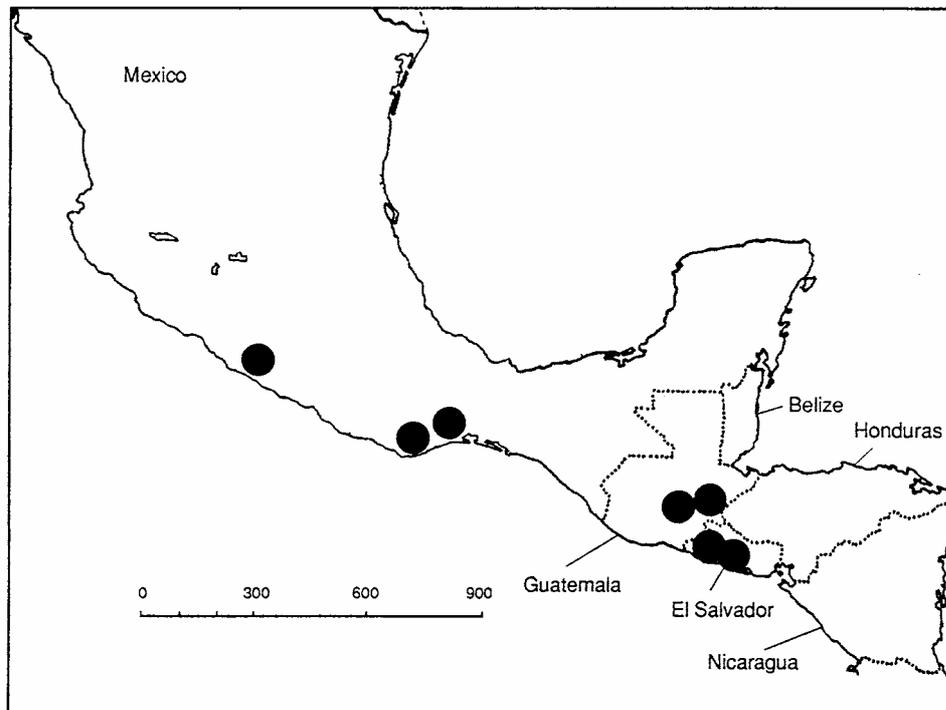
**Inflorescence:**

Scape erect, 20-40cm long. Scape bracts imbricate, leaf-like, their blades to 30cm long and 1cm wide, densely covered with scales. Inflorescence to ca. 30cm long, compound, with 9-30 spirally arranged spikes. Spikes 5-15x1-2.5cm, 5-15-flowered, flattened. Primary bracts red, densely covered with scales, shorter than the spikes. Floral bracts 2-5cm long, green to reddish-yellowish, distichous and densely imbricate, glabrous. Sepals 3-4cm long, glabrous, the outside ones keeled. Petals ca. 5-8cm long, pale lilac, forming a narrow tube. Stamens and style exserted.

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**Distribution:**

Mexico, Guatemala, El Salvador; epiphytic and lithophytic at 200-600m above sea-level.

**Similar species:**

*Tillandsia fasciculata* Swartz has narrower leaf blades, channeled to folded throughout; the smaller leaf sheaths appear dark brown due to less dense covering of scales; in general the plants appear to be grey-green rather than silvery-white (Luther, 1994).

*Tillandsia rothii* Rauh has coarse leaf-blades, greyish-green above, sometimes reddish, scales smaller and more appressed, leaf sheaths less inflated.

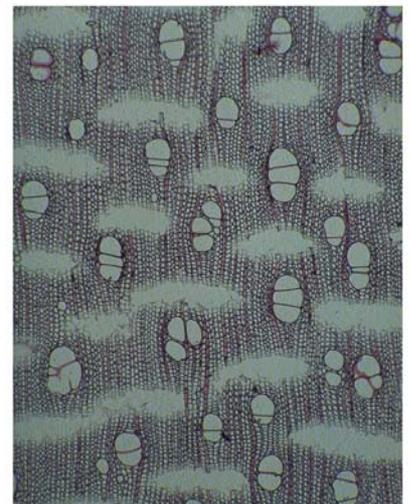
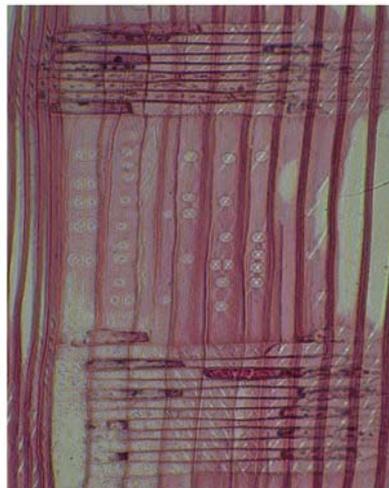
**Remarks:**

A very slow growing species, reported to develop in 12-18 years from seed until flowering, but propagation through offsets is much faster. Plants from Guatemala and El Salvador are smaller and of stouter habit than those from Mexico. Plants collected in the wild often have detritus (leaf fragments etc.) in the leaf-sheaths. Young plants in the trade may be labelled *T. "Fasciculata Blanca"* or *T. "Spharocephala"*. Vegetatively propagated from offsets in large quantities in Guatemala. (Luther, 1994).



## Timber identification

### Introduction



**Illustrations on front page:**

Microscopical sections:

*Fitzroya cupressoides*; transversal section*Araucaria araucana*; radial section*Aquilaria malaccensis*; transversal section

This manual has been prepared under the supervision of Prof. Dr **Margarita Clemente Muñoz**, University of Cordoba.

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**Acknowledgement:**

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## Introduction

More than 100,000 species of plants have been identified as being shrubs or trees with stems or trunks of many different dimensions. Nonetheless, it is estimated that only about 500 of these have value on the international market as timber-yielding species. The wood of trees is either used locally, or is exported for use in countries far from where they grow.

The identification of wood is not always easy, but it is generally possible to the genus level (e.g. this is wood of a species of the genus *Magnolia*) using a light microscope (see page 11 of this chapter). However, in the event of confiscation or legal proceedings it is often necessary to call in an expert. This is also the case for many other species of plants and animals included in the CITES appendices.

The main purpose of this section is to provide regulatory authorities with information and criteria that will allow them to determine whether they are examining one of the timber-yielding species included in the CITES appendices.

The easiest approach to initial identification is to begin with the commercial or common name used to identify the wood. Regularly updated lists of vernacular names are distributed by the CITES Secretariat through Notifications to the Parties (check with the national CITES Management Authority). If a scientific name has been identified, it can be determined whether the species is listed in the CITES appendices. The origin of the shipment is also very useful because frequently the wood is exported from a country within the natural distribution of the species. The geographical distribution of that species should always be checked. If a species included in the CITES appendices is identified, it is advisable to consult the information sheets for this species to verify whether all parts and derivatives are regulated by CITES. Once this has been done, information in the identification sheets on anatomical aspects and similar species should be consulted.

If at this stage there still is doubt about the identification of the specimens under inspection and there is a possibility of microscopic study of the wood, the wood's microscopic characteristics should be compared with the information provided in the identification sheets of the species concerned.

Of course, it is not intended that regulatory officials become specialists in wood anatomy using these identification sheets. In the event of doubt about the identification of a species or in the event of a need to have the opinion of a specialist, the Management Authority should be consulted.

## General characteristics of wood

The naked eye or a 10x to 20x hand lens can be used to identify certain characteristics of a wood sample. Arrangement, size and pattern of the various cell tissues in wood can frequently provide information on the identity. The components of timber wood are described below.

### Wood

Wood is the vascular tissue that forms the trunk, roots and branches of woody plants, but not the bark.

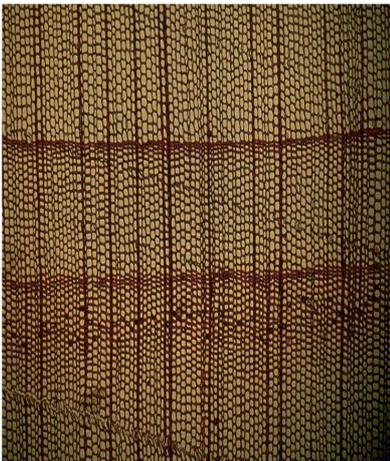
Vascular plants produce specialized conductive tissues called xylem (wood) and phloem (bark). The xylem transports nutrients taken from the soil, mainly water and minerals, from the roots to the leaves. Phloem is responsible for the transport of nutrients formed by the chlorophyll in the leaves to the roots. Wood is produced by perennial plants; plants that grow for a number of years to develop into shrubs or trees.

The typically woody plant has continuous growth in diameter that is independent of growth in length. The commercially traded woody plants are found among the gymnosperms and angiosperms of the spermatophytes (seed plants). Among the gymnosperms only the wood of conifers is of interest for the commercial trade.

Wood is not a homogenous material. It is composed of many different cell types which are organized into different tissues. These tissue cells carry out the three fundamental functions for woody plants: conduction of sap, storage of products and the provision of support for the tree or shrub. This heterogeneity of wood produces some of its defects and also some of its advantages. The macroscopic heterogeneity of wood is recognizable using either the naked eye or a hand lens. Heterogeneity is even more clear using a microscope with magnifications of up to 2000 times.

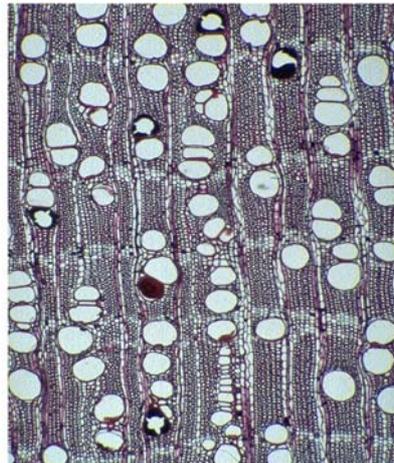
Wood can be divided into:

- ◇ Softwood  
non-porous wood (i.e. conifers) where there are no vessels (a special cell type) for transport of water and nutrients). (Fig. 1).
- ◇ Hardwood  
porous wood (Angiosperms, mostly broad-leaved species), characterized by the presence of vessels. (Fig. 2).



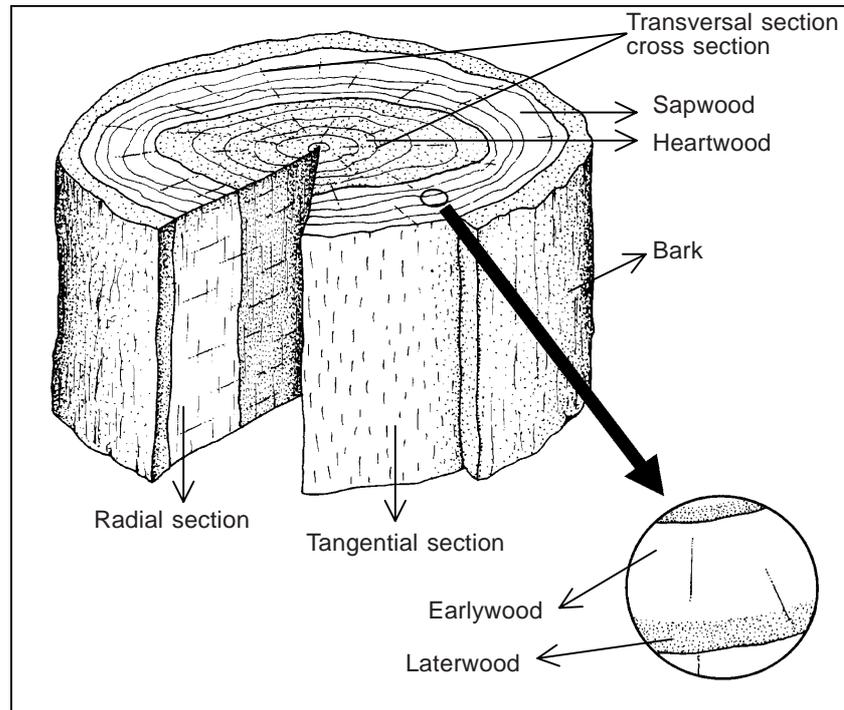
non-porous wood

**Figure 1**



porous wood

**Figure 2**



Schematic drawing showing the transversal, radial and tangential planes used when identifying

**Figure 3**

To understand the heterogeneity of wood, the following three sections have been established for macroscopic or microscopic examination (Figure 3):

- ◇ **Transversal:** perpendicular to the axis of the branch or trunk.
- ◇ **Radial:** passing through the axis and forming a radius of the branch or trunk.
- ◇ **Tangential:** a plane perpendicular to the radial axis.

The examination of the sections of the three planes of a tree trunk can reveal the following easily identifiable distinguishing characteristics:

- ◇ **Bark:** the epidermal tissue; composed of non-functional (dead) phloem cells forming the (outside) protective layer of the tree, and living cells for transporting nutrients.
- ◇ **Cambium:** the thin layer of special cells that produces new wood tissue (to the inside) and new bark tissue (to the outside).
- ◇ **Xylem:** the woody tissue that forms most of the tree trunk; composed of living cells, the sapwood, and dead cells, the heartwood. The heartwood (duramen) is no longer functional for the transport of nutrients. It is easily distinguishable from the lighter-coloured outer area called the sap-wood (alburnum), the living wood tissue.

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## Cell types in wood (xylem)

### Annual or seasonal growth rings

Annual or seasonal *growth rings*\* are in several timber taxa easily distinguishable to the naked eye. Within each growth ring, a distinction can be rather easily made between wood formed in the spring (the so-called spring wood in the case of annual growth rings or early wood in the case of seasonal growth rings) and that formed during the summer (summer wood in the case of the annual growth rings and late wood in the case of seasonal growth rings). (See Fig. 3).

The difference in growth rings is not only expressed by a difference in colour, but also in the distribution of vessels and *parenchyma* or in the thickness of cell walls. This corresponds to the dry season or summer (thick wall; slow growth) or rainy season or spring/summer seasons (thin walls; relatively fast growth). In areas where the seasons are not well defined, a situation which occurs in many areas of tropical forest, identification of growth rings is difficult or not at all possible.

### Heartwood and sapwood

Sapwood, the wood responsible for transporting raw sap, is closest to the outside of the trunk. Usually lighter in colour, the wood of the heartwood and its conductive tissues are mostly free from obstructions by deposits or tylosis. As new layers of sapwood are formed, those closest to the heartwood begin to lose gradually their conductive function.

Frost occasionally inhibits the metabolic processes required for the sapwood to change into heartwood, preventing the formation of the latter. This produces a ringed zone inside the heartwood without colouring that is given the name internal sapwood.

Formation of heartwood is characterized by anatomical and chemical modifications. In the broad-leaved species, *tylosis* are formed: vesicular expansions from the parenchyma cells that penetrate the nearby vessels obstructing them. In conifers, the pits are closed.

In addition to the anatomical modifications that occur during the formation of heartwood, several very important chemical processes occur as well.

In conifers, the coloured heartwood contains much more resin and oil that penetrates the interstices of the cellular wall. This impregnation reduces swelling and loss, and prevents the penetration of liquids. In addition, it contains soluble substances such as carbohydrates, polysaccharides, alkaloids and tannins that give it a dark colour when oxidized.

In broad-leaved species, the chemical phenomena that accompany the formation of heartwood are similar to those of conifers but usually more complex. The heartwood also contains substances soluble in water such as tannins or colorants and often minerals such as carbonate, lime oxalate and siliceous acid. The formation of heartwood protects the wood against fungus infection, by closing the pits and impregnating tissues with substances that have antiseptic properties. This is one of the advantages of the natural use of wood, but is, nonetheless, an inconvenience for artificial impregnation or treatment with chemicals. Not only is heartwood frequently darker but it is also denser and more resistant to attacks by insects, while the exterior part of the trunk, the sapwood, is lighter in colour, more porous, softer, less resistant and therefore often less valuable. Nevertheless, from the point of view of physical manipulation, the sapwood is easier to treat and work, using most of the machining and mechanical processing. Because of this characteristic and because the formation of heartwood is a process that takes many years, younger trees are preferred for use in the chip industry.

\* terms in *italics* are further clarified in the glossary (pages 13 – 20).

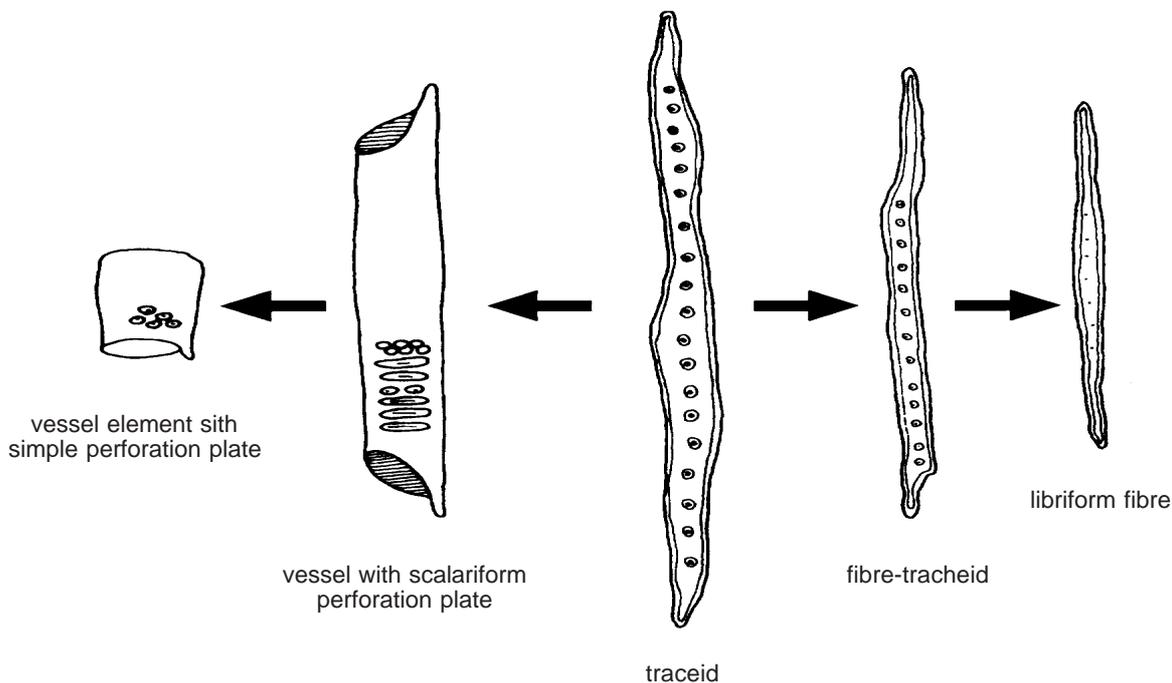


Figure 4

### Fibres and vessels

The main cell components of wood are the “*fibres*”. These cells are very narrow and long, and have a support function. They also determine the strength of the wood. In conifers these “*fibres*” are called *tracheids* (Fig. 4). In the absence of vessels (see below) these tracheids function as support element as well as transport element. To facilitate transport of water and nutrients from the roots to the leaves these tracheids are connected through pores, the *pits*. The shape of these pits (visible only with the help of a microscope) can be helpful in identifying wood of conifers (see Fig. 21).

In the broad-leaved trees fibre-tracheids and libriform fibres (Fig. 4) perform the support function. The transport function has been taken over by vessels (Fig. 4). Vessels are an axial series of cells (the *vessel members*) that form an articulated tube of indeterminate length. The vessel members are much wider than the fibres and are open at the ends. In certain types of woods these openings may still contain bars (*scalariform perforation*) but in most tree species these bars have disappeared completely (see also Fig. 18). The vessels transport water and nutrients from the roots to the leaves. The arrangement of the vessels (single, in radial rows, in groups) and their diameter is a useful characteristic for the identification of timber (see also glossary: *Distribution of vessels*).

The other type of cell found in wood is the *parenchyma* cell. These are small, square to rectangular cells with mainly a storage function. These cells are either found in association with the vessels, or solitary or in groups throughout the wood. The various forms in which the parenchyma is distributed is very useful for the identification of wood (see glossary: *Parenchyma*).

Also composed of parenchyma cells, but with a different function and arrangement, are the *xylem rays* (see below).

All these elements are connected with each other through small perforations in the cell wall; these perforations are called “*pits*”. These pits permit the transport of water and nutrients from one cell to another. Their arrangement and shape can be an important, microscopical, characteristic.

## Xylem rays

The *rays* form continuous strands from the outside of the wood to the centre. Apart from storage, these cells also have a transport function. Rays can be one cell wide or more than 10 cells wide; they can be composed of square cells only, elongated cells only or of both cell types. The various combinations possible are often highly characteristic and very useful for a particular species. The various forms of xylem rays are described and illustrated in the glossary (see *Rays*).

It is sometimes possible to observe in the radial section the rays with the naked eye or a hand lens, in particular when there is a difference in tissue colour or cell-wall thickness. The rays are sometimes darker as in the case of oak and beech. When the rays are very thin or of a colour almost equal to the rest of the tissue, they are not visible. While they are easily visible in oak, beech and holm oak (*Quercus ilex*), they are practically invisible in conifers and in some broad-leaved species such as birch and black poplar, owing to their thinness and slight difference in coloration.

## Other features

### Figure

This term refers to the pattern of wood once it has been sawn and it depends on the texture and the grain, and the manner in which each of these become exposed as a result of the direction of sawing. Grain and figure are both used in different languages for the same type of wood.

### Texture and grain

Texture is a term applied to the relative size and amount of variation in size of the elements. When the wood has large vessels and broad rays, it is described as having a coarse texture. When the wood has small vessels and narrow rays it is described as having a fine texture. An even texture refers to wood with no perceptible difference between the early and late wood. An uneven textures refers to wood where these differences are very evident.

Grain is a term used when referring to the direction of the elements in the wood relative to the longitudinal axis of the trunk.

### Colour

Cellulose, the basic material in the composition of wood, is colourless. Any other colour of wood is determined by the substances deposited in the cellular lumen or impregnated in the cell walls, such as pigments, tannins, resins, gums or by-products that may vary over time due to oxidation. These colours are normally only found in heartwood. Also, taking into account that wood is a fibrous material, the orientation of the fibres produces colour effects through reflection and refraction. It may occur, and indeed it does occur in many species, that reflection–refraction produces shades of colour depending on the intensity of light on the planes of the fibres.

The intensity of colour varies with age. The living wood (sapwood) ranges from a yellowish to sometimes reddish or brownish. When the sapwood is transformed into heartwood, the tones become darker, and differences become more noticeable. The colouring of wood has a wide range that makes it possible to use this variation for decorative effects.



Species currently included in the CITES appendices have the following colours:

<b>Yellowish white</b>	<i>Podocarpus neerifolius</i> <i>Podocarpus parlatorei</i>
<b>Yellow</b>	<i>Aquilaria malaccensis</i> <i>Caryocar costaricensis</i>
<b>Pinkish yellow</b>	<i>Araucaria araucana</i>
<b>Light brown</b>	<i>Abies guatemalensis</i> <i>Oreomunnea pterocarpa</i> <i>Magnolia liliifera</i>
<b>Reddish brown</b>	<i>Platymiscyum pleiostachyum</i> <i>Swietenia humilis</i> <i>Swietenia macrophylla</i> <i>Swietenia mahagoni</i> <i>Prunus africana</i> <i>Taxus wallichiana</i>
<b>Olive-brown</b>	<i>Pericopsis elata</i>
<b>Olive-green</b>	<i>Guaiacum</i> spp.
<b>Violet-black</b>	<i>Dalbergia nigra</i>



*Fitzroya cupressoides*



*Guaiacum* spp.



*Dalbergia melanoxylon*

The following table gives colours of various species that can be used for comparison.

<b>Pink</b>	<i>Picea sitchensis</i> <i>Crataegus oxyacantha</i> <i>Rhamnus zeyheri</i>	<b>Sitcka spruce</b> <b>Hawthorn</b> <b>Pink ivory</b>
<b>Red</b>	<i>Sequoia sempervirens</i> <i>Santalum spp.</i> <i>Schinopsis balansae</i>	<b>Redwood</b> <b>Sandalwood</b> <b>Red quebracho</b>
<b>Reddish yellow</b>	<i>Prunus avium</i>	<b>Cherry</b>
<b>Yellow</b>	<i>Chlorophora tinctoria</i>	<b>Fustic</b>
<b>Greenish</b>	<i>Liriodendron tulipifera</i>	<b>Yellow-Poplar</b>
<b>Blue</b>	<i>Haematoxylon campechianum</i>	<b>Brazilwood</b>
<b>Violet</b>	<i>Peltogyne spp.</i>	<b>Purpleheart</b>
<b>Black</b>	<i>Diospyros spp.</i>	<b>Ebony</b>

The wood of most species darkens with exposure to air and light, owing to oxidation and a reduction in products available for impregnation. Colour is one of the most important characteristics in decorating and furniture-making. In some species, colour can be used for identification, although this criterion must be used with caution. Changes in colour often indicate that a wood is not healthy.

Finally, it must be pointed out that colour is a very subjective quality and often varies within a species and even within a single tree. In spite of this, it is still a characteristic that can be very helpful in the process of identification.

### Odour

Cellulose, the main element of the woody structure, does not produce odour; in other words they do not easily release molecules into the air. As a result, when they do produce a smell it is because of the materials with which the wood has been impregnated or because of the activity of fungi or other micro-organisms in sapwood. Smell can also be attributed to the decomposition of stored products in the parenchyma; products such as carbohydrates, proteins, wax or essential oils. Proteins readily give off an offensive smell when they decompose. This explains why the sapwood of some species, when cut during a hot summer, has a strong and disagreeable smell.

Healthy wood does not usually give off a smell or the smell is too weak to be detected by humans. The smell produced by impregnated substances is more pronounced in green (undried) wood than in wood that has dried. Also, it is more pronounced in heartwood and in recently cut surfaces than in sapwood.

Prolonged exposure to air or water and kiln-drying cushions or eliminates this smell. Smell may be either an advantage or an inconvenience. For example, juniper wood (*Juniperus* spp) emits a smell that repels insects. It is for this reason that it has been used for many centuries for the construction of storage trunks. *Cinnamomum camphora* has the same properties. Cigars are kept in boxes of tropical cedar (*Cedrela* spp.) because of the smell of this wood. In religious and funeral ceremonies, a powder of sandalwood has been burned on the altars in the Orient, because of its pleasant odour. Odour as an identification factor should be used sparingly because it is difficult to define.



## Microscopical analysis of wood

The anatomical characteristics of wood are in most cases only to a limited extent affected by ecological conditions and are therefore of great importance for identification to the genus level regardless of the origin of the specimen.

For the identification of wood using a microscope, it is important to have a useful permanent reference collection of microscopic slides. It is also important to have an adequate collection of reference books describing the characteristics of other commonly traded timber species that are not included in the CITES Appendices. There are specialized institutions that have collections of this type of material.

Preparing these microscope slides is the work of a specialist and few regular customs offices have the appropriate equipment and their disposal. A brief explanation on how to prepare wood samples for microscopic analysis is included in Annex 1 to this section.

It is important to realize that these microscopic slides are also treated with colorants, to ensure a better contrast between the various elements composing the wood. This also explains why the microscopic slides have a colour that is completely different from that of wood sample.

### General remarks

The glossary following these paragraphs provides explanations and illustrations of the various elements composing wood. Only the most relevant wood elements have been illustrated.

This glossary should be used together with the description of the wood of the species currently included in the appendices. These descriptions are included at the end of this section.

It is important to note that the information provided in for verification purposes only. From the list of "similar species" it is clear that there is sometimes a great similarity in the wood in trade. The origin of the shipment may help to eliminate some of these similar species.

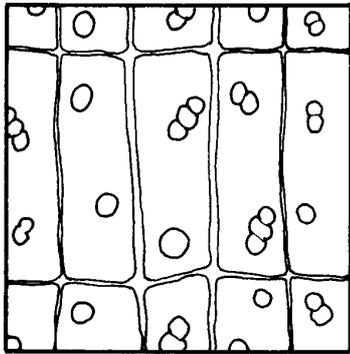
There may also be differences in the technical properties of the wood. Again, to determine these, the assistance of specialized laboratories is required.





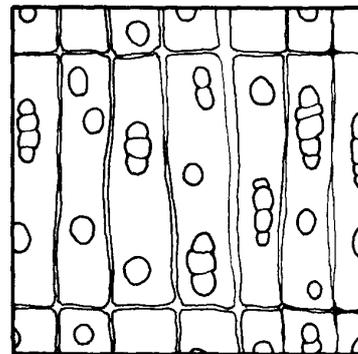
## Glossary of terms used to describe wood

**Distribution of vessels:** This refers to the way in which vessels are seen in transversal section: solitary, oblique multiples, arranged radially or in groups.



vessels solitary and in oblique multiples of 2 to 3

Figure 5

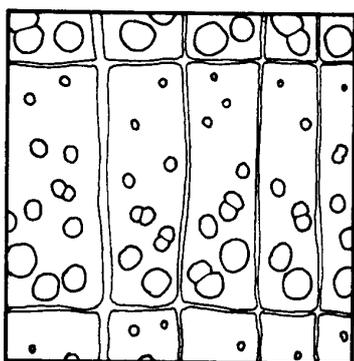


vessels solitary and in radial multiples of 3 to 5

Figure 6

**Ring porous wood:** Hardwood in which the pores of the spring or early wood are noticeably larger than the fall or late wood, forming a well-defined area or ring (Fig. 7).

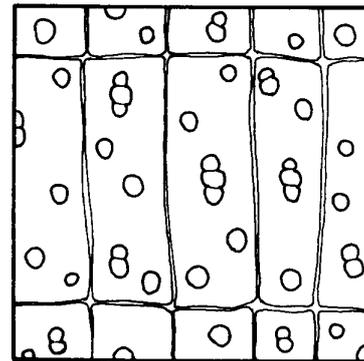
**Diffuse porous wood:** Hardwood in which the dimensions and distribution of the pores are similar throughout the growth ring (Fig. 8).



ring porous wood

Figure 7

→ spring wood ←



diffuse porous wood

Figure 8

**Fibres:** A common term in the description of wood for any long and narrow cell of wood other than vessels and the parenchyma. In broad-leaved species, there are two basic types of fibres: libriform fibres and fibre-tracheid (Fig. 4).

**Fibre-tracheid:** Imperforate elements present in broad-leaved trees similar to a tracheid that usually have thick walls with small pitting (Fig. 4).

**Libriform fibre:** Imperforate elements usually with thick walls that have a simple pit in the longitudinal walls, (Fig. 4).

**Growth rings:** The concentric layers of wood produced during a single period (annual or seasonal) of growth of a tree.

**Early wood:** Wood formed inside a growth ring during spring and summer growth in temperate countries and during the rainy season in tropical countries. This is characterized by cellular elements of various diameters and large lumens with thin walls when viewed in transversal section.

**Late wood:** Wood formed within a growth ring during the end of the summer and autumn in temperate countries or during the dry season in the tropics. This wood is characterized by cellular elements of small diameters and lumens, as well as thickened walls when compared with early wood in a transversal section.

**Heartwood:** The central cylinder of a tree trunk, consisting of internal layers of wood. Heartwood contains no living cells. The dead cells are often used to store reserve materials which have been converted into heartwood substances. Heartwood is normally darker in colour than sapwood, although the difference is not always readily identifiable (see also sapwood).

**Idioblast or oil cell:** A special type of cell larger than the others found in the rays of broad-leaved trees and that contain oily substances. This type of cell is characteristic for some plant families.

**Intercellular canal:** Tubular intercellular space of indeterminate length that contain substances (gums, resins, etc.) produced by the epithelial cells that surround them. These canals can be a natural characteristic of the wood, but may also develop following damage caused by external factors (e.g. insects).

**Lumen:** The space enclosed by a cell wall.

**Micron ( $\mu\text{m}$ ):** A unit of measurement in the metric system used for measuring cell components. It is one thousandth of a millimetre.

**Parenchyma:** Tissue formed by square or rectangular cells with simple pitting and whose main function is storage and distribution of food materials. The woody parenchyma can be divided into categories or types, which, in turn, can be further subdivided.

**Apotracheal parenchyma:** Tissue is arranged independently from the pores or vessels. (Figures 9 - 12).

- a) **Banded apotracheal:** Axial parenchyma forming concentric lines or bands, as seen in cross section.
- b) **Diffuse apotracheal:** One or a few cells distributed irregularly among the fibres (Fig. 9).
- c) **Diffuse-in-aggregates:** The cells tend to grouped in short tangential groups (Fig. 10).

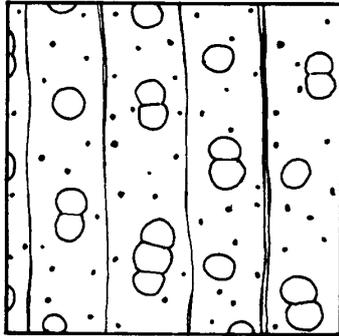


Figure 9

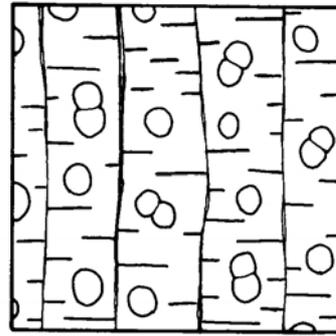
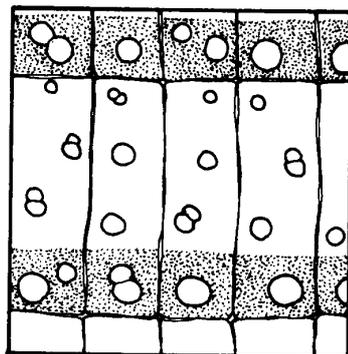


Figure 10

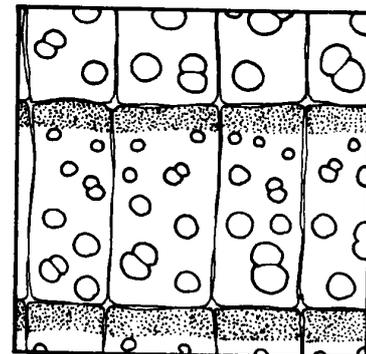
- d) **Marginal:** Parenchyma cells occurring either singly or forming a more or less continuous layer of variable width at the beginning of a season's growth (Fig. 11; initial parenchyma) or at the close of a season's growth (Fig. 12; terminal parenchyma).



marginal (initial) parenchyma

Figure 11

→ spring wood ←

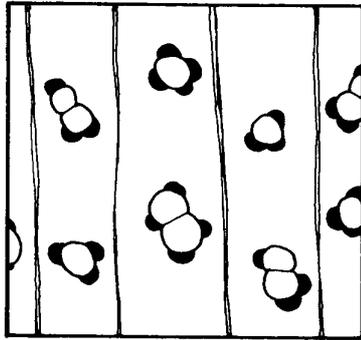


marginal (terminal) parenchyma

Figure 12

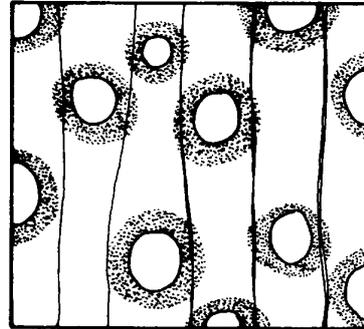
**Paratracheal parenchyma:** When the tissue is associated with the vessels. This can be divided into the following main types: (Figures 13 - 17).

- Scanty paratracheal:** When the cells of the parenchyma are randomly arranged around the pores (Fig. 13).
- Vasicentric paratracheal:** Forming a complete sheath around the vessels of variable width, circular or slightly oval (Fig. 14).



scanty paratracheal parenchyma

Figure 13



vasicentric parenchyma

Figure 14

- c) **Aliform/confluent paratracheal:** When the cells form extensions in the form of wings or when the wings become coalescent joining two or more pores without forming long, continuous bands (Fig. 15 and Fig. 16).

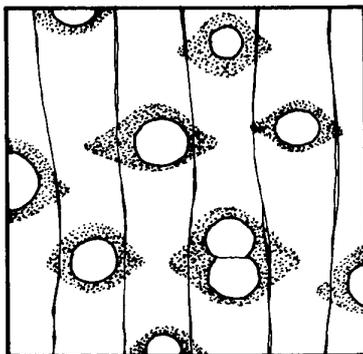


Figure 15

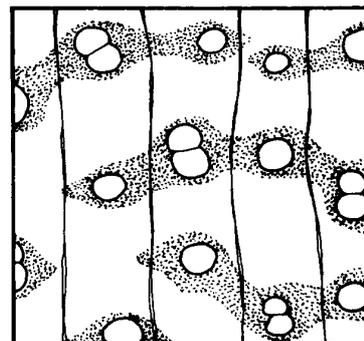
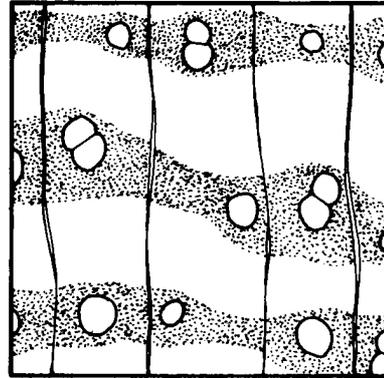


Figure 16

- d) **Banded paratracheal:** Associated with the vessels, forming concentric bands. (Fig. 17).



banded parenchyma

Figure 17

**Perforation plate:** An opening between two vascular elements. There are four types of perforation plates: simple, scalariform (a plate with multiple perforations elongated and parallel, the remnants of the plate between the openings are called “bars”), reticulate (a plate with multiple perforations having a net-like appearance) and foraminiate (a plate having a small group of circular openings). The first two types are the most frequent.

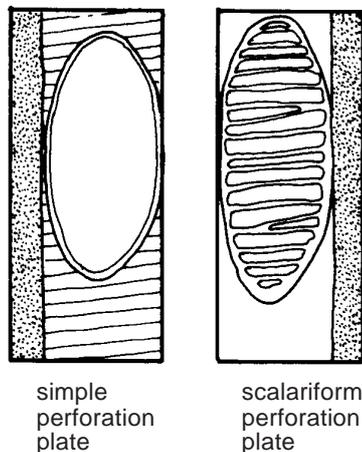
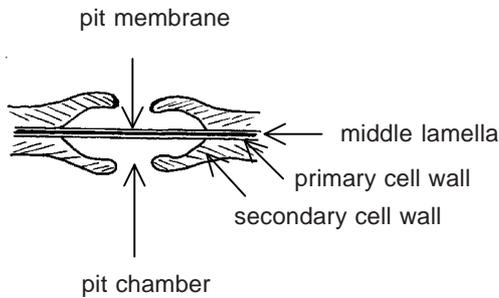
simple  
perforation  
platescalariform  
perforation  
plate

Figure 18

**Phloem, included:** A patch of phloem surrounded by secondary wood produced by abnormal secondary growth.

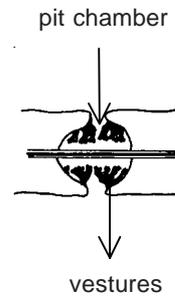
**Pit:** A perforation in the secondary wall of the cell, opening internally in the cell lumen, ending in the primary cell wall or pit membrane; a pit is usually connected to a similar pit in the wall of the adjacent cell. The two corresponding pits provide the possibility of transport of nutrients from one cell to another.

**Bordered pit:** A pit in which the membrane is overarched by the cell wall, forming a cavity, perforated at the tip leaving underneath a space or chamber. (Figure 20).



bordered pit

Figure 19



vestured pit

Figure 20

**Cross-field pits:** The area defined by the intersection of the walls of a longitudinal tracheid with a radial parenchyma cell. This is one of the most useful microscopic characteristics for the identification of non-porous wood. At the point of intersection, five types of pits can be identified that characterize the main groups of conifers: piceoid (*Picea*, *Larix* and *Pseudotsuga*); cupressoid (*Cupressaceae*); taxodioid (*Sequoia* and *Taxodiaceae*); pinoid (*Pinaceae*) and fenestrate (*Pinaceae*). (Figure 21).

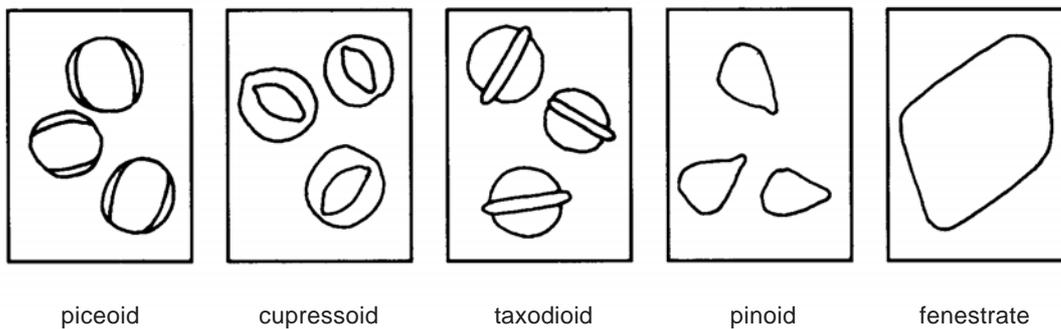
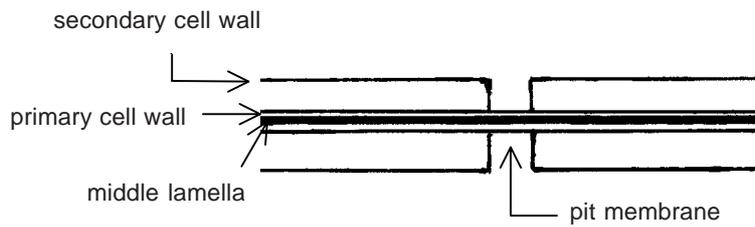


Figure 21

**Intervascular pit:** Pits or small perforations in the walls between vessels. According to their arrangement in the walls of the vessels, the intervacular pits can be classified as scalariform, opposite and alternate.



**Simple pit:** Simple interruption of the secondary wall that gives on to the cell lumen and does not form a cavity.



simple pit

Figure 22

**Vestured pit:** A bordered pit with the pit cavity wholly or partially lined with projections from the tertiary cell wall. (Figure 20).

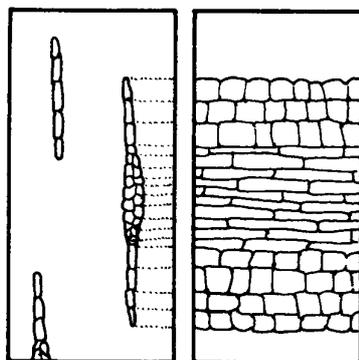
**Pore:** A common term for the transversal section of a vessel.

**Rays:** The series of parenchyma cells formed by the cambium that extend radially throughout the wood.

The descriptions below refer to individual ray types. There may be combinations or several types in most species of wood.

**Aggregated ray:** A group of woody rays that give the impression of being a very wide single ray.

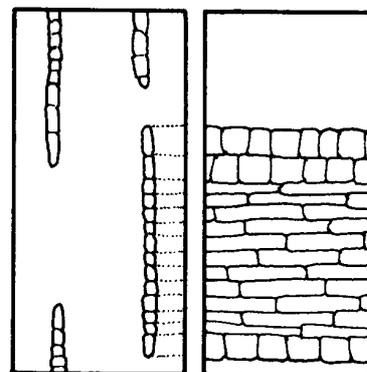
**Heterocellular ray:** A ray formed by more than one type of cell. (Figures 23 and 24).



tangential

radial

Figure 23

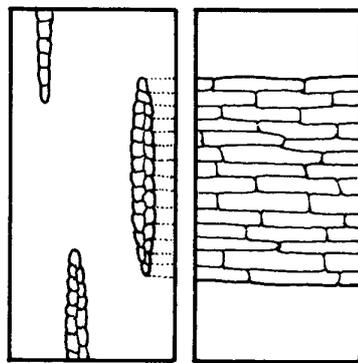


tangential

radial

Figure 24

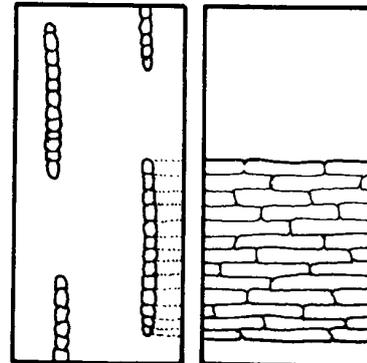
**Homocellular ray:** A ray formed by a single type of cell. (Figures 25 and 26).



tangential radial

multiseriate

Figure 25



tangential radial

uniseriate

Figure 26

**Multiseriate ray:** A ray more than one cell in width (seen in a tangential section) (Fig. 23 and 25).

**Uniseriate ray:** A ray only one cell in width (seen in the tangential section) (Fig. 24 and 26).

**Sapwood (alburnum):** The younger, softer living or physiologically active outer portion of wood that lies between the cambium and the heartwood. It is more permeable, less durable and usually lighter in colour than the heartwood.

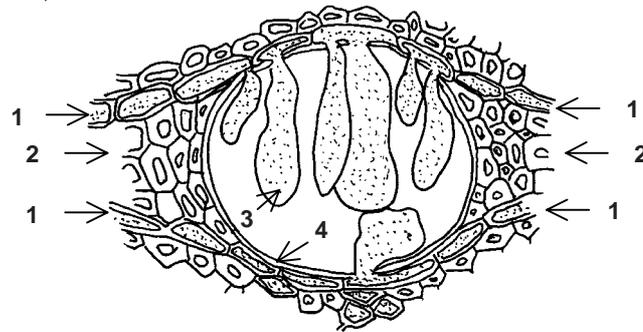
**Storied:** A term used to describe the axial cells and rays when these are arranged in horizontal series as seen on tangential surfaces.

**Tracheid:** The imperforate conducting element of non-porous wood (conifers) that also fulfils the mechanical function of support; of relatively large dimensions characterized by the presence of ordered pits in its walls. The tracheids are the elements used to move water and nutrients from the soil to the green parts of the plant (Fig. 4).



**Tylosis:** An outgrowth from an adjacent ray or axial parenchyma cell through a pit cavity in a vessel wall, partially or completely blocking the vessel lumen.

1. Parenchyma cells
2. Libriform fibres
3. Tylosis
4. Vessel wall



tylosis

Figure 27

**Vessel frequency (porosity):** The number of vessels per square millimeter in a transversal section (see also: Distribution of vessels).

**Vessel member:** The special cell elements that have coagulated to form an articulate tube-like structure of indeterminate length (see also Fig. 4).





## Annex

Given the fact that wood is an object with a certain hardness (some more than others), wood offers resistance to being cut and thus most woods must be specifically treated to be soft enough to make very thin slices of it. Normally small samples of wood, usually 1 cubic centimetre, are used. This means pieces with faces of approximately 1 centimetre square, although slightly larger samples may be used.

There are several chemical treatments used to soften wood including a mixture of acetic acid and hydrogen peroxide as well as nitric acid. Most specialists prefer to boil samples in water over a period of two to four weeks for wood of medium hardness. Although empirical, the method used to determine whether a wood sample is ready to be sliced in thin sections is to firmly pass a thumbnail across a transversal section of the wood. If the wood registers a mark, the sample is ready for slicing. If there is no mark, then the wood should be boiled longer.

Once the sample has reached the correct softness for sectioning or cutting, it should be stored in a covered container in a mixture of distilled water and glycerine in equal proportions, especially if the sample is not going to be cut immediately.

In order to make precise cuts, it is necessary to have a sliding microtome, because the samples, although softened, always offer some resistance that can cause the knife's carriage to raise and lead to an accident (a too thick slice).

Before beginning an explanation of each of the characteristics that make possible the identification of wood, it is necessary to point out that there are three sections or basic planes used for the identification of the structures (see also figure 1).

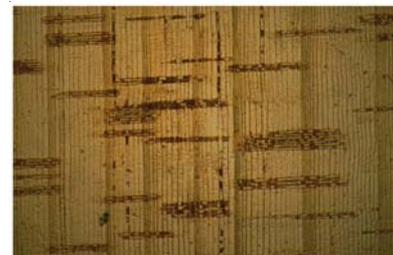
- ◇ **Transversal section:** With the help of a magnifying glass, identify the cross section in which the vessels or pores of broad-leaved trees or the tracheids, in the case of conifers, are cut in cross section and appear as small holes and the woody rays as lines that cross them. Once identification has been made, the sample is positioned in order that the knife is perpendicular to the axial parts and parallel to the woody rays.
- ◇ **Tangential longitudinal section:** Using a magnifying glass, look for the surfaces of the sample that have axial elements running parallel to the surface and wood rays arranged in bunches or short lines.
- ◇ **Radial longitudinal section:** With the help of a magnifying glass, inspect the faces of the block with the axial elements in the same direction and the wood rays forming light and dark bands.



transversal or cross section



tangential section



radial section





## Technical properties

### A. Toughness

The combination of the various types of cells that compose the total structure of wood, also offers a means to identify species or groups of species. The combination of cell types make a particular wood very suitable for flooring, but not for construction, for making wooden shoes but not for exterior wall decoration (bridges, walls of ditches) or for use inside only, etc. This section is rather technical but certainly relevant in wood identification.

Toughness is the quality of resistance of a particular wood to penetration by another specific body. A more technical definition is that hardness is the resistance of a surface to aggression at a very localized point.

In wood, hardness is especially important in relation to the ease or difficulty that a surface offers to being worked with tools (adze, axe, saw or chisel).

Toughness, like other properties of wood, varies depending on the direction of the fibre in the surface in question.

Axial toughness is usually 1.5 to 2.5 times the hardness of the surface perpendicular to the fibre. There is little appreciable difference between tangential and radial toughness. In addition, toughness quickly decreases with an increase in humidity.

In summary, the toughness of wood is directly proportional to specific weight and is a reliable key to identification, taking into account seasonal variation.

### B. Density (or specific weight)

In spite of variation such as the influence of humidity within a species, this characteristic is a very useful complement for the identification of species of wood. In cases where density is extreme (<0,35 or > 0,9 g/cm<sup>3</sup>), this physical property is very important.

The property of specific weight, namely the physical relationship between weight and volume, has special characteristics that, for wood, are used in a practical interpretation.

It should be kept in mind that specific weight (in the metric system) is the weight of a cubic centimetre of material compared to the weight of one cubic centimetre water but relative specific weight, for wood used as "its density" is the relation between weight and volume. In the timber industry, this is a very important characteristic of wood.

By definition, Density is:  $\rho = \frac{\text{weight (in kg)}}{\text{volume (in m}^3\text{)}}$

For wood, volume and weight are influenced by ambient humidity. In order to obtain comparable results, it is necessary to specify the conditions of ambient humidity under which the measurements determining the density are made. As reference points, rates of 0 per cent and 12 per cent humidity are used as a standard, but other humidity values are used as well.

The value found at 0 % humidity is called anhydrous weight and that found at 12 per cent humidity is called normal specific weight. They are represented in this text by  $\rho_0$  and  $\rho_{12}$ , respectively.

With regard to volume, wood being the porous body that it is, will have an apparent volume and a real volume. What is left after discounting the interior spaces (eliminating the volume of intercellular spaces and that of the space in individual cells, but also the ultramicroscopic ones; in fact, any space that can be infiltrated by a liquid like water) is called real volume. The one including the interior spaces is called apparent volume.

Any increase in volume caused by increased humidity is slight. It increases until the wood reaches a percentage of humidity that corresponds to the point of saturation of the cell wall; (water or preserving liquids) approximately 30 per cent for all the species for which technical calculations are made. After this point, volume remains constant because the water that penetrates the lumen of the cells does not produce a swelling of the cell wall. The value of 30 per cent is a value to be used in practice, although each species has a specific saturation point for its cell walls. This makes wood, once it has been treated properly, such an excellent material for utilization under many different conditions related to the different properties of the species used.

These standards are not constantly applicable, since for some woods volume continues to increase until reaching a maximum of water content for the species.

### **Commercial specific weight**

Commonly known as the commercial density, commercial specific weight is an approximate value used for calculations in commercial transactions. This usually refers to dry wood at ambient humidity.

The following values are used as standards (expressed in kg/m<sup>3</sup>):

Resinous	520
Tropical broad-leaved trees for growth	850
Tropical broad-leaved trees for sawing	900

Various studies have shown that the specific weight of summer wood in conifers is equal to approximately 2.5 times that of spring wood. As a result, the apparent specific weight of conifers depends on growth conditions.

### **Magnitudes**

Weight is measured using sufficiently sensitive scales and applying pertinent standards. Weight is measured with accuracy to within 0.01g.

Humid weight is determined directly in the first instance, and then is corrected to the value for a humidity of 12 per cent.

Anhydrous weight is obtained by drying a sample in an oven at 103° ( $\pm$  2°C), until a constant weight is reached, indicating that the wood has no more water to lose.

Volume may be measured using two different methods: the stereometric method - the direct measurement of the dimensions of a sample - or the method using the displacement of a liquid or gas of known specific weight. The first method requires the careful preparation of the sample in order to avoid cracks or bulges. The measurement of precise dimensions is difficult and complicated. In light of this, this method is not usually used; the method of displacement is preferred.

Measurement by displacement is basically the use of a wood sample to displace a volume of liquid that is measured as accurately as possible. Interaction between the displaced fluid and the sample whose volume is being measured has an important influence on the result. The hygroscopic characteristics of wood make the use of water inadvisable. The use of substances as grease, oil and paint to prevent the wood from absorbing water does not really overcome the inconveniences of this method.

Mercury is usually used to determine apparent volume of wood by displacement as well as helium which has small molecules that are neither absorbed nor retained by wood to determine real volume.



# Turbinicarpus alonsoi

Glass &amp; Arias 1996

**Common names:** none

**Scientific synonyms:** = *Pediocactus alonsoi* (Glass & Arias) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Rosette-like, grey cactus with elongated, distinctly angled and keeled tubercles of hard consistence and non pungent, rather soft, curved and twisted, dehiscent spines. Seedlings quite different, dark green with rounded tubercles and small, white, recurved radial spines. Found in deep canyons, on steep, gravelly slopes with sparse vegetation.

---

**Roots:** Stem base and roots forming a napiform unit.  
**Stem:** Solitary, flattened, 6-9 cm Ø, divided into tubercles.  
**Tubercles:** Angled, 15 mm long, 13 mm wide at base, slightly keeled on both surfaces, ± glaucous to grey-green in colour, becoming corky from the tip towards the base when ageing.  
**Areoles:** Apical, large, bearing reddish brown wool, turning grey with age, later becoming naked and spineless.  
**Spines:** 3-5, to 20 mm long, flattened, cardboard-like, grey with darker tip, non-pungent, irregularly curved inwards, dehiscent.  
**Flowers:** 25-38 mm long, 20-30 mm Ø, cerise to rose-magenta, from the centre of the stem apex.  
**Fruits:** Up to 10 mm long, to 5 mm Ø, smooth, reddish purple, opening by 1 or 2 longitudinal slits.  
**Seeds:** 1 mm long, 0.75 mm wide, seedcoat black, tuberculate.  
**Juvenile specimens:** Globular, dark green, shiny, tubercles rounded, not elongated, spines short, white, appressed and recurved.

**Distribution:** State of Guanajuato, Mexico.



**Trade:** This species has been accidentally discovered in 1994 by Alonso García Luna, a young Mexican horticulturist, for whom it was named, during a fieldtrip to the region of Xichu in northeastern Guanajuato. It immediately became one of the most thought after cacti. The discovery and immediate publication caused quite some sensation among collectors for the big stem size and the flower, which is exceptionally coloured for the “Turbinicarpus” in a strict sense. The species was and still is artificially propagated in very high numbers in Czech Republic and subsequently was traded also in Germany and other European countries. A single nursery in Czech Republic produced as much as approximately 40'000 seeds in 1998, only two years after publication of the species. Grafted seedlings and seeds are already quite common in international trade, but at the same time, the wild population has suffered a lot from illegal collecting. The species has almost disappeared from sites near the road, where it has been abundant in 1995 (pers. observation). Artificial propagation works very well and with grafting of seedlings, a second generation can be produced in less than a year. All material, motherplants and possibly seeds, has been exported illegally from Mexico. The only legal offspring outside Mexico (a very small proportion of the whole contemporary production) is produced in a few places from confiscated specimens. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** Young specimens of *Obregonia denegrii* are similar to some extent, but have distinctly ascending to appressed, green and smooth tubercles, whereas *Turbinicarpus alonsoi* has spreading, porrect, rather grey tubercles, forming a more open rosette. Comparison is also with *Ariocarpus*, but these usually lack spines. In deed, *T. alonsoi* was compared with *Obregonia* and *Ariocarpus* at first sight.

**Bibliography:** Glass, C. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): Turbinicarpus im Bild. Mitteilungen der Turbinicarpus-Gruppe 9.  
Zachar, M., R. Staník, A. Lux, I. Dráb (1996): Rod Turbinicarpus. Vydavatel'stvo Roman Stanik. Bratislava.



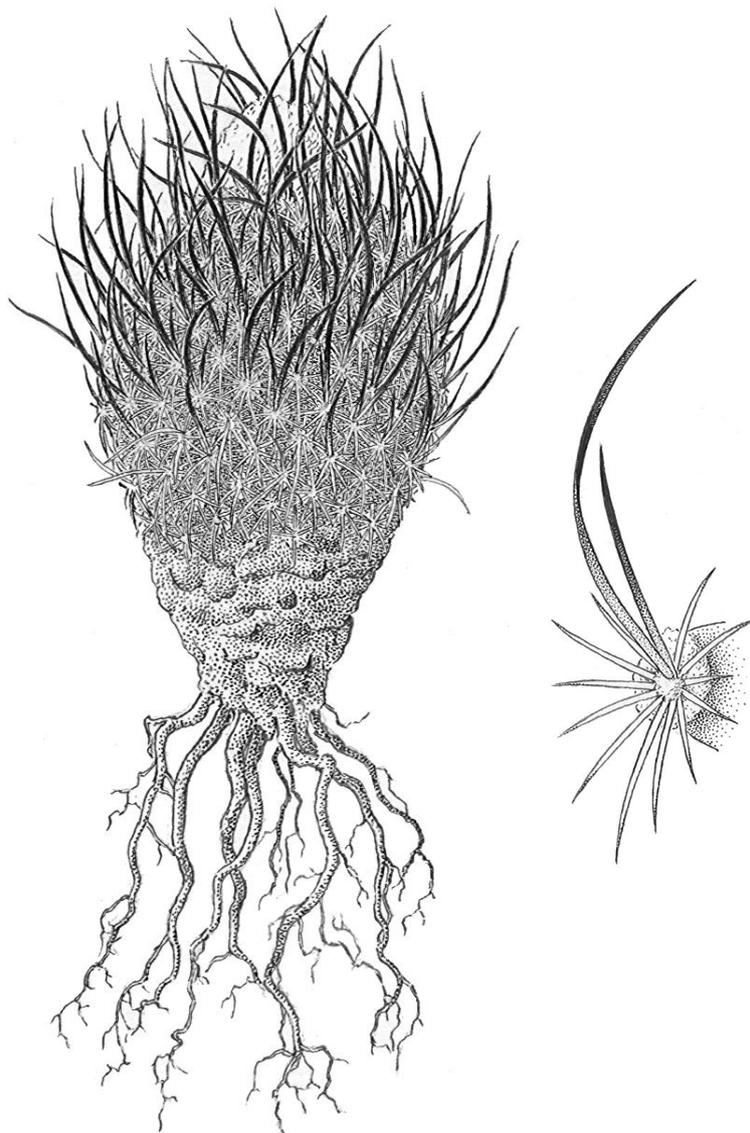
# Turbinicarpus dickisoniae

(Glass &amp; Foster) Glass &amp; Hofer 1997

**Common names:** none

**Scientific synonyms:** = *Turbinicarpus schmiedickeanus* var. *dickisoniae* Glass & Foster 1982  
= *Neolloydia schmiedickeana* var. *dickisoniae* (Glass & Foster) E. F. Anderson 1986  
= *Pediocactus schmiedickeanus* var. *dickisoniae* (Glass & Foster) J. J. Halda 1998  
= *Turbinicarpus gracilis* ssp. *dickisoniae* (Glass & Foster) Panarotto 1999

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Dwarf globular cactus with non-pungent, strikingly dimorphic spination: Juvenile phase densely covered with white, radiating spines. Adult specimens with additional long, thin, ascending, curved and twisted, strongly contrasting dark central spines in the apical region. Grows in fissures of nearly naked limestone outcroppings.

---

Roots: Fibrous, from a short napiform stem base.  
Stem: Solitary, globose to slightly elongated with age, 2.5-3 cm Ø, dark shiny green.  
Tubercles: 3-5 mm long, thick, obtuse.  
Areoles: Bearing some long, white, cobwebby, dehiscent wool, becoming naked with age.  
Spines:  
    Radial spines: 18-23, ca. 2.5 mm long, finely acicular, white, slightly recurved, radiating.  
    Central spines: 1-3, the lowest longest, 13-22 mm long, the upper ones if present ca. 7 mm long, very thin, dark brownish-grey, almost terete, somewhat flexible, ascending, slightly incurved to tortuous, almost circular to slightly flattened in cross-section.  
Flowers: From the centre of the stem apex, yellowish-white, rather narrowly funnel-shaped, ca. 20 mm long, 17 mm Ø.  
Fruits: Small, opening by a longitudinal slit.  
Seeds: Ca. 1 mm long, ovoid, with black, finely tuberculate surface.  
Juvenile specimens: Completely white in appearance, lacking dark central spines.

**Distribution:** State of Nuevo León, Mexico.



**Trade:** Local endemic, known from a single locality in the valley of Aramberri, southern Nuevo Leon. Named for Shirley Dickson, a cactus collector from Texas. Heavily collected for international trade after its discovery, but seemingly recovering. Artificial propagation works very well from seeds and is fastest by grafting seedlings, what allows production of a second generation in less than a year. The species is fairly common in collections today and demand therefore is rather moderate. Nurseries registered for artificial propagation: Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Obvious comparison is with *Turbinicarpus schmiedickeanus* (Bödeker) Buxbaum & Backeberg with its various subspecies, from all of which it differs notably by retaining the radial spines in adult stage and by the non-papery nature of its central spines. *T. schmiedickeanus* ssp. *gracilis* (Glass & Foster) Glass, maybe comes closest superficially and is also a close geographical neighbour. Apart from the already mentioned differences, ssp. *gracilis* has distinctively longer, more slender tubercles.

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
Glass, Ch. E. (1998): *Identification Guide to Threatened Cacti of Mexico*. Fideicomiso Fondo para la Biodiversidad. Mexico.  
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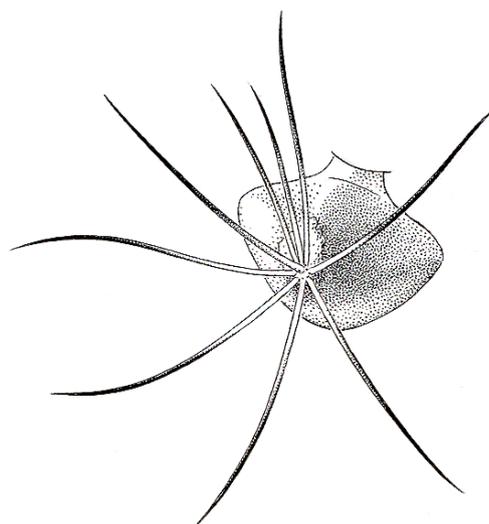
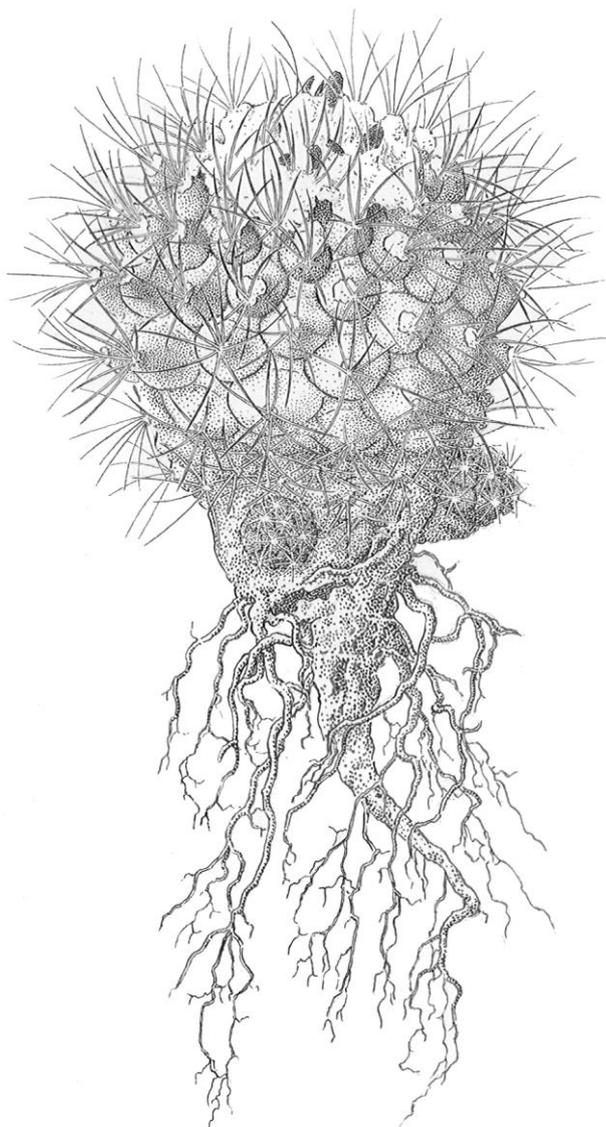
# Turbinicarpus gielsdorfianus

(Werdermann) John &amp; Riha 1983

**Common names:** none

**Scientific synonyms:** = *Echinocactus gielsdorfianus* Werdermann 1929  
= *Thelocactus gielsdorfianus* (Werdermann) Borg 1937  
= *Gymnocactus gielsdorfianus* (Werdermann) Backeberg 1951  
= *Neolloydia gielsdorfianus* (Werdermann) Knuth 1935  
= *Pediocactus gielsdorfianus* (Werdermann) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:**

Quite distinctive, small, globular, clustering, rather few-spined cactus with a very characteristic, pale whitish- to bluish-green stem colour and rather sharply angled tubercles, which are notably separated from each other at the base by very distinctive, fine, sinuated folds. Stem apex with conspicuous white wool, spines sharply bicoloured, white at the base with black tips. Grows in fissures of nearly naked limestone outcroppings.

---

**Roots:** Fibrous.  
**Stem:** Clustering, forming small groups, globose to ovate to shortly cylindric, 5-7 cm high, 4.5-5 cm Ø, pale, dull whitish- to bluish-green, apex covered with white wool.  
**Tubercles:** 6 mm long, ca. 5 x 5 mm and ± sixangled at the base, conical to pyramidal, with rather sharp angles, with apical areole.  
**Areoles:** Elliptic, 2 mm Ø, with thick, white wool, especially in the upper, adaxial, floriferous portion of the areole, eventually becoming naked.  
**Spines:** Not obviously dimorphic, all interpreted as radial spines by some authors.  
    **Radial spines:** 6 (-8), to 20 mm long, acicular, radiating, spreading, straight to slightly recurved, strikingly and rather sharply bicoloured, with white base and brown to black tip, later turning grey.  
    **Central spines:** 0-1, porrect to ascending, from the centre of the areole, similar to the radial spines.  
**Flowers:** From the centre of the stem apex, funnelform, 2-2.5 cm long, ca. 2 cm Ø; yellowish-cream coloured.  
**Fruits:** Green, 5-6 mm long, 3-4 mm Ø, opening by a longitudinal slit.  
**Seeds:** 1-1.2 mm long, about 1 mm Ø, with black, finely tuberculate surface.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Local endemic, known from a single locality in central San Luis Potosí. Named for K. Gielsdorf, investigator with the Botanic Garden and Museum of Berlin-Dahlem, Germany. The species is well represented in collections for a long time and easy to propagate from seeds or vegetatively by detaching and rooting branches. Demand therefore is rather moderate. Some extreme collectors of the genus however could try to obtain new material from the recently rediscovered habitat. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Switzerland P-CH-1001.

**Similar species:** The species is quite easily identified for its characteristic, pale stem colour, well limited tubercles and bicoloured spines. The most similar, also clustering taxa are *Turbinicarpus viereckii* (Werdermann) John & Riha and *Turbinicarpus horripilus* (Lemaire) John & Riha, which always show pronounced central spines and rather leaf-green stems.

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
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Hunt, D. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.



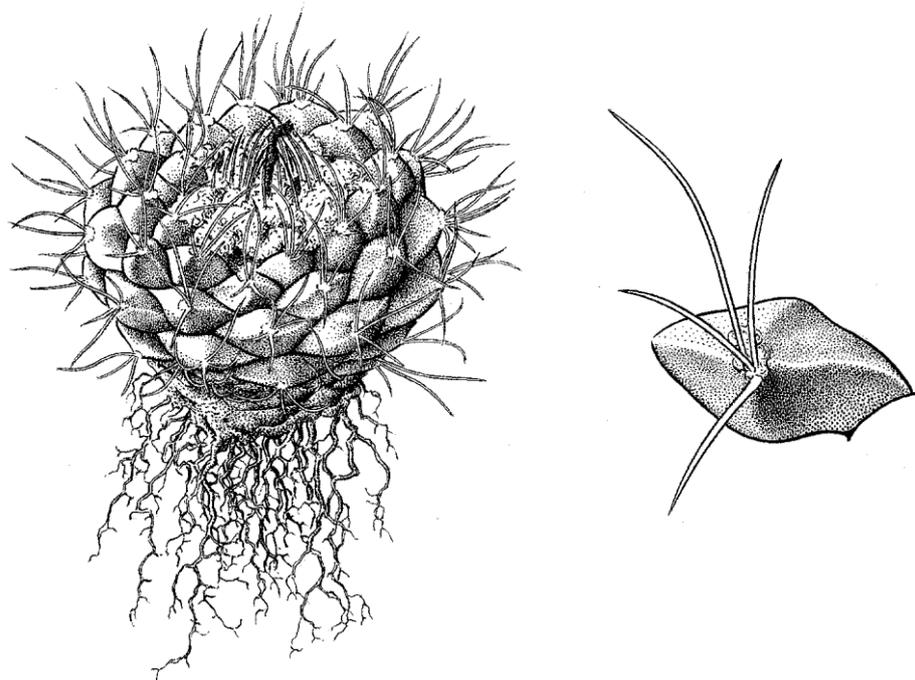
# Turbinicarpus hoferi

J. Lüthy &amp; Lau 1991

**Common names:** none

**Scientific synonyms:** = *Pediocactus hoferi* (J Lüthy & Lau) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:**

- Small, disk-shaped, distinctly whitish-green, hard textured, few-spined cactus with rather short, rhomboidal tubercles and acicular spines. Grows on nearly naked gipsium slopes.
- Roots:** Fibrous, from a short, napiform stem-base.
- Stem:** Disk-shaped, apex strongly flattened, 3-5 (-7) cm Ø, greyish- to whitish-green.
- Tubercles:** Broadly rhomboidal, 4-10 mm x 4-7 mm, 4 mm high, with notably keeled upper and lateral edges.
- Areoles:** Apical, round, 1 mm Ø, young areoles with some white wool.
- Spines:** 4-7, slightly flattened in cross section, stiff, acicular, grey with darker tip. 0-2 lateral, 0-1 directed downwards, 3-5 mm long, 1-3 ascending, slightly curved and twisted, up to 2 cm long.
- Flowers:** From the centre of the stem apex, up to 25 mm long, 15-20 mm Ø, broadly funnelform, white.
- Fruits:** 5-7 mm long, 3.5-4 mm Ø, greenish, drying and opening by a longitudinal slit.
- Seeds:** 0.9 mm long, 0.7 mm broad, 0.5 mm thick, with dark brown, finely tuberculate surface.
- Juvenile plants:** 6-13 white radial spines, 2 (-3) mm long, spreading, pectinate, no central spines.

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**Distribution:** State of Nuevo León, Mexico.



**Trade:** Local endemic, known from a single locality in southern Nuevo Leon, in the valley of Aramberri, where it was accidentally discovered in 1988 by the Swiss collector and expert of the genus Anton Hofer, for whom it was named. Heavily collected for international trade soon after its discovery. The only known population has been significantly reduced. Rather difficult to grow from the minute seeds, extremely slow growing, even when grafted, probably the most difficult species of the genus. Not yet well distributed in collections and in quite some demand by collectors focusing on the genus *Turbinicarpus*. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, Switzerland P-CH-1001.

**Similar species:** Some other taxa of *Turbinicarpus* show similar, finely acicular spination and can be confounded with *T. hoferi*, especially if flowers are lacking. *Turbinicarpus swoboda* L. Diers (stem usually not as flattened, often with a brownish hue, flower shorter, yellowish), *Turbinicarpus lophophoroides* (Werdermann) Buxbaum & Backeberg (tubercles more rounded, less and shorter spines; 3-5, to 1 cm, flower bigger, 3.5 cm Ø), *Turbinicarpus laui* Glass & Foster (stem glossy green, spines spreading, regularly radiating, slightly recurved, flower pink, 3.5 cm Ø). Further, *Strombocactus disciformis* (De Candolle) Britton & Rose looks very similar, but has tubercles arranged in more obvious spirals, usually soon turning corky at their tips and spines all ascending, dehiscent and usually only present in the stem apex.

**Bibliography:** Chalet, J. M. (1997): *Turbinicarpus hoferi* (Lüthy and Lau). *Succulent* 19 (3): 3-5.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): *Turbinicarpus* im Bild. *Mitteilungen der Turbinicarpus-Gruppe* 9.  
Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.



# Turbinicarpus horripilus

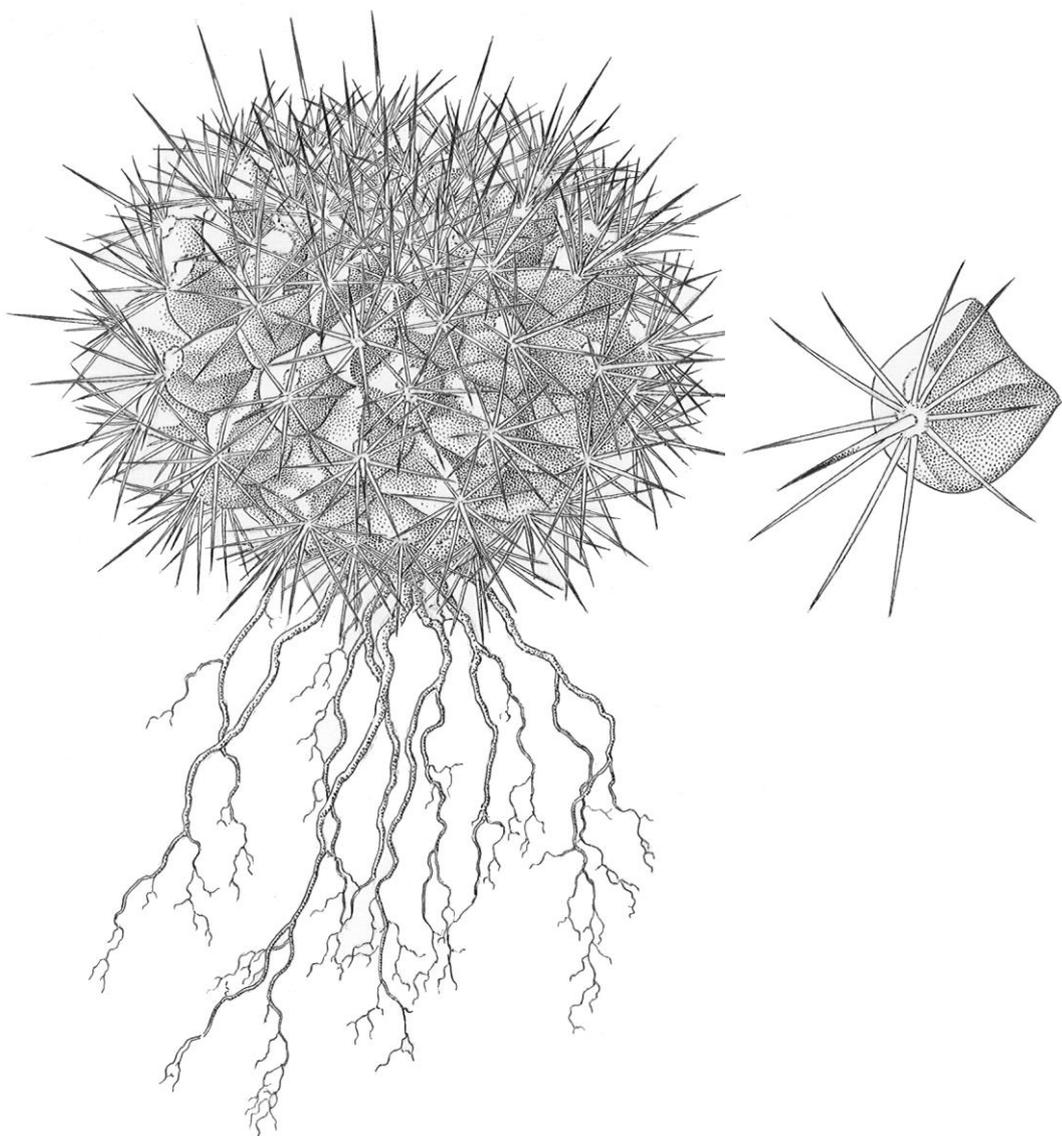
(Lemaire) John &amp; Riha 1983

**Common names:** none

**Scientific synonyms:**

- = *Mammillaria horripila* Lemaire 1838
- = *Echinocactus horripilus* (Lemaire) Lemaire 1839
- = *Neolloydia horripila* (Lemaire) Britton & Rose 1923
- = *Gymnocactus horripilus* (Lemaire) Backeberg 1951
- = *Thelocactus horripilus* (Lemaire) Kladiwa & Fittkau 1970
- = *Echinocactus cespititius* Pfeiff. 1845 (nom. nud.)
- = *Echinocactus horripilus* var. *longispinus* Monv. Ex Labouret 1853
- = *Bravocactus horripilus* (Lemaire) A. Doweld 1998
- = *Pediocactus horripilus* (Lemaire) J. J. Halda 1998
- *Thelocactus goldii* Bravo 1955
- = *Gymnocactus goldii* (Bravo) Y. Ito 1981 (nom. inval.)
- *Turbinicarpus horripilus* ssp. *wrobelianus* Nitzschke & Anaya Montes 2000
- *Turbinicarpus horripilus* ssp. *kvetae* Chvastek & Halda 2000

**CITES category:** Appendix II since 01.07.1975, Appendix I in 11.06.1992 (Prop. USA).



- Characteristics:** Medium sized, globular, tuberculate cactus with a rather dense, predominantly white, rather erect and stiff, notably pungent spination.
- Roots:** Fibrous.
- Stem:** Globose to shortly columnar, often clustering from the base with age, 7-10 (-18) cm high, 6-12 cm Ø, divided into tubercles, bright green, with slightly woolly apex.
- Tubercles:** Conical, 7-9 mm long, 5-7 x 5-7 mm at the base, with apical areole.
- Areoles:** Elliptic, 3-4 mm Ø, first with conspicuous, white wool, prolonged into a very short woolly groove on the upper (adaxial) side.
- Spines:**
- Radial spines: 9-14, 9-20 mm long, somewhat erect, radiating, straight to slightly recurved, acicular, with a white base and brown tip, later turning grey.
  - Central spines: Usually 1, thicker than the radials, ca 1 mm Ø at base, (12-) 20 (-40) mm long, porrect, straight, yellow to brown with a dark tip.
- Flowers:** From the centre of the stem apex, campanulate, 2-4 cm long, 2.5-3.5 cm Ø; magenta with a white centre.
- Fruits:** Ovoid, 6-9 mm long, 3-7 mm Ø, reddish-green, opening by a longitudinal slit.
- Seeds:** 1.2-1.7 mm x 0.8-1.1 mm, seedcoat black, tuberculate..
- Distribution:** State of Hidalgo, Mexico.



- Trade:** Endemic to the valley of Venados. The species has been in cultivation for a very long time and is well represented in collections. Reproduces very well from seeds and also by rooting or grafting of branches. Demand therefore is moderate, no negative influence on wild populations from collecting is reported. However, the description of some rather doubtful subspecies in recent times may stimulate collection of plants from the habitat and illegal trade. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Switzerland P-CH-1001.
- Similar species:** Might be confused maybe with *Thelocactus conothelos* (CITES App. II), which has ascending tubercles with a well developed adaxial groove, more appressed radial spines and sometimes more than one central spine. The recently described *Turbinicarpus horripilus* ssp. *wrobelianus* is distinguished by the authors by smaller and more globular stems and a higher number of radial spines, which are more flexible and mostly silvery white but never brown. The flower, as illustrated in the first description, lacks a whitish or pale centre, like it is often observed in ssp. *horripilus*, but the new subspecies seems to fall well within the variability of the species. *Turbinicarpus horripilus* ssp. *kvetae* most probably is referring to the same plants.
- Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.



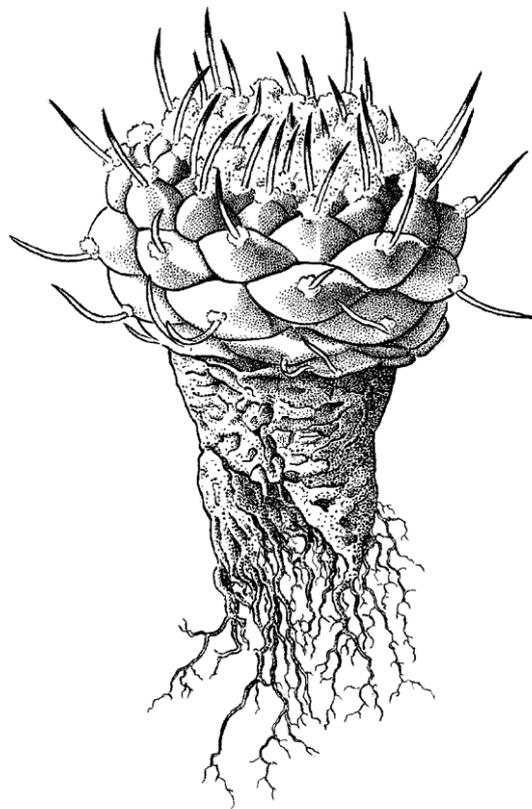
# Turbinicarpus jauernigii

Frank 1993

**Common names:** none

**Scientific synonyms:** = *Turbinicarpus lophophoroides* ssp. *jauernigii* (Frank) Battaia & Zanovello 1995  
= *Pediocactus lophophoroides* var. *jauernigii* (Frank) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Small, flattened, tuberculate, distinctly greyish (non-green) cactus with rather strangely only a single, rather thick and straight, notably dark tipped, porrect to ascending, non-pungent spine per areole. Grows in limestone gravel between rocks on gentle slopes of hills among shrubs.

**Roots:** Stem base and thick taproot forming a napiform unit, 30 mm long, 15 mm Ø.

**Stem:** Solitary, globose-depressed, 10 (-20) mm high, up to 50 mm Ø, with a white woolly apex, epidermis grey, with conspicuous cuticular wax, described as "minute white tufts".

**Tubercles:** Flat, rounded-hexagonal.

**Areoles:** Oval, with long white silk-like hair on new growth, later becoming naked.

**Spines:** 1 single, 5-8 mm long, erect and straight to slightly bent, sub-rigid, greyish-white with black tip, thick and oval in cross section, with rough surface.

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Flowers: November-December, from the centre of the stem apex, broadly funnelform, 25 mm long, 15 (20) mm  $\varnothing$ , whitish to light yellow-brown with a brown to pinkish midstripe on perianth segments.  
Fruits: Naked, small, greenish, drying and opening by a longitudinal slit.  
Seeds: 1.2 mm long, 0.7 mm  $\varnothing$ , with black, finely tuberculate surface.  
Juvenile plants: 7-10 small radial spines, white, spreading, 3-5 mm long, no central.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Endemic to a small region north of Las Palomas. Heavily collected for international trade after collection of the type by Johann Jauernig in spring of 1991, which was seemingly not the first report of this species (a photo has been published in 1989 by Meyran, who identified it as *T. lophophoroides*). *T. jauernigii* is nearly extinct in some locations and additionally specifically threatened by habitat destruction through road construction and extraction of limestone gravel. The species is already well distributed in cultivation. Demand has been high after description and is still remarkable. Propagation from seeds is quite fast and easy. Grafted seedlings may flower in much less than a year. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, Switzerland P-CH-1001.

**Similar species:** The species is one of the rather well identifiable ones within the genus for its very characteristic stem colour, combined with a flattened stem and first of all for the rather strange, single, nearly straight and notably bicoloured spine per areole. It has been compared and even combined with *Turbinicarpus lophophoroides* (Werdermann) Buxbaum & Backeberg, which differs, among other characters, by a green, slightly glaucous stem and 3-5 spreading spines per areole.

**Bibliography:** Battaia, L. & C. Zanovello. (1995): Due storie singolari e una nuova combinazione: *Turbinicarpus lophophoroides* subsp. *jauernigii* (Frank) Battaia & Zanovello comb. et stat. nov. *Piante Grasse* 15 (3): 75-81.  
Chalet, J. M. (1997): *Turbinicarpus jauernigii* (G. Frank). *Kaktus og andere Sukkulenter* 32 (4): 77-78.  
Frank, G. (1993): *Turbinicarpus jauernigii* Frank spec. nov. *Succulenta* 72 (2): 113-114.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): *Turbinicarpen im Bild. Mitteilungen der Turbinicarpus-Gruppe* 9.  
Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.



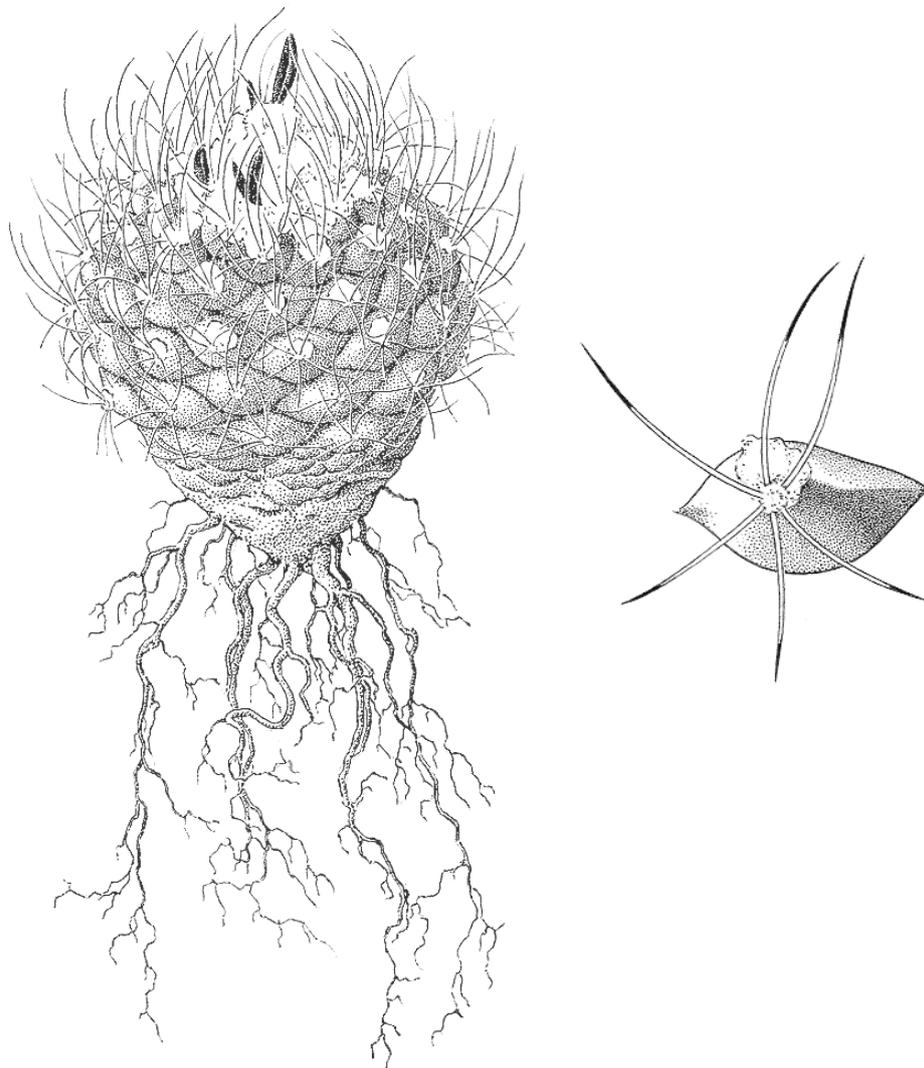
# Turbinicarpus laui

Glass &amp; Foster 1975

**Common names:** none

**Scientific synonyms:** = *Strombocactus laui* (Glass & Foster) Mays 1979  
= *Neolloydia laui* (Glass & Foster) E. F. Anderson 1986  
= *Pediocactus laui* (Glass & Foster) J. J. Halda 1998  
→ *Neolloydia pilispina* (J. Purpus) Britton & Rose 1923 (nom. inval.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, globular, green, tuberculate cactus, often with a reddish hue, with woolly stem apex and rather few, thin, curved, glassy white spines. Grows in fine limestone gravel or on gypsum in open spaces among low trees.

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**Roots:** Fibrous from a short, subterranean, napiform stem base.  
**Stem:** Solitary, sub-globose to depressed globose, to 3.5 cm Ø, up to 1.5 cm high (in cultivation up to ca. 4 cm), bluish-green to yellow-green, often tinged reddish, if exposed to sun.  
**Tubercles:** Broadly conical, rounded, 2-3 mm long, to 10 mm broad, to 5 mm high.  
**Areoles:** Ca. 1 mm Ø, with abundant white, deciduous wool in the apex, later becoming naked. Flowering areoles with a small extension beyond the spines, on the upper (adaxial) side of the tubercle.  
**Spines:** 6 (-7), all interpreted as radials, sometimes with an additional upper subcentral spine, glassy white with blackish tip, slender acicular, relatively stiff and slightly recurved, spreading, radiating, the lower up to 5 mm long, upper lateral spines to 7 mm long, upper most spine(s) ca. 18-22 mm long and generally incurved, connivent over the top of the stem or occasionally erect or ± tortuous.  
**Flowers:** From the centre of the stem apex, funnellform, white to pinkish, 30-35 mm long, ca. 18-25 mm Ø.  
**Fruits:** Small, greenish to brown, ca. 5 mm Ø, 5-7 mm long, opening by a longitudinal slit.  
**Seeds:** 1.1 mm long, 0.7-1 mm Ø, with black, finely tuberculate surface.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Endemic to a rather extended region near Los Cerritos, but not abundant in any place. The species has first been collected by C. A. Purpus and invalidly published as early as 1923. Only after its rediscovery by the German collector Alfred Lau and valid description in 1975, it got popular among collectors, but a few specimens have apparently already been in cultivation before (pers. observation). Demand was very high after rediscovery, and the natural populations have suffered from illegal collecting. It is still in some demand for its nice flowers and is fast and easy to propagate from seeds. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The species could be confounded with *Turbinicarpus lophophoroides* (Werdermann) Buxbaum & Backeberg for its similar stem shape, rather low number of spines and often quite green aspect, but the latter has only 5, notably shorter spines and a large taproot. *T. laui* has also been compared with *Turbinicarpus saueri* ssp. *knuthianus* (Bödeker) J. Lüthy, which has a much higher number of spines (18-20 radials, 1 central), but similar stems and flowers. For the spine characters, *T. laui* belongs rather to the "Gymnocacti" within the genus, than to the "Turbinicarpus" in a very strict sense.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research Vol. 2, Royal Botanic Gardens, Kew, UK.  
Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
Glass, Ch. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): *Turbinicarpus* im Bild. Mitteilungen der *Turbinicarpus*-Gruppe 9.



# Turbinicarpus lophophoroides

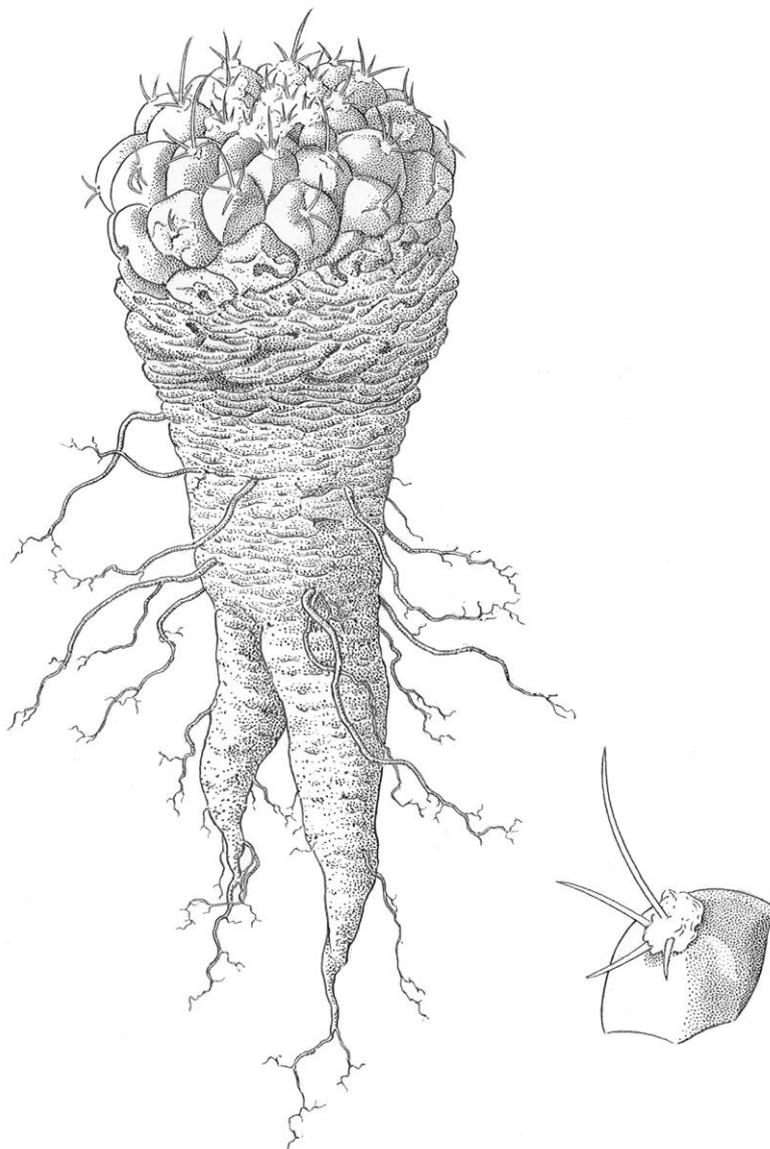
(Werderm.) F. Buxb. &amp; Backeb. 1937

**Common names:** none

**Scientific synonyms:**

- = *Thelocactus lophophoroides* Werdermann 1934
- = *Strombocactus lophophoroides* (Werdermann) Knuth 1935
- = *Toumeyia lophophoroides* (Werdermann) Bravo & Marshall 1956
- = *Neolloydia lophophoroides* (Werdermann) E. F. Anderson 1986
- = *Pediocactus lophophoroides* (Werdermann) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Small, globular, flattened, greyish or bluish green, nearly naked cactus with short, flattened tubercles, only a few weak spines and an extremely big taproot. Grows in fine sediments of dry lakes, where it retreats completely underground in dry periods.

Roots: Long, thick taproot from a conspicuous napiform stem base, strongly contractile.  
Stem: Solitary, depressed-globose to hemispherical, tuberculate, 4-4.5 cm Ø, 3-4 cm high, mostly subterranean, apex flattened, glaucous greyish-blue to blue-green.  
Tubercles: Broad and flattened, 9-12 mm long, 10-12 mm broad, only 2-4 mm high, rounded or slightly keeled and angled.  
Areoles: Oblong, 2.2-2.5 mm Ø, first with conspicuous white wool, later nearly naked.  
Spines:  
    Radial spines: 2-4, stiff, 8-9 mm long, whitish or grey with a darker tip, subulate, spreading, the upper longest.  
    Central spines: 1, about 1 cm long, straight, erect to slightly incurved, grey or whitish with a darker tip.  
Flowers: From the centre of the stem apex, funnellform, to 3.5 cm Ø, white.  
Fruits: Light green, dehiscent by a longitudinal slit.  
Seeds: Black, with finely tuberculate surface.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Well introduced in horticulture. The extreme taproot causes some difficulties in cultivation, requesting deep containers and a good drainage. Addition of gypsum is recommended. Demand in trade is moderate. The species is severely threatened because of habitat destruction. Reproduction from seeds is not too difficult. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The name implies comparison with *Lophophora* spp., which however completely lack spines, are often clustering and have even more flattened tubercles, bearing a protruding tuft of wool in the areoles. Confusion could be with *Turbinicarpus hoferi* or *T. swoboda* for the similarly flattened stem and rather few, weak spines, but in these two species, the tubercles are notably angled and the main difference is the absence of the remarkable taproot. Further, it is compared and has even been united with *T. jauernigii* (*T. lophophoroides* ssp. *jauernigii*) from which it differs notably by the greyish stem colour and the single, bicoloured spine of the latter.

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
Battaia, L. & C. Zanovello. (1995): Due storie singolari e una nuova combinazione: *Turbinicarpus lophophoroides* subsp. *jauernigii* (Frank) Battaia & Zanovello comb. et stat. nov. *Piante Grasse* 15 (3): 75-81.  
Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
Glass, Ch. E. (1998): *Identification Guide to Threatened Cacti of Mexico*. Fideicomiso Fondo para la Biodiversidad. Mexico.  
Hunt, D. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): *Turbinicarpus im Bild*. *Mitteilungen der Turbinicarpus-Gruppe* 9.

# Turbinicarpus mandragora

## ssp. *beguinii* (incl. ssp. *pailanus*)

(N. P. Taylor) J. Lüthy 1999



**Common names:** esp. Cola de Venado

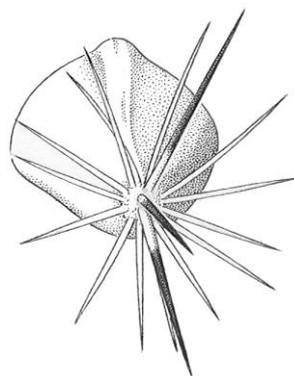
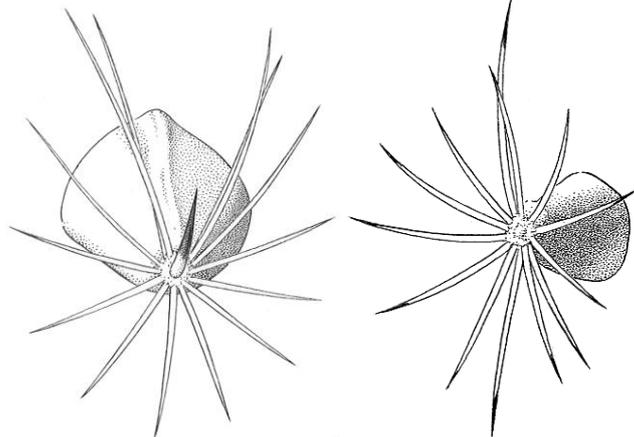
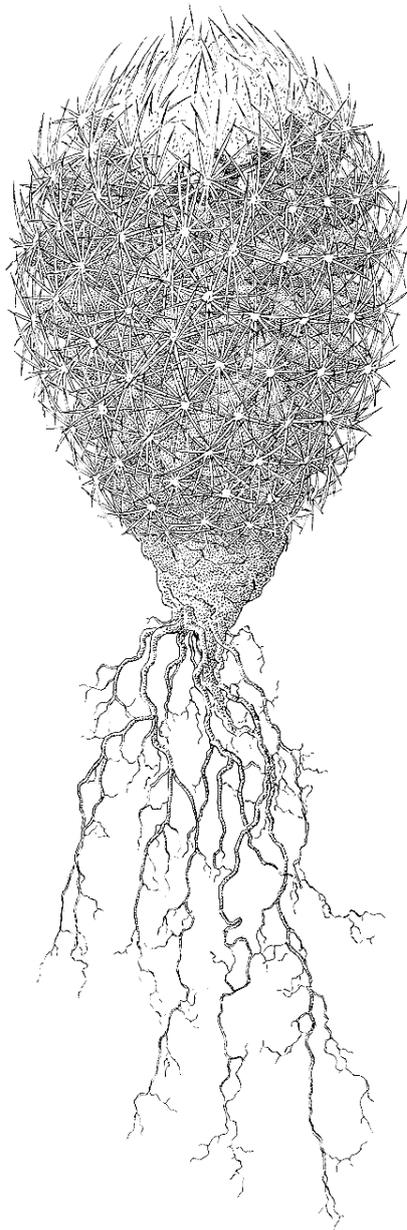
**Scientific synonyms:**

- = *Thelocactus beguinii* N. P. Taylor 1983
- = *Turbinicarpus beguinii* (N. P. Taylor) Mosco & Zanovello 1997
- = *Neolloydia glassii* A. Doweld 2000 (nom. nov.)
- *Mammillaria beguinii* Hort. (nom. nud.)
- = *Echinocactus beguinii* F. A. C. Weber 1885 (nom. nud.)
- = *Echinocactus beguinii* F. A. C. Weber ex K. Schumann 1898 (nom. illeg.)
- = *Neolloydia beguinii* Britton & Rose 1923 (nom. illeg.)
- = *Gymnocactus beguinii* Backeberg 1961 (nom. illeg.)
- *Neolloydia beguinii* var. *senilis* Borg 1951 (nom. illeg.)
- *Neolloydia smithii* var. *beguinii* Kladiwa & Fittkau 1972 (nom. illeg.)

**Included here:** → *Turbinicarpus beguinii* ssp. *hintoniorum* A. Hofer 2000

**Not illustrated:** *Turbinicarpus mandragora* ssp. *pailanus* (Halda & Panarotto) J. Lüthy 1999  
= *Turbinicarpus pailanus* Halda & Panarotto 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Distribution:**

States of Coahuila, Nuevo León, Zacatecas, Tamaulipas and San Luis Potosí, Mexico



- Excluded taxa:**
1. *Neolloydia gautii* L. Benson 1974 = *Echinomastus gautii* (L. Benson) Mosco & Zanovello 1997 = *Turbincarpus gautii* (L. Benson) A. Zimmermann 1991 = *Pediocactus gautii* (L. Benson) Halda 1998
  2. *Echinocactus smithii* Mühlenpfordt 1846 → *Thelocactus conothelos* (Regel & Klein) F. Knuth. = *Thelocactus smithii* (Mühlenpfordt) Borg 1937 = *Neolloydia smithii* (Mühlenpfordt) Kladiwa & Fittkau 1971 (misapplied) = *Pediocactus smithii* (Mühlenpfordt) Halda 1998 (misapplied)
- Characteristics:** Small to medium sized, globular to cylindrical cactus, densely covered with straight, pungent, pointing outwards, white-translucent, partly black-tipped acicular spines. Apex with conspicuous white wool. Considerable variation in stem size and shape as well as in number and length of spines is observed. Specimens with abundant wool in the apex, longer, more slender spines and thicker stems are usually cultivated as “senilis”.
- Roots:** Fibrous, from a subterranean, tapering stem base.
- Stem:** Globose to cylindrical or club-shaped with rounded apex, variably deep-seated with only the stem apex emerging from the substrate to mostly emerging with slightly sunken stem base (cultivated specimens globose to distinctly club-shaped, much elongated with time), unbranched, 7-15 cm high, 3-10 cm Ø, slightly glaucous to greyish-green, apex sometimes with conspicuous amounts of white wool (especially in cultivated specimens).
- Tubercles:** Conical, 3-5 mm long, 3-4 mm broad, 2-3 mm high, with apical areole, axil naked.
- Areoles:** Circular to elliptic, 2-7 mm Ø, with white wool and spines.
- Spines:** All spines circular in cross section, translucent, glassy-white, partly tipped black or brown.
- Radial spines:** 12-27, radiating, 3-18 mm long, straight to slightly curved, white, often with a brown or black tip, sometimes with a few additional, bristle-like, ascending, white spines in upper portion of areole.
- Central spines:** (0-) 1-3 (-4), 12-18 (-30) mm long, straight, erect, the lower one porrect, horizontally pointing outwards, white, always with a brown or black tip.
- Flowers:** From the centre of the stem apex, 3-4 cm long, funnel-shaped (ca. 2 cm Ø), usually magenta, but also yellowish with distinct, darker midstripes (apricot) in “*T. pailanus*” or whitish-yellow.
- Fruits:** Globular to ovoid, 8-13 mm Ø, to 10-15 mm long, reddish-green, drying and opening by a longitudinal slit.
- Seeds:** Variable, subglobular to drop-shaped with subbasal hilum, 1.2-2.1 mm long, 1-1.5 mm Ø, seedcoat black, tuberculate.
- Juvenile specimens:** Globular to cylindrical, with strongly plumose, white, spreading spines, lacking centrals.
- Trade:** Locally abundant in its wide geographical range, found in very diverse types of vegetation, ranging from woodland to desert shrub. Has been in cultivation for a very long time and is well represented in collections. Reproduces very well from seed. Demand therefore is moderate. The newly described segregate ssp. *hintoniorum* (dwarf, few-spined, with yellowish flowers, on gypsum) could stimulate illegal trade. Ssp. *pailanus* is not illustrated separately here. It differs mainly by flower colour and by the spines of seedlings. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Switzerland P-CH-1001 (incl. ssp. *pailanus*).
- Similar species:** Similar to other taxa with straight, pungent, white-translucent and partly black tipped spines, referred here to a single species. Ssp. *mandragora* and ssp. *booleanus* (have a tuberous root, connected to the stem by a neck), ssp. *zaragosae* (has a taproot, a distinctively club-shaped stem and narrow, brownish flowers), ssp. *subterraneus* (has a tuberous root, a very long, slender neck and a small head). The geographically separated ssp. *pailanus* from southern Coahuila (Sierra Paila) has a white flower with pink midstripe and slightly coarser spines, most similar to ssp. *mandragora*, but it lacks a tuberous root and has seedlings with naked spines. It is in many respects intermediate between ssp. *mandragora* and ssp. *beguinii*. The recently discovered *T. beguinii* ssp. *hintoniorum* is a distinctive, dwarf gypsum dweller with yellow flowers, known from only two independent localities (Hinton 2000 in lit.), but otherwise fits well in the variable *T. mandragora* ssp. *beguinii*. Further similar taxa: *Sclerocactus mariposensis* (has chalky-white spines), *Thelocactus conothelos* (CITES App. II, various ssp.; has much longer spines, the centrals to ca. 5 cm, somewhat flattened, without black tip). Especially seedlings may be confused. *Escobaria laredoi* (CITES App. II, has similar translucent, pungent spines but is usually highly cespitose and shows areolar grooves).
- Bibliography:**
- Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.
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# Turbinicarpus mandragora ssp. booleanus

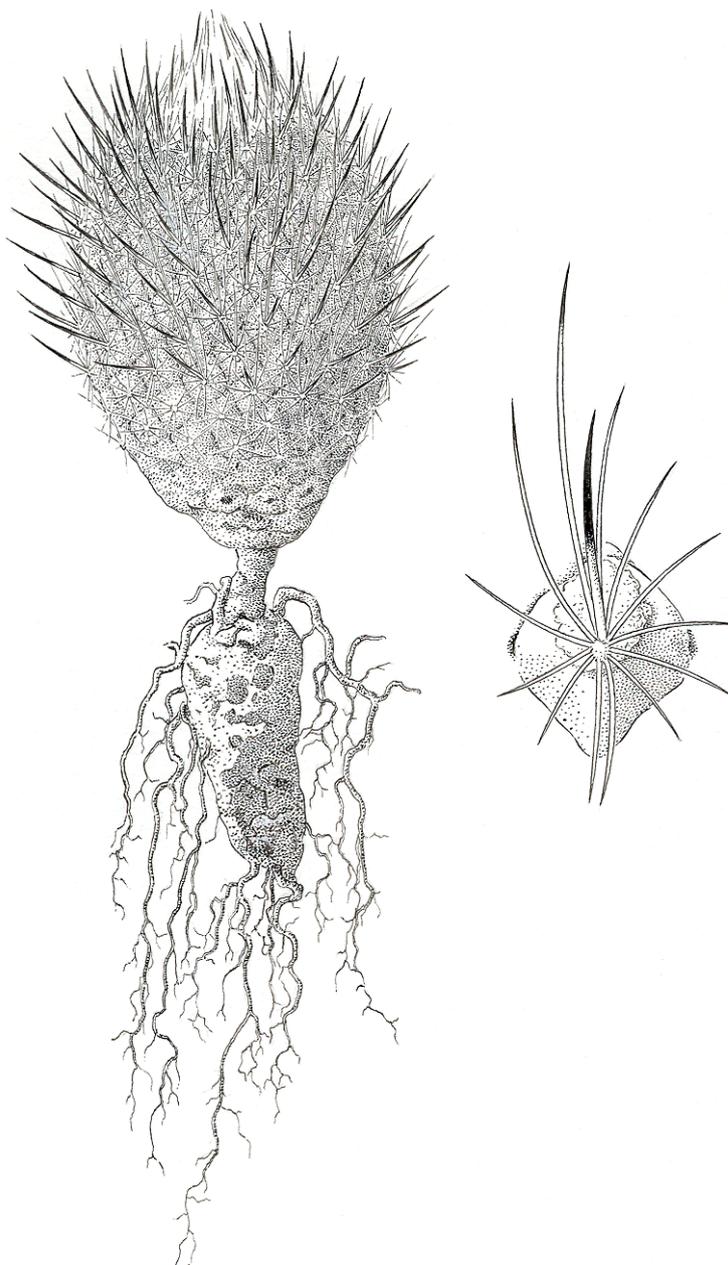
(G. S. Hinton) J. Lüthy 1999



**Common names:** none

**Scientific synonyms:** *Turbinicarpus booleanus* G. S. Hinton 1996  
*Neolloydia booleana* (G. S. Hinton) A. Doweld 2000

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Small, non branching, globular cactus, densely covered with straight, acicular, white-translucent, partly black-tipped spines, apex with some white wool. Tuberous root, connected to the stem by a slender, subterranean neck. Grows on nearly bare gypsum slopes under pine trees.

**Roots:** Tuberos, 2.0-5.7 cm long, 0.8-2.8 cm Ø, connected to the stem by a thin, subterranean neck, 1-5 cm long, 3-5 mm Ø.

**Stem:** Solitary, obovoid, 2.5-4.5 cm high, 2.5-5.5 cm Ø, whitish-green, stem base deep-seated, subterranean, in older specimens strongly flattened.

**Tubercles:** Rhomboidal in cross section, 4 mm long, 5 mm Ø at base, with apical areole, axil naked.

**Areoles:** Elliptic, 1.5-2 mm long, 1 mm broad, bearing spines and in the apical area of the stem some white, dehiscent wool.

**Spines:** All spines circular in cross section, translucent, glassy-white, partly tipped black or entirely brown to black.

**Radial spines:** (14-) 18-20 (-28), pungent, white, tipped brown or reddish, 3-6 mm long, the lowest shorter, 0.1 mm Ø at base, slightly bent.

**Central spines:** 2, nearly entirely brown to black, the upper ascending to appressed, (10-) 12-15 (-21) mm long, the lower ascending to porrect, often only slightly protruding, (10-) 12-18 (-21) mm long.

**Flowers:** From the centre of the stem apex, ca. 2.5 cm long and 2 cm Ø, funnel-shaped, magenta.

**Fruits:** Dark green to purple, ca. 7 mm long and 6 mm Ø, opening by a longitudinal slit.

**Seeds:** Ovoid with subbasal hilum, 1 x 1.8 mm, seedcoat black, tuberculate.

**Juvenile specimens:** Seedling distinctly elongated with very short, shortly hairy, appressed spines, later with a long, slender stem base above the substrate and a globular apex, finally globular with a subterranean "neck".

**Distribution:** State of Nuevo León, Mexico.



**Trade:** Local endemic, restricted to 2 localities, a few kilometres apart, in southern Nuevo Leon. Named for George Boole Hinton, son of the author George Sebastian Hinton, who accompanies him on his fieldtrips. Less than 3 years after publication as a new species, seeds and a few wild-collected specimens are already reported in (illegal) international trade and it can be found in certain nurseries, as grafted seedlings. The actual state of the very restricted wild population is unknown. Demand for this "novelty" by collectors focused on the genus *Turbincarpus* is presently very high. No legal exports from Mexico are reported. Some legal offspring can be produced from confiscated specimens. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** Similar to other taxa with straight, pungent, white-translucent and partly black tipped spines, referred here to a single species: *Turbincarpus mandragora* ssp. *mandragora* (differs by stronger, more protruding central spines, with only their tips brown coloured and by white flower colour), ssp. *subterraneus* (differs by its very long, slender neck, emerging from the substrate and fewer and shorter, fully glassy-white radial spines), ssp. *zaragozae* (differs by a club-shaped stem and taproot, white base of the central spines and by distinctly striped, brownish, narrow flowers), ssp. *beguinii* and ssp. *pailanus* (both lack a basal neck and tuberos root). Further similar taxa: *Sclerocactus mariposensis* (has chalky-white spines and fibrous roots), *Thelocactus conothelos* (CITES App. II, various ssp.; has much longer spines, the centrals to ca. 5 cm, somewhat flattened, without black tip). Especially seedlings may be confused. *Escobaria laredoi* (CITES App. II, has similar translucent, pungent spines but is usually highly cespitose with fibrous roots and areolar grooves).

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Lüthy, J. M. (2000): *Turbincarpus mandragora* neu klassifiziert. Mitteilungen der Turbincarpus-Gruppe 8: 1-26.  
 Lüthy, J. M. (2001): The *turbincarpus mandragora* complex. *Bradleya* 19: 19-54.  
 Mosco, A. & C. Zanollo (1999): *Turbincarpus zaragozae*. *BCSJ* 17 (2): 106-108.

# Turbinicarpus mandragora

## ssp. mandragora

(A. Berger) A. Zimmermann 1991

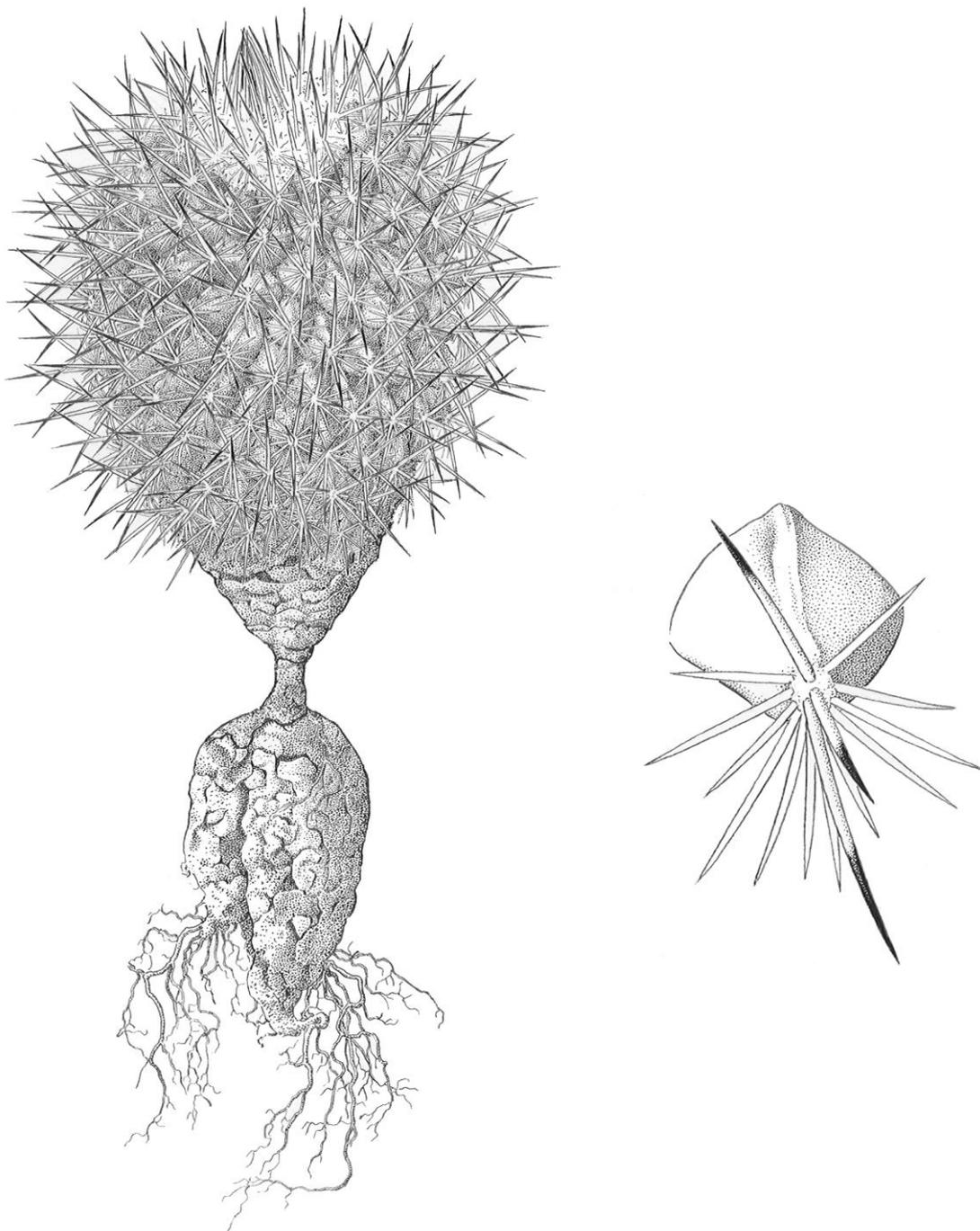


**Common names:** none

**Scientific synonyms:**

- = *Echinocactus mandragora* Frič ex A. Berger 1929
- = *Rapicactus mandragora* (Frič ex A. Berger) Buxbaum & Oehme 1943
- = *Gymnocactus mandragora* (Frič ex A. Berger) Backeberg 1961
- = *Neolloydia mandragora* (Frič ex A. Berger) E. F. Anderson 1986
- = *Pediocactus mandragora* (Frič ex A. Berger) Halda 1998
- = *Lodia mandragora* (Frič ex A. Berger) Mosco & Zanovello 2000
- *Echinocactus mandragora* Frič (nomen nudum)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Rather small, globose cactus, densely covered with rather strong, acicular, straight, pungent, protruding, white-translucent, partly brown-tipped spines, lending the stem a white aspect. Apex with some white wool. Tuberous root, connected to the stem by a slender neck. Grows on low hills

in fissures of a splintery limestone shale.

**Roots:** Tuberous, round to heart-shaped, exfoliating (usually laterally compressed in wild collected specimens for growing in rock fissures), connected to the stem by a thin, subterranean neck.

**Stem:** Solitary, 3-5 cm high, 4-6 cm Ø, globose, slightly glaucous to greyish-green, new growth with little white wool (especially in cultivated specimens, which may grow to a more cylindrical shape with time).

**Tubercles:** Conical, firm, rhomboidal in cross section, 8 mm long and Ø at the base, with apical areole, axil naked.

**Areoles:** Elliptic, 1.5-2 mm long, 1 mm broad, bearing spines and little white, dehiscent wool, axils naked.

**Spines:** All spines circular in cross section, translucent, glassy-white, partly tipped brown.

**Radial spines:** 12-14, 7-15 mm long, radiating, acicular, white, often with 1-2 additional, bristle-like, ascending spines in the upper part of the areole.

**Central spines:** 2 (-3), slightly thicker, protruding, 2 cm long, the lower porrect to descending, the upper porrect to ascending.

**Flowers:** From the centre of the stem apex, funnellform, 2 cm long, 2.5 cm Ø, white with variably pink or yellowish midstripe on perianth segments.

**Fruits:** Globose, 5 mm Ø, 8 mm long, opening by longitudinal slit.

**Seeds:** Drop-shaped with subbasal hilum, 1.2-1.7 x 1.8-2.5 mm, seedcoat black, tuberculate.

**Juvenile specimens:** Elongated, cylindrical, lacking central spines.

**Distribution:** State of Coahuila, Mexico.



**Trade:** Local endemic, known from a single valley in southern Coahuila, south of Parras. First collected by Theo Schwarz in Mexico, who sent a shipment of plants to Frič in 1925. Has been observed in international trade as wild collected specimens over a long period, up to the mid 1980s mostly originating from the Mexican trader Gustavo Aguirre in Parras. Acclimatisation of wild collected plants is very slow and difficult. Flowers are only produced rather sporadically in cultivation. Hence, *T. mandragora* ssp. *mandragora* is still not common in collections. It is not very easy to grow from seed and seed is rarely available. The plants are still quite abundant in the extremely restricted and remote habitat. There is some demand by collectors focusing on the genus *Turbinicarpus*. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** Similar to other taxa with straight, pungent, white-translucent and partly black tipped spines, referred here to a single species. *Turbinicarpus mandragora* ssp. *subterraneus* (differs by its very long, slender neck, emerging from the substrate, a smaller head and by magenta flower colour), ssp. *booleanus* (differs by entirely dark coloured central spines, an ascending to appressed upper central spine and magenta flower colour), ssp. *zaragosae* (differs by a more slender, elongated, club-shaped stem, a taproot and a narrow, brownish flower), ssp. *beguinii* (differs by fibrous roots and usually by magenta flower colour), ssp. *pailanus* (lacks a tuberous root). Further similar taxa: *Sclerocactus mariposensis* (has chalky-white spines and fibrous roots), *Thelocactus conothelos* (CITES App. II, various ssp.; has much longer spines, the centrals to ca. 5 cm, somewhat flattened, without a black tip). Especially seedlings may be confused. *Escobaria laredoi* (CITES App. II, has similar translucent, pungent spines but is usually highly cespitose with fibrous roots and areolar grooves).

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
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 Lüthy, J. M. (2000): *Turbinicarpus mandragora* neu klassifiziert. *Mitteilungen der Turbinicarpus-Gruppe* 8: 1-26.  
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 Mosco, A. & C. Zanovello (2001): *Lodia mandragora* and *Turbinicarpus pailanus*: a questionable relationship. *Mitteilungen der Turbinicarpus-Gruppe* 10: 23-28.

# Turbinicarpus mandragora

## ssp. subterraneus

(Backeberg) J. Lüthy 1999

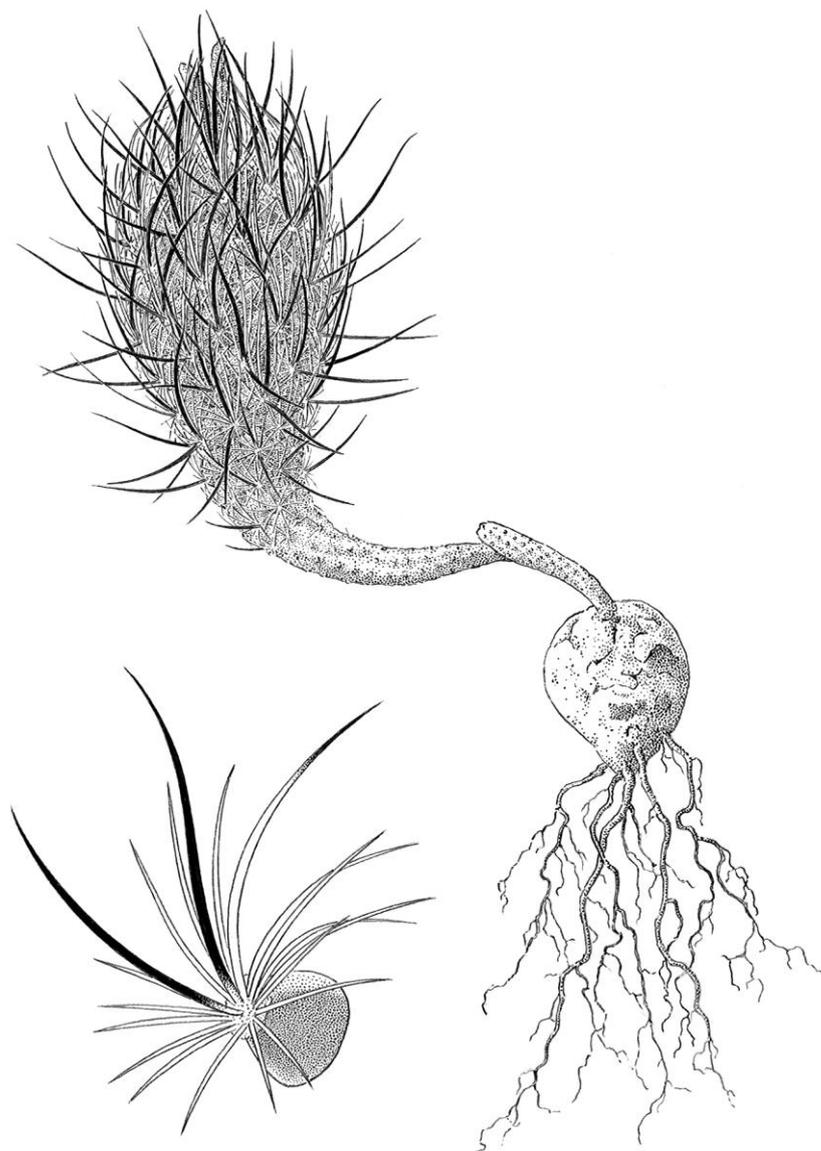


**Common names:** none

**Scientific synonyms:**

- = *Echinocactus subterraneus* Backeberg 1932
- = *Thelocactus subterraneus* (Backeberg) Backeberg & Knuth 1935
- = *Rapicactus subterraneus* (Backeberg) Buxbaum & Oehme 1942
- = *Gymnocactus subterraneus* (Backeberg) Backeberg 1951
- = *Neolloydia subterranea* (Backeberg) H. Moore 1975
- = *Pediocactus subterraneus* (Backeberg) Halda 1998
- = *Turbinicarpus subterraneus* (Backeberg) A. Zimmerman 1991

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:**

Small, strange-looking cactus, with a very distinctive shape of stem and roots: The globular to club-shaped stem apex is located on a long, erect, extremely slender, stalk-like stem base, which connects it to the tuberous root. The stem apex is densely covered with straight, acicular, white-translucent and some contrasting, black spines. Grows on low hills in limestone gravel, among grasses.

**Roots:** Tuberos, round.  
**Stem:** Usually solitary, leaf-green, head (stem apex) globose to club-shaped, 1.5-3 cm Ø, lower part of stem forming an exceedingly thin, elongate, erect stalk, rising ca. 10 cm above the ground, only 2-4 mm Ø (stem apex in cultivated specimens, especially if grafted, often thicker and much elongated, 5-10 cm long or more, club-shaped to cylindrical, later decumbent, creeping or hanging).  
**Tubercles:** Conical, 3-4mm Ø at base, 3-5 mm long, moderately 4-angled, with apical areole, axil naked.  
**Areoles:** Slightly elongated, 2 mm broad, about 3 mm long, bearing spines and in the apical area of the stem some white, dehiscent wool.  
**Spines:** Generally circular in cross section, translucent, glassy-white, partly tipped black or entirely brown to black.  
     **Radial spines:** 16-25, glassy white, 2-6 mm long, radiating, acicular, straight, often with a few additional bristle-like, ascending spines, to 3 cm long, in the upper part of the areole, these white at the base, becoming darker on the outer three-fourths.  
     **Central spines:** 2, the upper ascending, the lower ± porrect, black nearly to the base, to 2 cm long, in big specimens slightly flattened and somewhat twisted.  
**Flowers:** From the centre of the stem apex, 3 cm Ø, funnellform; magenta.  
**Fruits:** Opening by a longitudinal slit.  
**Seeds:** Globose with basal hilum, 1.2-1.6 mm Ø, seedcoat black, tuberculate.  
**Juvenile specimens:** Strongly elongated, very slender, covered with dense, soft, white hairs, later forming a globular apex.

**Distribution:** State of Nuevo León, Mexico.



**Trade:** Endemic to a rather restricted region in southern Nuevo Leon, around Dr. Arroyo. Found by the German collector H. W. Viereck. Well known and fairly widely distributed in cultivation. It is not too difficult to propagate either from seed or by rooting or grafting of branches, mainly of grafted specimens. In moderate demand, rather by collectors specialised in the genus. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Similar to other taxa with straight, pungent, white-translucent and partly black tipped spines referred here to a single species, however differing from all of them by the long, slender, stalk-like stem base: *T. mandragora* ssp. *booleanus* (differs by its shorter, subterraneous neck and bigger stem size), ssp. *mandragora* (differs by notably bigger stem size, stronger spination with protruding central spines, white at the base and by white flower colour), ssp. *zaragozae* (differs by a bigger, club-shaped stem, a taproot, white base of the central spines and by a distinctly striped, not fully opening, brownish flower), ssp. *beguinii* and ssp. *pailanus* (both lack a tuberos root and reach considerably bigger stem sizes).

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
 Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
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 Lüthy, J. M. (2000): *Turbinicarpus mandragora* neu klassifiziert. *Mitteilungen der Turbinicarpus-Gruppe* 8: 1-26.  
 Lüthy, J. M. (2001): The *Turbinicarpus mandragora* complex. *Bradleya* 19: 19-54.  
 Mosco, A. & C. Zanovello (1999): *Turbinicarpus zaragozae*. *BCSJ* 17 (2): 106-108.

# Turbinicarpus mandragora ssp. zaragosae

(Glass & Foster) J. Lüthy 1999

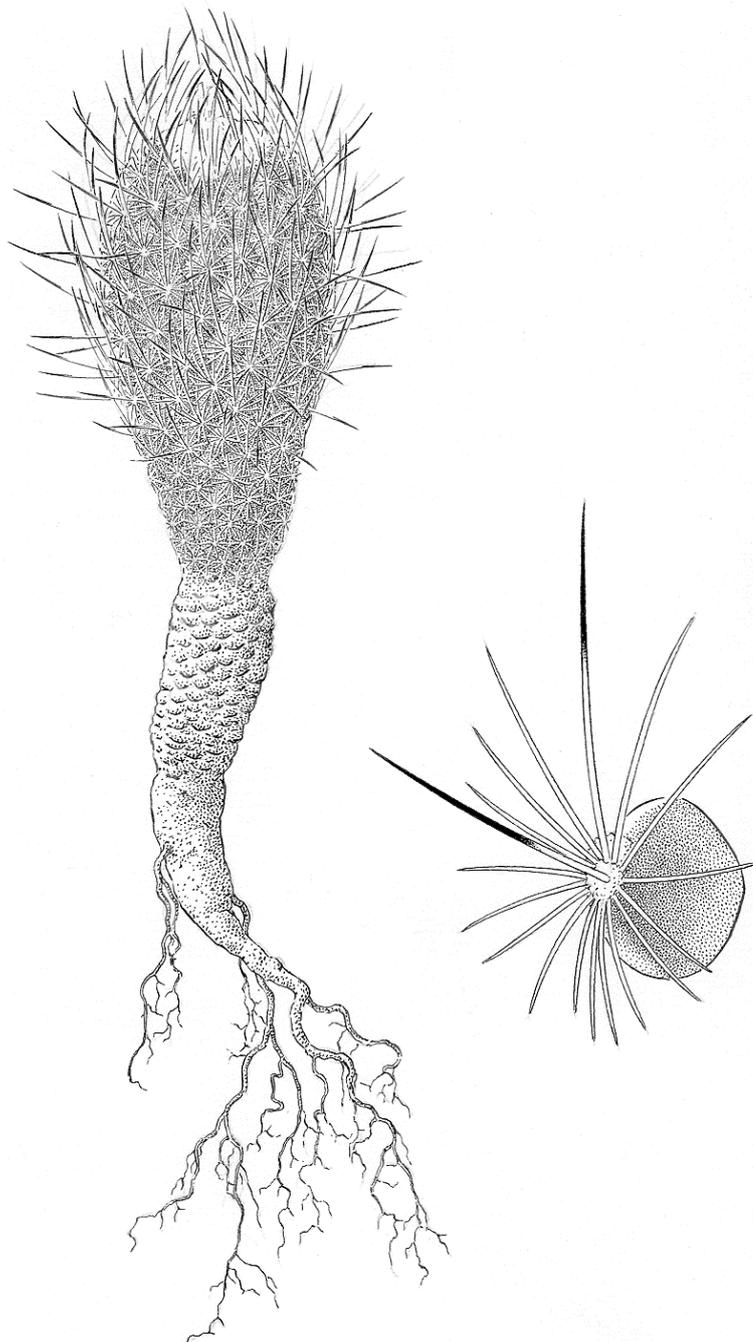


**Common names:** none

**Scientific synonyms:**

- = *Gymnocactus subterraneus* var. *zaragosae* Glass & Foster 1978
- = *Thelocactus subterraneus* var. *zaragosae* (Glass & Foster) Bravo 1980
- = *Neolloydia subterranea* var. *zaragosae* (Glass & Foster) E. F. Anderson 1986
- = *Turbinicarpus subterraneus* var. *zaragosae* (Glass & Foster) A. Zimmerman 1991
- = *Turbinicarpus zaragozae* (Glass & Foster) Glass & Hofer 1997
- = *Pediocactus subterraneus* var. *zaragosae* (Glass & Foster) Halda 1998
- = *Neolloydia zaragozae* (Glass & Foster) A. Doweld 2000

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



- Characteristics:** Small, non-branching, club-shaped cactus with a thick taproot, stem of white appearance, densely covered with straight, white-translucent, partly black-tipped, acicular spines. Grows on gypsum slopes with sparse vegetation.
- Roots:** Thick, elongated taproot.
- Stem:** 3.5-4 cm Ø, leaf-green, club-shaped (much elongated in cultivated specimens), apex rounded, with some white wool (especially in cultivated specimens), stem base tapering gradually to the taproot.
- Tubercles:** Conical, 3-5 mm long, 3-4 mm Ø at base, with apical areole, axil naked.
- Areoles:** Slightly elongated, 2 mm long, 1 mm broad, bearing spines and in the apical area of the stem some white, dehiscent wool.
- Spines:** All spines circular in cross section, acicular, translucent, glassy-white, partly tipped brown to black.
- Radial spines:** 20-25, radiating, slightly recurved, glassy white, partly tipped brown, 3-6 mm long, with 2-3 additional, bristle-like, ascending, white spines in upper portion of areole, to 2 cm long.
- Central spines:** 2, white at base, dark brown to black towards tip, upper 16-17 mm long, ascending, lower 10-15 mm long, porrect to slightly ascending.
- Flowers:** From the centre of the apex, 18-20 mm long, slender-funnelform, not fully opening, 15 mm Ø, whitish to yellowish-reddish-brownish, with distinctly longitudinally striped perianth segments (darker midstripe).
- Fruits:** Small, globose, opening by a longitudinal slit.
- Seeds:** Globose, 1.1-1.5 mm Ø, seedcoat black, tuberculate.
- Juvenile specimens:** Elongated, cylindric, with fine, white, hair-like and plumose spines, lacking central spines.

**Distribution:** State of Nuevo León, Mexico.



**Trade:** Local endemic of some gypsum hills in southern Nuevo Leon, near the city of Zaragoza, discovered by the US cactus traders Charles Glass & Robert Foster. Many plants have been removed from the very restricted habitat after the discovery in 1972 and a decline has been reported. But it is fairly easy to propagate either from seeds or by rooting or grafting of branches of grafted specimens, which can be forced to branch. It is not too common in collections and demand is rather moderate, maybe because of the rather unspectacular flowers. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** Similar to other taxa with straight, pungent, white-translucent and partly black tipped spines, referred here to a single species, however differing from all of them by the narrow, not fully opening, brownish flowers: *T. mandragora* ssp. *mandragora* (differs by a globular stem with a distinctive neck, tuberous root, stronger spination and white flower colour), ssp. *subterraneus* (differs by its very long, extremely slender neck, emerging from the substrate, a small head and magenta flower colour), ssp. *booleanus* (differs by a globular stem with a distinctive neck, tuberous root, darker central spines and magenta flower colour), ssp. *beguinii* and ssp. *pailanus* (both differ by fibrous roots). Further similar taxa: *Sclerocactus mariposensis* (has chalky-white spines and fibrous roots), *Thelocactus conothelos* (CITES App. II, various ssp.; has much longer spines, the centrals to ca. 5 cm, somewhat flattened, without black tip). Especially seedlings may be confounded. *Escobaria laredoi* (CITES App. II, has similar translucent, pungent spines but is usually highly cespitose with fibrous roots and areolar grooves).

- Bibliography:**
- Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.
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- Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.
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- Lüthy, J. M. (2001): The Turbinicarpus mandragora complex. Bradleya 19: 19-54.
- Mosco, A. & C. Zanovello (1999): Turbinicarpus zaragozae. BCSJ 17 (2): 106-108.

# Turbinicarpus pseudomacrochele ssp. krainzianus (incl. var. lausseri)

(G. Frank) Glass 1997

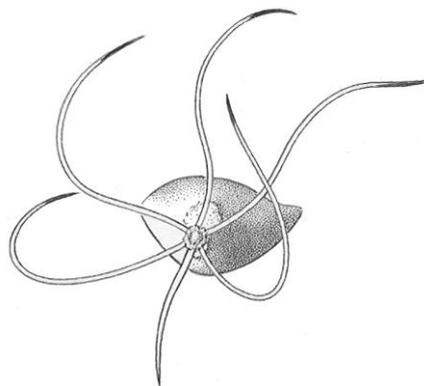
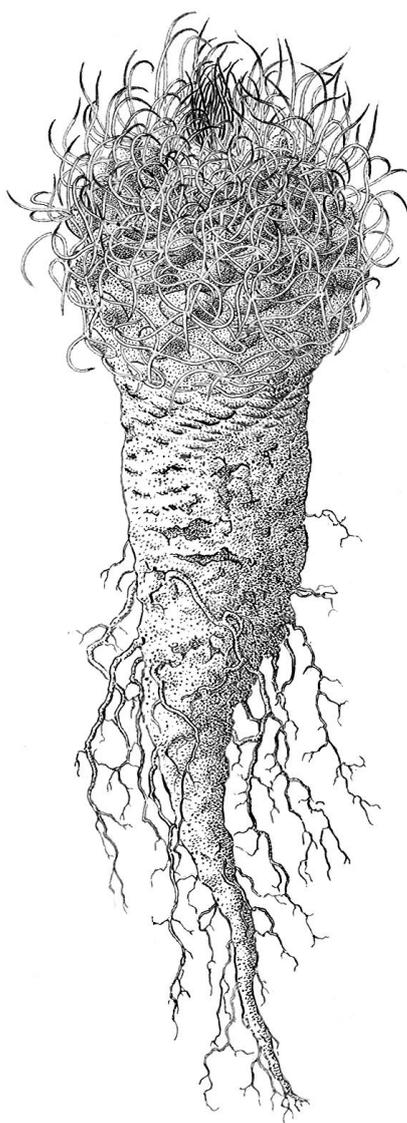


**Common names:** None

**Scientific synonyms:**

- = *Toumeyia krainziana* G. Frank 1960
- = *Turbinicarpus krainzianus* (G. Frank) Backeberg 1961
- = *Toumeyia pseudomacrochele* var. *krainziana* (G. Frank) Kladiwa 1966
- = *Strombocactus pseudomacrochele* var. *krainzianus* (G. Frank) Rowley 1974
- = *Turbinicarpus pseudomacrochele* var. *krainzianus* (G. Frank) Glass & Foster 1977
- = *Neolloydia krainziana* (G. Frank) A. T. Powell 1995
- = *Pediocactus pseudomacrochele* var. *krainzianus* (G. Frank) Halda 1998
- *Turbinicarpus pseudomacrochele* var. *lausseri* Diers & G. Frank 1991
- = *Turbinicarpus pseudomacrochele* ssp. *lausseri* (Diers & G. Frank) Glass 1997
- = *Pediocactus pseudomacrochele* var. *lausseri* (Diers & Frank) Halda 1998
- = *Kadenicarpus pseudomacrochele* var. *lausseri* (Diers et Frank) A. Doweld 1998
- = *Turbinicarpus pseudomacrochele* ssp. *krainzianus* fa. *lausseri* (Diers & G. Frank) Panarotto 1999
- *Turbinicarpus pseudomacrochele* var. *sphacellatus* Diers & G. Frank 1993 (nom. inval.)
- = *Pediocactus pseudomacrochele* var. *sphacellatus* (Diers & G. Frank) Halda 1998 (nom. inval.)
- = *Kadenicarpus pseudomacrochele* var. *sphacellatus* (Diers et G. Frank) A. Doweld 1998 (nom. inval.)
- *Turbinicarpus pseudomacrochele* var. *roseiflorus* Hort. (nom. nud.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Distribution:** State of Querétaro, Mexico.



<b>Characteristics:</b>	Dwarf, globular, dark green, tuberculate cactus with a big taproot and very characteristic, distinctly tortuous, thin, non-pungent spines obscuring the white-woolly apex. Strongly dimorphic, juvenile plants densely covered with short, white, radiating spines. Grows in fissures of limestone cliffs.
Roots:	Stem base and thick taproot forming a napiform unit.
Stem:	Solitary or moderately branching (freely branching in grafted specimens), 3-4 cm high, 2-3.5 cm Ø, globose to globose-cylindrical, with deep-seated, subterranean stem base, dark green, with a white woolly apex.
Tubercles:	Rhomboidal at the base, conoidal above, up to 4 mm high.
Areoles:	White woolly, becoming naked with age.
Spines:	6-8, ± tortuous, 12-30 mm long, the upper longest, flexible, non-pungent, first yellowish brown, becoming grey with dark tip.
Flowers:	Several flowering periods, flowers from the centre of the stem apex, slender funnellform, 2 cm long, pale yellow to cream coloured (deep pink in var. <i>lausseri</i> and var. <i>sphacellatus</i> ).
Fruits:	Ovate to globose, 3-5 mm Ø, green, becoming reddish at maturity, dehiscent by longitudinal slit.
Seeds:	Ca. 1 mm long, ovoid, black with finely tuberculate surface.
Juvenile plants:	Very different from adult specimens, narrowly columnar, densely covered by short, white, radiating spines, 11-16 per areole (the same as in young branches of adult specimens).
<b>Trade:</b>	<p>Endemic to a small region in Querétaro. First described from a shipment of unknown origin, habitat found only recently (1995). Some pink flowering specimens have been included in the original shipment of ssp. <i>krainzianus</i>. These have been kept separate in cultivation and described in 1993 as var. <i>sphacellatus</i>, referring to the original trade name. The natural habitat remains unknown, the plants are not well distributed in collections. The plants in trade are the yellow flowering, "typical" <i>krainzianus</i>, which is rather well distributed in collections for a long time and very easily artificially propagated, mostly from seeds or also by grafting of branches of grafted, freely clustering motherplants. Nurseries registered for artificial propagation: Germany P-DE-1001, P-DE-1002, Spain P-ES-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001 (also "<i>sphacellatus</i>").</p> <p>A deep pink flowering population was discovered in 1986 by the German trader Alfred Lausser in the Sierra del Doctor and described in 1991 as var. <i>lausseri</i>. This population has meanwhile been collected to near extinction in the only known, very remote locality and, being a novelty, it is highly in demand by collectors. Nurseries registered for artificial propagation: Czech Republic P-CZ-1001, Switzerland P-CH-1001.</p>
<b>Similar species:</b>	The species <i>Turbincarpus pseudomacrolele</i> is well characterised for its numerous, tortuous, thin, non pungent spines and napiform root as well as for the strong dimorphism between seedlings and adult specimens. The 3 subspecies however can easily be confounded. Ssp. <i>krainzianus</i> is characterised by slightly elongated tubercles, not flat as in ssp. <i>pseudomacrolele</i> . The latter further grows in a different type of habitat, in gravelly soils and it has a whitish-pink flower. Sparse branching as well as a thicker, not elongated stem base separates ssp. <i>krainzianus</i> from ssp. <i>minimus</i> .
<b>Bibliography:</b>	<p>Anderson, E. F. (1985): A revision of the genus <i>Neolloydia</i> B. &amp; R. (Cactaceae). <i>Bradleya</i> 4: 1-28.</p> <p>Diers, L. &amp; G. Frank (1993): <i>Turbincarpus pseudomacrolele</i> (Backeberg) F. Buxbaum &amp; Backeberg var <i>sphacellatus</i> Diers &amp; Frank. <i>Kakt. and. Sukk.</i> 44 (8): 158-161.</p> <p>Glass, C. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.</p> <p>Hofer, A. (1999): <i>Mitteilungen der Turbincarpus-Gruppe</i> 6.</p> <p>Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.</p> <p>Lechner, P., ed. (2000): <i>Turbincarpus im Bild. Mitteilungen der Turbincarpus-Gruppe</i> 9.</p> <p>Nagl, H. &amp; al., eds (1999): <i>Der Pseudomacrolele-Krainzianus Komplex. Mitteilungen der Turbincarpus-Gruppe</i> 6.</p> <p>Perndl, H. (2001): <i>Turbincarpus pseudomacrolele und seine infraspezifischen Taxa – Teil II. Mitteilungen der Turbincarpus-Gruppe</i> 10: 3-9.</p> <p>Sajeva, M. &amp; A. M. Orlando (1989): Handbook for the identification of the Cactaceae included in the Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). <i>Piante Grasse</i> 9(4), supplement.</p> <p>Zachar, M., R. Staník, A. Lux, I. Dráb (1996): <i>Rod Turbincarpus</i>. Vydavatel'stvo Roman Staník. Bratislava.</p>

# Turbinicarpus pseudomacrochele ssp. minimus

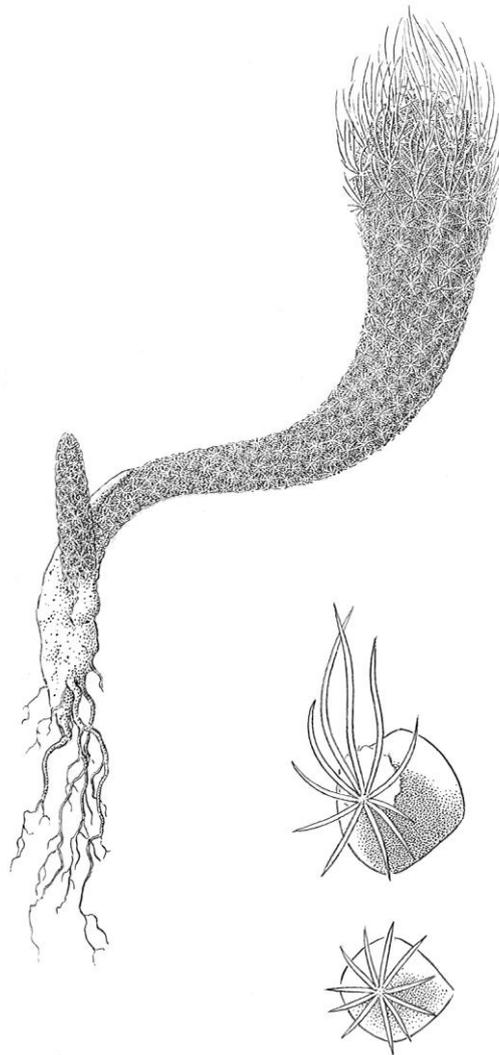
(G. Frank) J. Lüthy &amp; Hofer 1999



**Common names:** none

**Scientific synonyms:** = *Turbinicarpus krainzianus* fa. *minimus* G. Frank 1989  
 = *Turbinicarpus krainzianus* var. *minimus* (G. Frank) Diers 1990  
 = *Neolloydia krainziana* var. *minima* (G. Frank) A. T. Powell 1995 (nom. inval.)  
 = *Turbinicarpus pseudomacrochele* fa. *minimus* (G. Frank) Zachar & al., 1996

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Dwarf, clustering cactus with globular stem apex, very slender, variably elongated, cylindrical stem base and big taproot. Strongly dimorphic. Juvenile stems (seedling or branches of adult specimens) densely covered with white, short, radiating spines, mature stems with long, thin, tortuous spines in the apex. Immature stems predominating in the clusters. Stem bluish-green with short tubercles. Grows in fissures of limestone cliffs.

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**Roots:** 40-60 (-100) mm long, napiform.  
**Stem:** Clustering, 15-20 mm high (in cultivation much elongated and decumbent, 10 cm), 8-12 mm Ø, club-shaped, elongated, with a very slender stem base and a globular apex.  
**Tubercles:** Rhomboidal at the base, conoidal above, up to 4 mm high.  
**Areoles:** White woolly, becoming naked with age.  
**Spines:** 6-8, ± tortuous, 12-30 mm long, the upper longest, flexible, non-pungent, first yellowish brown, becoming grey with dark tip.  
**Flowers:** Several flowering periods, flowers from the centre of the stem apex, slender funnelform, 2 cm long, pale yellow to cream coloured.  
**Fruits:** Ovate to globose, 3-5 mm Ø, green, becoming reddish at maturity, dehiscent by longitudinal slit.  
**Seeds:** 0.6 mm long, 0.4 mm wide, ovoid, black with finely tuberculate surface.  
**Juvenile plants:** Very different from adult specimens, narrowly columnar, densely covered by short, white, radiating spines, 11-16 per areole (the same as in young branches of adult specimens).

**Distribution:** State of Hidalgo, Mexico.



**Trade:** Endemic to a small region in Hidalgo. Discovered in april 1987 by the German collector H. J. Bonatz. Despite the recent discovery and introduction, this taxon is already well distributed in collections and widely available in trade, due to its easy propagation from seeds. It is quite popular for its dwarf size and status as a novelty. Nurseries registered for artificial propagation: Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The species *Turbinicarpus pseudomacrochele* is well characterised for its numerous, tortuous, thin, non-pungent spines and napiform root as well as for the strong dimorphism between seedlings and adult specimens. The 3 subspecies however can easily be confounded. Ssp. *minimus* is characterised by a club-shaped, elongated, slender stem and freely branching growth.

**Bibliography:** Zachar, M., R. Staník, A. Lux, I. Dráb (1996): Rod Turbinicarpus. Vydavatel'stvo Roman Staník. Bratislava.  
Lechner, P., ed. (2000): Turbinicarpus im Bild. Mitteilungen der Turbinicarpus-Gruppe 9.  
Nagl, H. & al., eds (1999): Der Pseudomacrochele-Krainzianus Komplex. Mitteilungen der Turbinicarpus-Gruppe 6.  
Perndl, H. (2001): Turbinicarpus pseudomacrochele und seine infraspezifischen Taxa – Teil II. Mitteilungen der Turbinicarpus-Gruppe 10: 3-9.

# Turbinicarpus pseudomacrochele

## ssp. pseudomacrochele

(Backeb.) Buxb. &amp; Backeb. 1937

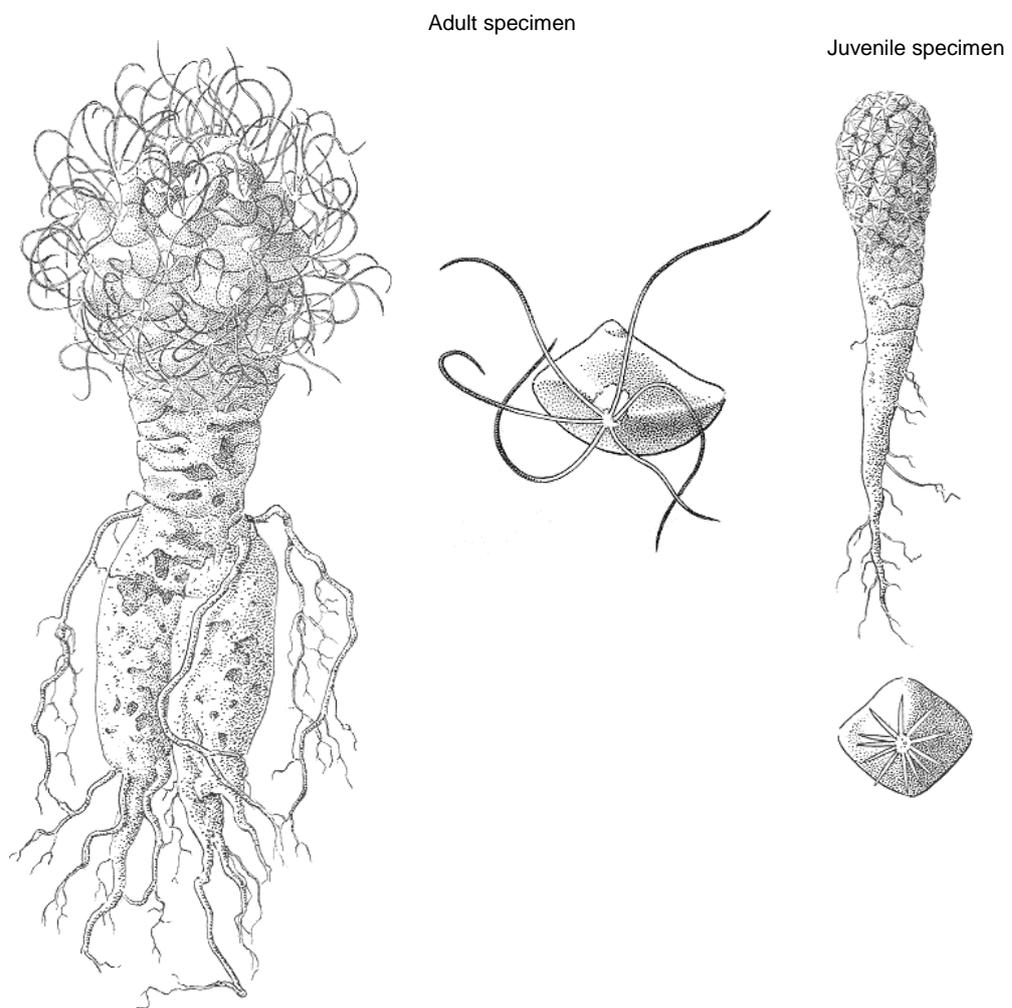


**Common names:** engl.: Hairy-spined turbinicarpus

**Scientific synonyms:**

- = *Strombocactus pseudomacrochele* Backeberg 1935
- = *Toumeyia pseudomacrochele* (Backeberg) Bravo 1946
- = *Neolloydia pseudomacrochele* (Backeberg) E. F. Anderson 1986
- = *Pediocactus pseudomacrochele* (Backeberg) Halda 1998
- = *Kadenicarpus pseudomacrochele* (Backeberg) Doweld 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, globular, very cryptic, bluish-green cactus with rather flat, rounded tubercles, a big taproot and very characteristic, distinctly tortuous, thin, non pungent spines obscuring the white-woolly apex. Strongly dimorphic, juvenile plants densely covered with short, white, radiating spines. Grows on gentle slopes of hills in humus-rich soil with limestone gravel.

**Roots:** Stem base and thick taproot forming a napiform unit.  
**Stem:** Usually solitary (freely branching in grafted specimens), up to 6 cm high including the deep-seated, subterranean stem base, 3 cm Ø, globose to globose-cylindrical, pale green or bluish, with a white woolly apex.  
**Tubercles:** Rather flat, Rounded, weakly angled, 6-8 mm long.  
**Areoles:** Oblong, strongly white woolly, becoming naked with age.  
**Spines:** 5-8, up to 3 cm long, thin, flexible, tortuous, non pungent, yellowish-brown, becoming grey with age (no dimorphism of spines, no division into radial and central spines).  
**Flowers:** Only a single flowering period, flowers from the centre of the stem apex, 3.3- 5 cm Ø, funnelform, pale pink to white or yellowish, with darker pink midstripe on perianth segments.  
**Fruits:** Ovate to globose, 3-5 mm Ø, green, becoming reddish at maturity, dehiscent by longitudinal slit.  
**Seeds:** Ca. 1 mm long, ovoid, black with finely tuberculate surface.  
**Juvenile plants:** Very different from adult specimens, narrowly columnar, densely covered by short, white, radiating spines, 10-14 per areole, as illustrated (in adult stage fewer and much longer).

**Distribution:** States of Querétaro and Hidalgo, Mexico.



**Trade:** Endemic to a rather extended region, but restricted to small, isolated habitats; open spaces in grassland and low desert shrub. Very well distributed in collections for a long time and very easily artificially propagated, mostly from seeds but also by grafting branches of grafted, freely clustering motherplants. Nurseries registered for artificial propagation: Germany P-DE-1001, P-DE-1002, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The species *Turbinicarpus pseudomacrolele* is well characterised for its numerous, tortuous, thin, non-pungent spines and napiform root as well as for the strong dimorphism between seedlings and adult specimens. The 3 subspecies however can easily be confounded. Ssp. *pseudomacrolele* does not grow in fissures of limestone rock, as both other subspecies, but in gravely soil. It is characterised by rather flat tubercles (not slightly elongated, as in ssp. *krainzianus*). Sparse branching as well as a thicker, non-elongated stem base separates it from ssp. *minus*.

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
 Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
 Hunt, D. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Lechner, P., ed. (2000): *Turbinicarpus im Bild*. *Mitteilungen der Turbinicarpus-Gruppe* 9.  
 Nagl, H. & al., eds (1999): *Der Pseudomacrolele-Krainzianus Komplex*. *Mitteilungen der Turbinicarpus-Gruppe* 6.  
 Perndl, H. (2001): *Turbinicarpus pseudomacrolele und seine infraspezifischen Taxa – Teil II*. *Mitteilungen der Turbinicarpus-Gruppe* 10: 3-9.  
 Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.



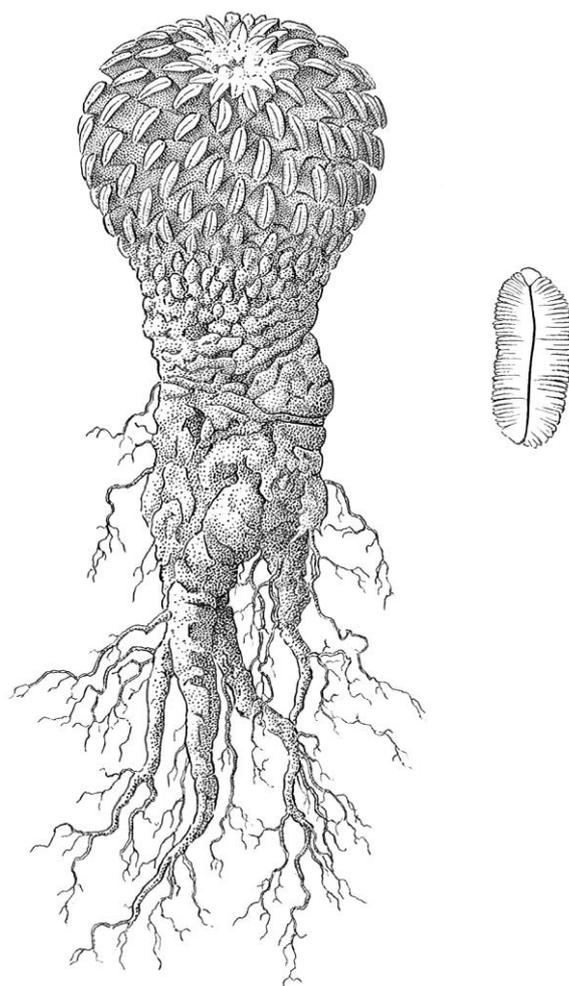
# Turbinicarpus pseudopectinatus (Backeberg) Glass & Foster 1977

**Common names:** none

**Scientific synonyms:**

- = *Solisia pseudopectinata* Backeberg 1930 (nom. nud.)
- = *Pelecyphora pseudopectinata* Backeberg 1935
- = *Mammillaria pseudopectinata* (Backeberg) Kelsey & Dayton 1942
- = *Thelocactus pseudopectinatus* (Backeberg) E. F. Anderson & Boke 1969
- = *Normanbokea pseudopectinata* (Backeberg) Kladiwa & Buxbaum 1969
- = *Neolloydia pseudopectinata* (Backeberg) E. F. Anderson 1986
- = *Pediocactus pseudopectinatus* (Backeberg) J. J. Halda 1998
- *Turbinicarpus pseudopectinatus* ssp. *jarmilae* Halda & Chvastek 2000

**CITES category:** Appendix II 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, very cryptic cactus with flattened stem apex and elongated, subterranean stem base and taproot, outstanding for the strongly comb-like or pectinate arrangement of the densely set, white spines, which is shared with only two other species of cacti (see below). Grows in fine limestone gravel, with which it blends extremely well, on hilltops and gentle slopes in open Chihuahuan desert vegetation.

**Roots:** Stem base and thick taproot forming a napiform unit.  
**Stem:** Solitary, deep seated and largely subterranean in habitat, only stem apex emerging from the substrate, depressed globose to flattened, 2-3 cm high, 2-3 (-4) cm Ø, bluish-green, hidden by the numerous spines.  
**Tubercles:** Laterally compressed and hatchet shaped, 3-3.5 mm long, 2-3 mm broad at base, 3 mm high, truncate.  
**Areoles:** Linear, 3-4 mm long, 0.5-2 mm broad, with some dehiscent, white wool.  
**Spines:** 44-56, pectinate, straight, very densely set, appressed, 0.5-1.8 mm long, white to glassy, yellowish toward the base. No central spines.  
**Flowers:** From the centre of the stem apex, funnel-shaped, 2-3.5 cm long, ± 3 cm Ø, white to pink to deep pink with light to deep pink midstripe on perianth segments.  
**Fruits:** 7-8 mm long, 6-7 mm Ø, naked, dark olive green tinged reddish brown, opening by longitudinal slit.  
**Seeds:** 1.1-1.7 mm long, 0.8-1.3 mm Ø, with black, finely tuberculate surface.

**Distribution:** States of Tamaulipas, Nuevo León and San Luis Potosí, Mexico.



**Trade:** Distributed over a large area, but restricted to special habitats. Has been heavily exploited for international trade in the 1960s and 1970s, though not easy to detect, but is locally still abundant. Not only threatened through collecting, but also through road constructions. The species is much appreciated and well distributed in collections. Often plants of different localities are maintained separately in cultivation, especially the more white and the deep pink flowering populations. The latter, long known from north of Dr. Arroyo as "rubriflorus", was recently described as ssp. *jamilae*, but is certainly not worth the rank of a subspecies. Propagation from seeds is quite fast and easy. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Resembles two other Mexican cacti with very similar, pectinate spine arrangement and was formerly attributed to both of them: *Mammillaria pectinifera* Weber and *Pelecypora aselliformis* Ehrenberg (see synonyms). The former has overlapping, interwoven spines and lateral flowers from the axils of the tubercles, the latter has bigger, more truncate tubercles and longer areoles (5-9 mm vs. 3-4 mm) and a greyish epidermis. As the first association was with "*Solisia pectinata*" (= *Mammillaria pectinifera*), the name *Solisia* "pseudo"-pectinata was somewhat unluckily chosen for this *Turbinicarpus* by Backeberg.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
 Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
 Glass, Ch. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
 Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Lechner, P., ed. (2000): *Turbinicarpus* im Bild. Mitteilungen der Turbinicarpus-Gruppe 9.  
 Perndl, H. & P. Lechner (1997): *Turbinicarpus pseudopectinatus*, occurrence and variations. Mitteilungen der Turbinicarpus-Gruppe 3.  
 Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.



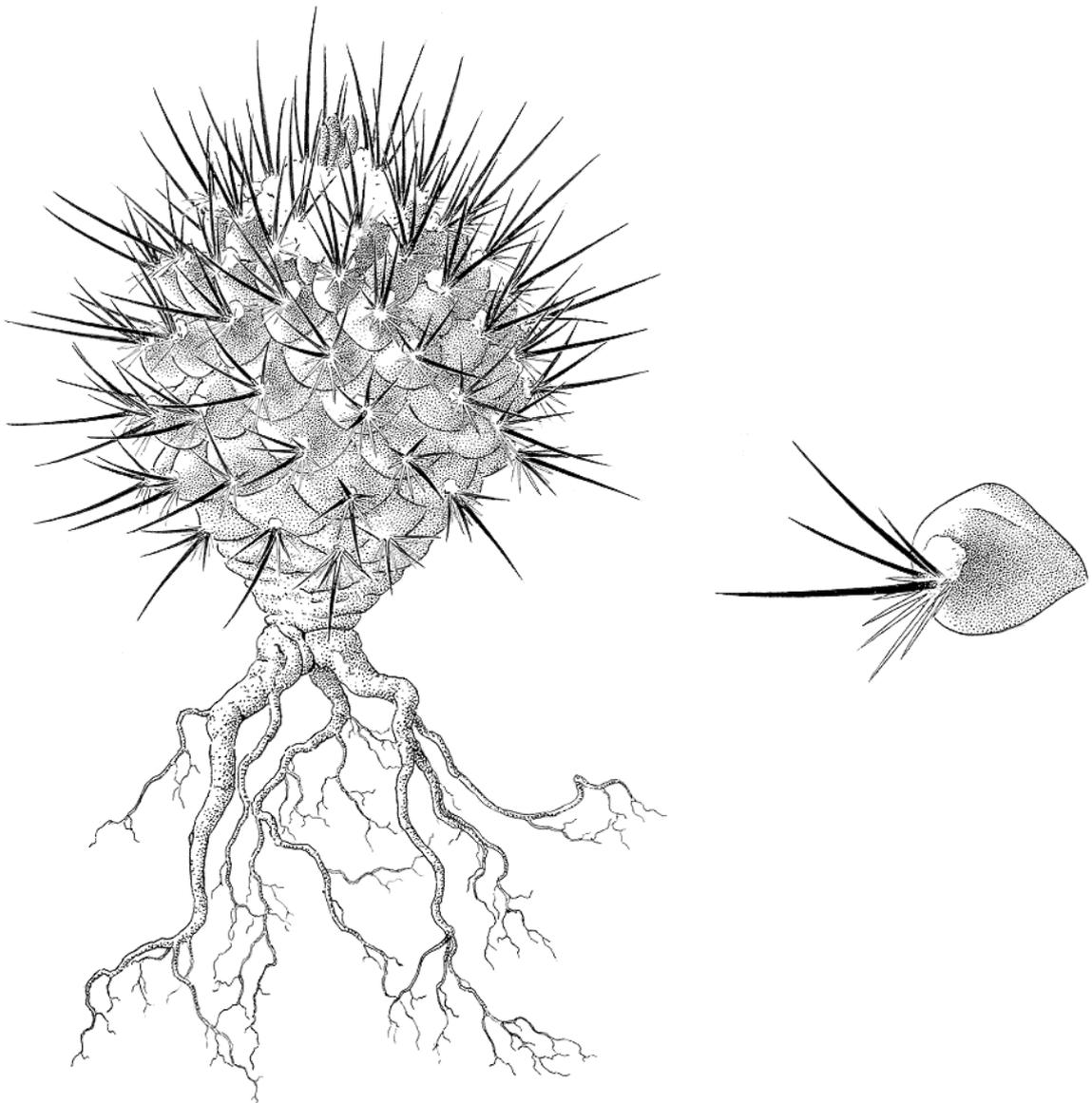
# Turbinicarpus roseiflorus

Backeberg 1963

**Common names:** none

**Scientific synonyms:** = *Strombocactus roseiflorus* (Backeberg) Hewitt 1975 (nom. inval.)  
= *Gymnocactus roseiflorus* (Backeberg) G. Frank 1993  
→ *Neolloydia roseiflora* A. T. Powell 1995 (nom. inval.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Small, globular cactus with distinctly angled, well defined, dull green tubercles, a white woolly apex and rather few spines, not hiding the stem, consisting of short white radials and strongly contrasting, long, dark centrals. Distribution and habitat unknown.

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Roots:	Fibrous.
Stem:	Solitary, globular to slightly flattened, dull green, up to 4 cm Ø, apex with white, dehiscent wool.
Tubercles:	Sixangled and quite sharply limited at base, shortly conical to pyramidal, with distinctly angled and slightly flattened sides and apical areole.
Areoles:	Elliptic, with thick, white wool, especially in the upper, adaxial, floriferous portion of the areole, eventually becoming naked.
Spines:	
Radial spines:	Up to 10-12 in younger specimens, later fewer, very short to max. 5 mm long, radiating, pure white (lower ones in the areole) to horn coloured with darker tips (in the upper part of the areole).
Central spines:	1-2, in a vertical line, ascending, curved towards the apex, mostly twice the length of the radials, black.
Flowers:	From the centre of the stem apex, funnelform, 2.5 cm long, pure pink.
Fruits:	Not described.
Seeds:	Not described.
<b>Distribution:</b>	Wild origin unknown, described from specimens in cultivation in the Saint-Pie collection, Asson, Basses-Pyrénées, France. If ever <i>T. roseiflorus</i> should prove to be a natural species, the origin must be Mexico, most probably the State of San Luis Potosí.
<b>Trade:</b>	Various quite different looking plants are in trade under this name, and not all correspond to the first description by Backeberg. Some of the impostors probably are hybrids. As the natural habitat is unknown, there are also speculations that Backeberg's original material of <i>T. roseiflorus</i> may have been an artificial hybrid originating from horticulture. However, the plants described and illustrated by Backeberg showed little variation and specimens propagated from seeds are consistent, which would rather indicate a good species. It would not be the first species that has to be rediscovered in nature long after its introduction into cultivation. Nurseries registered for artificial propagation: Germany P-DE-1001, P-DE-1002, Czech Republic P-CZ-1003, Switzerland P-CH-1001.
<b>Similar species:</b>	Compared by Backeberg with <i>T. lophophoroides</i> (Werdermann) Buxbaum & Backeberg, but differs quite strongly by lack of a napiform root and having a much stronger spination with black centrals. The black-and-white spination is rather reminiscent of <i>T. viereckii</i> (Werdermann) John & Riha, which however has a much denser spination (up to 22 radials, to 13 mm long and up to 5 centrals, to 20 mm long), obscuring the stem and clusters with age.
<b>Bibliography:</b>	Anderson, E. F. (1985): A revision of the genus <i>Neolloydia</i> B. & R. (Cactaceae). <i>Bradleya</i> 4: 1-28. Backeberg, C. (1979): <i>Kakteenlexikon</i> , ed. 6. Gustav Fischer Verlag, Stuttgart, pp. 444; 782. Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): <i>Las Cactáceas de México</i> , ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México. Hunt, D. (1999): CITES Cactaceae Checklist, 2 <sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Turbinicarpus saueri ssp. knuthianus

(Bödeker) J. Lüthy 2001

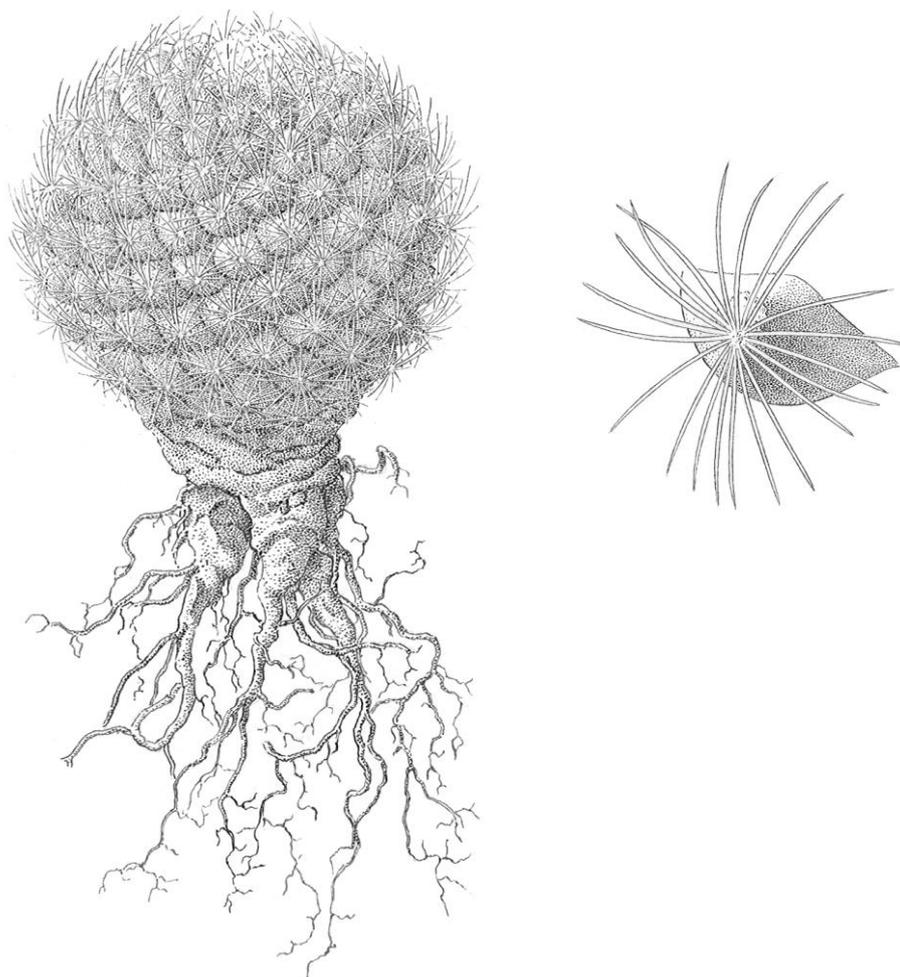


**Common names:** none

**Scientific synonyms:**

- = *Echinocactus knuthianus* Bödeker 1930
- = *Neolloydia knuthiana* (Bödeker) Knuth 1935
- = *Thelocactus knuthianus* (Bödeker) Borg 1937
- = *Gymnocactus knuthianus* (Bödeker) Backeberg 1951
- = *Turbinicarpus knuthianus* (Bödeker) John & Riha 1983
- = *Pediocactus knuthianus* (Bödeker) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Small, globular, tuberulate cactus, notably green and densely covered with silvery-glassy to slightly yellowish, curved, radiating spines, but stem not completely obscured.

- Roots:** Fibrous.
- Stem:** Solitary or sometimes branching from the base and forming small groups, individual stems globose to depressed globose, 3-6 cm high, about 6 cm Ø, shiny leaf-green, apex sunken, lightly covered with wool and spines.
- Tubercles:** Conical, 4-5 mm long, 5-7 mm broad, 5-7 mm high.
- Areoles:** Elliptic, 1-2 mm Ø, 8-9 mm apart, naked on young plants, on older plants with white wool, especially in the apex.
- Spines:**
- Radial spines:** 18-20, silvery white to yellowish, 6-8 mm long, very thin acicular, smooth, stiff, spreading horizontally, ± recurved towards the stem, slightly yellowish at base.
  - Central spines:** 1, somewhat ascending and incurved, to 10 mm long, slightly thicker than the radials, often in the upper portion barely discernibly grey to black-brown.
- Flowers:** Numerous, from the centre of the stem apex, funnelform, to 2.5 cm long and 1.8-2.5 cm Ø, light pink.
- Fruits:** Ovate, bright green to brown, 7-9 mm long, 7-8 mm Ø, fleshy at maturity, dehiscent by longitudinal slit.
- Seeds:** 1.2 mm long, 0.8-1.1 mm Ø, nearly ovate, test black, finely tuberculate.

**Distribution:** State of San Luis Potosí, Mexico.



- Trade:** Endemic to the Region of Cerritos, where it is fairly common on low mountain ranges. Has been in cultivation for quite a long time and is well represented in collections. Reproduces very well from seed, which is easy to produce and also by rooting or grafting branches. Demand therefore is moderate, no negative influence on wild populations from collecting is reported. Nurseries registered for artificial propagation: Germany P-DE-1001, Switzerland P-CH-1001.
- Similar species:** Rather distinctive, but sometimes compared with *Turbinicarpus laui*, which has a similar stem and flower, but only 6-7 spines. *T. saueri* ssp. *knuthianus* is closely related to ssp. *saueri*, which has only 12-14 radial spines, two dark brown centrals and a pale blue-green stem. The seedlings show a different development: Whereas ssp. *saueri* changes from plumose (juvenile) spines to naked (subadult) spines at the age of one year, ssp. *knuthianus* makes this change after two or more years.
- Bibliography:**
- Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.
  - Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.
  - Glass, Ch. E. (1998): *Identification Guide to Threatened Cacti of Mexico*. Fideicomiso Fondo para la Biodiversidad. Mexico.
  - Hunt, D. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Turbinicarpus saueri ssp. nelissae

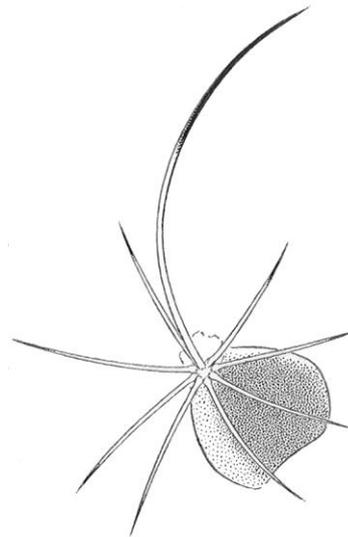
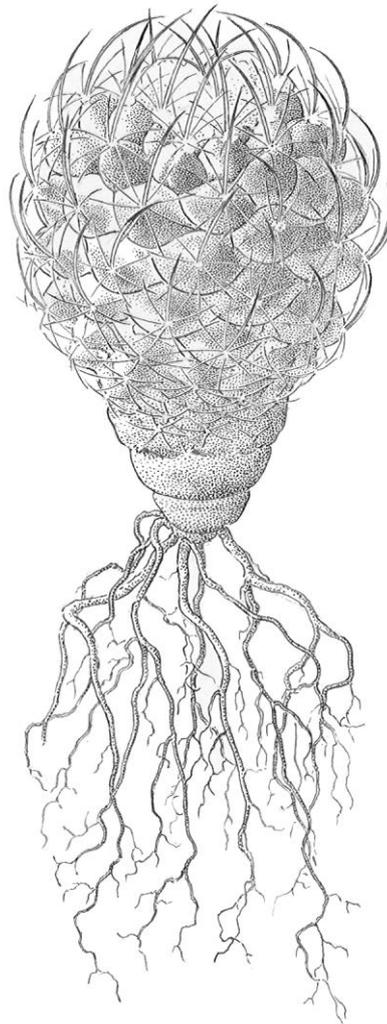
Halda & Panarotto 1998



**Common names:** none

**Scientific synonyms:** →*Gymnocactus preenii* (hort.) nom. nud.

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Small, globular, tuberculate, bluish-green cactus with white-woolly apex, short tubercles and rather few thin, radiating, glassy white and partly black-tipped spines. Grows among limestone rocks in open woodlands.

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Roots: Fibrous.  
Stem: Solitary, globose, with a deep-seated stem base, 6-7 cm Ø and 7-8 cm high, pale green to bluish-green, stem apex with white wool.  
Tubercles: Somewhat angular in outline, rounded above, 3-5 mm long.  
Areoles: Slightly elliptical, 5-6 mm Ø, 8-11 mm apart.  
Spines:  
    Radial spines: 8-14, 0.5-10 mm long, acicular, glassy white, radiating, ± straight.  
    Central spines: 1, about 10-35 mm long, greyish-black, acicular, ascending. 2 types can be observed in horticulture: individuals with ascending, straight centrals or with centrals curved towards the apex.  
Flowers: From the centre of the stem apex, 2 cm long, pale pink, narrowly funnelform.  
Fruits: Ca. 6 mm long, hidden in the apical wool, globose, naked, dehiscent by a longitudinal slit.  
Seeds: Ca. 1 mm long, with shiny black seedcoat, finely tuberculate.

**Distribution:** State of Tamaulipas, Mexico.



**Trade:** Local endemic, known from a single locality. Has been in cultivation since the mid 1980s under the unpublished name *Gymnocactus preenii* (after its discoverer Roger Preen from Germany) or as *Turbinicarpus* "spec. Bustamante". It is not well known among collectors and demand is moderate. Artificial propagation from seed is very fast and easy; seeds can be found in trade. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** A bit similar to *T. saueri* ssp. *saueri*, which differs by rounder tubercles as well as more numerous and slightly stronger spines, with shorter centrals. Ssp. *nelissae* interestingly has seedlings with non-plumose spines, much unlike ssp. *saueri*, whose seedlings have strongly plumose spines in the first year. Ssp. *ysabelae* differs more strongly by bigger dimensions and much stronger spination with more numerous, yellowish, rather straight radials and a distinctly ascending to appressed central. Ssp. *knuthianus* is quite similar, but has more numerous spines (18-20 radials) and the seedlings produce plumose spines in the first two years or longer. *Turbinicarpus viereckii* is similar in its glassy-white radial and dark-tipped central spines, but it usually branches and has longer, straight spines with 13-22 radials and most distinctively 3-5 ± porrect centrals.

**Bibliography:** --

# Turbinicarpus saueri ssp. saueri

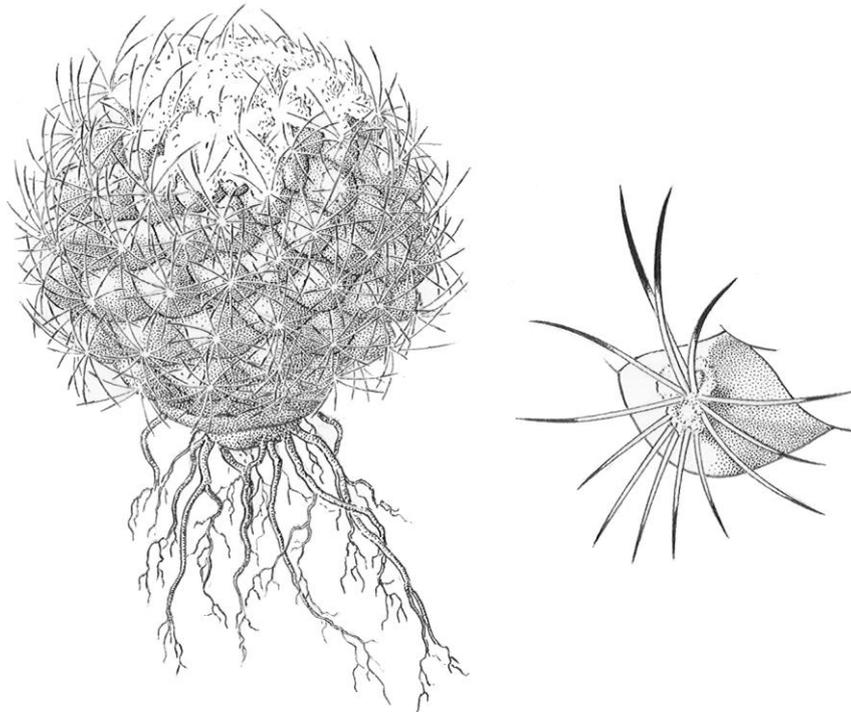
(Bödeker) John & Riha 1983



**Common names:** none

**Scientific synonyms:** = *Echinocactus saueri* Bödeker 1928  
= *Neolloydia saueri* (Bödeker) Knuth 1935  
= *Thelocactus saueri* (Bödeker) Borg 1937  
= *Gymnocactus saueri* (Bödeker) Backeberg 1938  
= *Pediocactus saueri* (Bödeker) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Small, globular, tuberculate, bluish-green cactus with white-woolly apex, short tubercles and radiating, elegantly recurved, glassy white and partly black-tipped spines. Grows among limestone rocks.

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**Roots:** Fibrous.  
**Stem:** Solitary, depressed globose to quite flattened, tuberculate, up to 5 cm high, to 7.5 cm Ø, shiny, pale greyish to blue-green, with a distinct woolly apex.  
**Tubercles:** Somewhat angular in outline, rounded above, 9-10 mm long, 7-9 mm broad, 2-5 mm high.  
**Areoles:** Slightly elliptical, 5-6 mm Ø, 8-11 mm apart, with white, dehiscent wool, later yellowish.  
**Spines:**  
    **Radial spines:** 12-14, 5-10 mm long, acicular, glassy white, evenly radiating, slightly recurved.  
    **Central spines:** 1-3 (usually 1), about 15 mm long, thicker than the radials, dark brown, erect, curving slightly upward, acicular.  
**Flowers:** From the centre of the stem apex, 1.5-2 cm long, 2-2.5 cm Ø, funnellform, whitish, often tinged rose.  
**Fruits:** Small, greenish, 4-7 mm long, 3-5 mm Ø, hidden in the apical wool, globose, naked, dehiscent by a longitudinal slit, somewhat dry at maturity.  
**Seeds:** 1.1 mm long, 0,7 mm thick, black with finely tuberculate surface.

**Distribution:** State of Tamaulipas, Mexico.



**Trade:** Known from a very restricted area. Introduced in horticulture quite a long time ago, but rather surprisingly not widely distributed; however quite easily propagated from seeds. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** Quite similar to *T. saueri* ssp. *ysabellae*, which differs by bigger dimensions and stronger spination with more numerous, yellowish, rather straight radials and a distinctly ascending to appressed central. Ssp. *nelissae* differs by rather fewer and thinner spines with a long central, up to 35 mm and seedlings with non-plumose spines from beginning. Ssp. *knuthianus* is quite similar, but has more numerous spines (18-20 radials) and retains the plumose juvenile spination for two or more years, whereas ssp. *saueri* changes from plumose to naked spines after one year. *Turbincarpus viereckii* is similar in its glassy-white radial and dark-tipped central spines, but it usually branches and has longer, straight spines with 13-22 radials and most distinctively 3-5 ± porrect centrals.

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* 4: 1-28.  
Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
Glass, Ch. E. (1998): *Identification Guide to Threatened Cacti of Mexico*. Fideicomiso Fondo para la Biodiversidad. Mexico.  
Hunt, D. (1999): *CITES Cactaceae Checklist*, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Turbinicarpus saueri

## ssp. ysabelae

(K. Schlange) J. Lüthy 1999

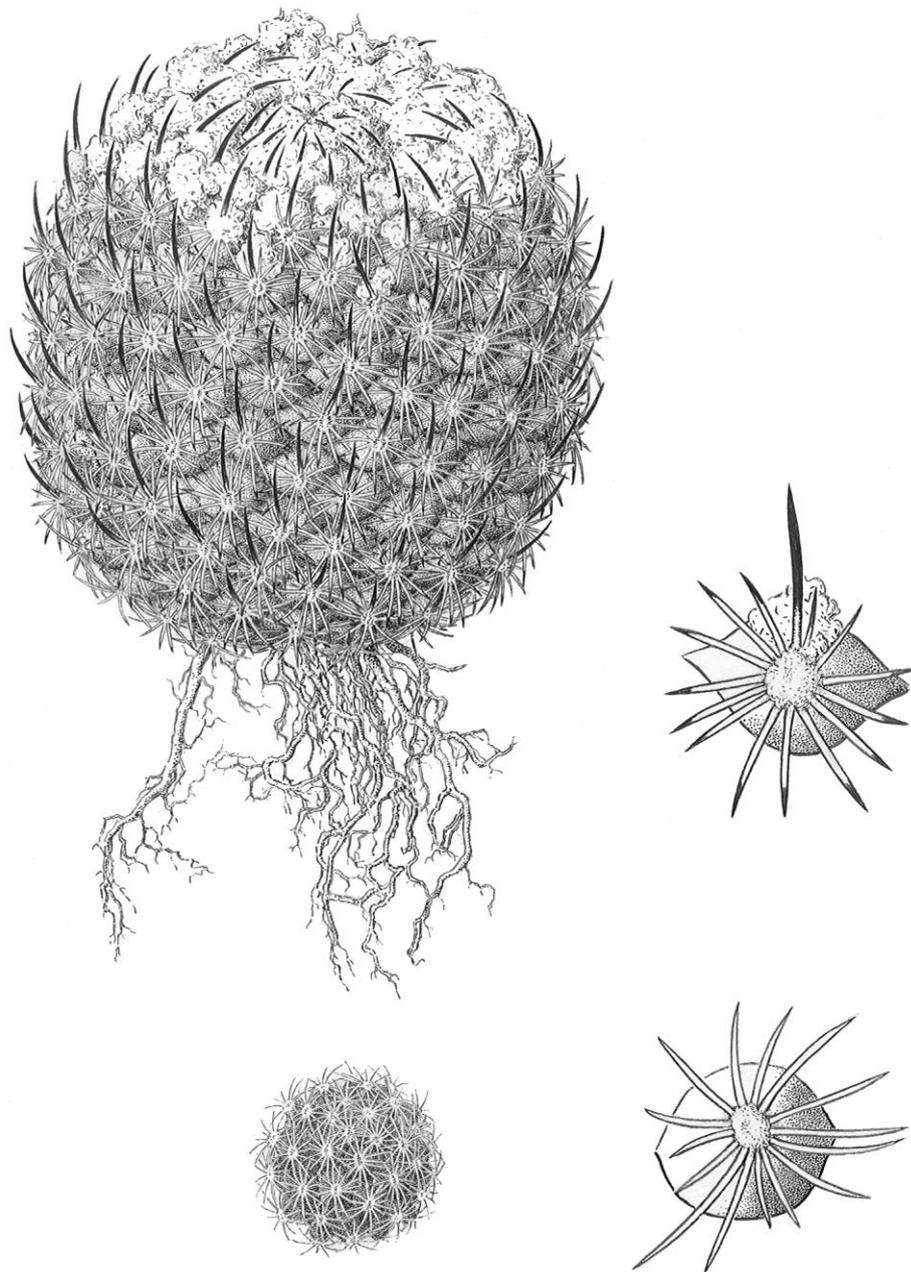


**Common names:** none

**Scientific synonyms:**

- = *Thelocactus ysabelae* K. Schlange 1934
- = *Gymnocactus ysabelae* (K. Schlange) Backeberg 1961
- = *Turbinicarpus ysabelae* (K. Schlange) John & Riha 1983
- = *Neolloydia knuthiana* var. *ysabelae* (K. Schlange) A. T. Powell 1995 (nom. inval.)
- = *Pediocactus ysabelae* (Schlange) J. J. Halda 1998
- *Thelocactus ysabelae* var. *brevispinus* K. Schlange 1934
- = *Gymnocactus ysabelae* var. *brevispinus* (K. Schlange) Backeberg 1961
- = *Turbinicarpus ysabelae* var. *brevispinus* (K. Schlange) John & Riha 1983

**CITES category:** Appendix II since 01.07.1975, transferred to Appendix I in 11.06.1992 (Prop. US).



- Characteristics:** Small to medium sized, medium green, globular, tuberculate cactus with nicely radiating, quite strong, white-translucent radial spines and, in adult specimens only, a single, strongly contrasting, ascending, black central spine. Tubercles slightly angled. The apex is covered with rather persistent, white wool. Grows on hillsides in gravelly soil among limestone rocks in open Chihuahuan desert vegetation.
- Roots:** Fibrous.
- Stem:** Medium green, depressed-globose (cultivated specimens tend to grow to a more slender, columnar shape), ca. 6 cm high, 7-9 cm  $\varnothing$ , apex depressed, woolly.
- Tubercles:** Short, stout, 5 mm long, 4-5-angled, 7 mm  $\varnothing$  at base, sub-terete at tip.
- Areoles:** Oblong, 3-4 mm long, 1.5-2 mm wide, strongly woolly when young, prolonged into a short woolly groove beneath the spines on the upper (adaxial) side of the tubercle.
- Spines:** Circular in cross section, acicular.
- Radial spines:** 16-20, 2-7 mm long, slightly bulbous at base, translucent, glassy white, yellowish at base and with yellowish brown tips, radiating and slightly recurved towards the stem, the longer radials in the upper and lower parts of the areole, the lateral ones shorter, making a rhomboidal outline and only slightly overlapping with radials of adjacent areoles.
- Central spines:** Solitary, located in the upper part of the areole, sometimes growing directly in line with the radials, slightly flattened and incurved, 7-9 mm long, chalky white with greyish to bluish black tip, bluish black when young.
- Flowers:** From the centre of the stem apex, funnel-shaped, 24 mm long, 10 mm or more in  $\varnothing$ , pinkish-white.
- Fruits:** Hidden in the apical wool, globose, naked, greenish, becoming dry, opening by a longitudinal slit.
- Seeds:** 1.2 mm long, 0.9 mm wide, with black, finely tuberculate surface.
- Juvenile plants:** Lacking central spines.

**Distribution:** States of Tamaulipas and possibly San Luis Potosí, Mexico.



- Trade:** As documented today, this taxon is a local endemic of a single, small locality and seems to be one of the most endangered cacti. It was completely absent from cultivation after its discovery in 1931 in San Luis Potosí and has been recollected only by Castañeda around the 1950s in Tamaulipas, but has not been reintroduced until its second rediscovery in 1984 by Italian cactus collectors Battaia & Zanovello near the city of Tula in Tamaulipas. Illegally wild-collected specimens have been found subsequently in Germany and Switzerland and the impact from heavy collecting is reported in a CITES project (Anderson, unpublished). Demand for this "novelty" is rather high. Today, seeds are readily available in commercial trade and plants from artificial propagation are found in a growing number of collections. They are most probably by far outnumbering the remaining individuals in the habitat. Nursery registered for artificial propagation: Switzerland P-CH-1001.
- Similar species:** *Turbinicarpus saueri* ssp. *saueri* (Bödeker) John & Riha from the same region is very similar, it only differs in smaller stem size and finer, longer spination with 12-14 radials, up to 10 mm long and notably interwoven and 2 more protruding centrals, up to 15 mm long, as well as slight differences in the microstructure of the seeds. The flowers are virtually identical.
- Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). In: *Bradleya* 4/1986, p. 1-28.  
 Battaia, L. & C. Zanovello (1985): In Messico a caccia di *Turbinicarpus* etc....(2). *Piante Grasse* 5 (2): 71-82.  
 Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
 Glass, Ch. E. (1998): Identification Guide to Threatened Cacti of Mexico. Fideicomiso Fondo para la Biodiversidad. Mexico.  
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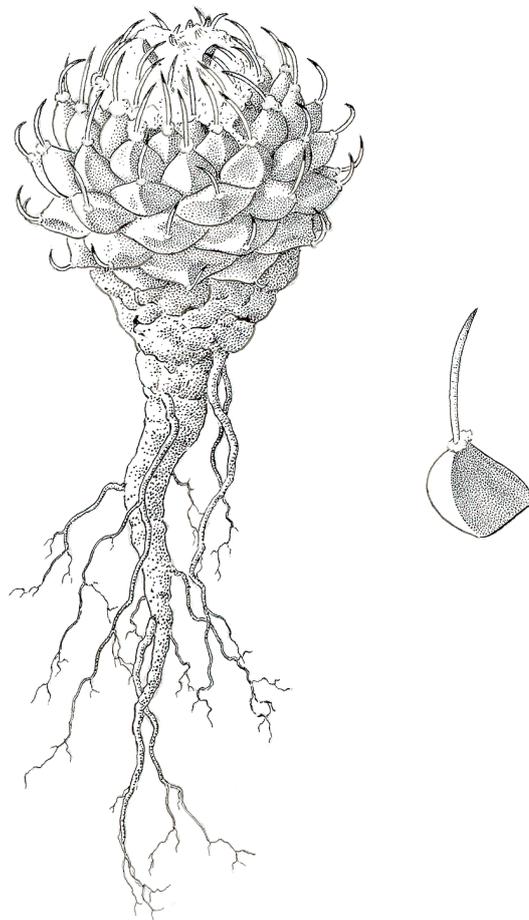
# Turbinicarpus schmiedickeanus ssp. andersonii



**Common names:** engl.: Anderson's turbinicarpus

**Scientific synonyms:** → *Turbinicarpus schmiedickeanus* var. *panarottoi* Riha 1996 (nom. inval.)  
= *Turbinicarpus schmiedickeanus* ssp. *panarottoi* (Riha) J. Lüthy 1999 (nom. inval.)  
→ *Turbinicarpus klinkerianus* var. *rubriflorus* Zachar & al. 1996 (nom. nud.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Dwarf, globular, distinctly tuberculate, dull cactus, quite cryptic in habitat, with a single, short, non-pungent, grey spine per areole. Grows in fine limestone gravel, with which it blends well, on gentle hills in open Chihuahuan desert vegetation.

**Roots:** Stem base and root forming a napiform unit.  
**Stem:** Solitary, globose to depressed-globose, 2-3 cm high, 2-5 cm Ø, dull blue-green, divided into tubercles, apex woolly, not covered by spines.  
**Tubercles:** Quite prominent, elongated, broadly sixangled at base, 5-10 x 3-6 mm, 5-8 mm high, conical with notably keeled edges.  
**Areoles:** With some white, dehiscent wool.  
**Spines:** Typically 1 single, very short, sharply ascending spine, directed towards the centre of the stem apex, grey with darker tip, flexible, non pungent, flattened, papery.  
**Flowers:** Appearing from november-february from the centre of the stem apex, funnelform, white with deep pink throat, the perianth segments with deep pink midvein and base.  
**Fruits:** Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.  
**Seeds:** Ca. 1 mm long, seedcoat black, tuberculate.  
**Juvenile specimens:** Densely covered with numerous strongly plumose, white radial spines, ca. 8-12 per areole, horizontally spreading, gradually changing to adult spination by first producing additional central spines and later centrals only and no radials.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** A sad example of overexploitation for international trade. The taxon has first been documented in 1963 by Edward F. Anderson, but considered to be identical with ssp. *klinkerianus*. It was subsequently in trade as “red flowering *klinkerianus*”. In 1993-1994, the Italian cactus trader Paolo Panarotto “discovered” the taxon in its habitat. In 1995, nearly the entire population was taken from the habitat and wild-collected specimens were traded in 1996 in Czech Republic as a novelty: “*T. panarottoi*”. In the same year, the taxon was invalidly published as *T. schmiedickeanus* var. *panarottoi* Riha (no holotype was indicated). Ssp. *andersonii* is still in rather high demand by collectors of the genus. It is still better known under the invalid name “*panarottoi*”, as the valid publication of ssp. *andersonii* is not known to most collectors. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** The *T. schmiedickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, “cardboard-like” or “paper-like”, spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers and immature specimens may look quite different in the various subspecies (ssp. *schmiedickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). Ssp. *andersonii* is characterised by red throated flowers, appearing in winter, by rather elongated, angled tubercles and by a single, very short, sharply ascending spine (tubercle and spine characters as in ssp. *klinkerianus*). The typical *T. schmiedickeanus* ssp. *klinkerianus* is very similar, differing mainly by its flowering period during summer and the white flower colour as well as the typically slightly longer spines and the sometimes higher number of spines (1-3). Not surprisingly, ssp. *andersonii* was first distributed as “red flowering *klinkerianus*”.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* (4): 1-28.  
 Lechner, P. & H. Perndl (1996): Rotschlundige Winterblüher – die *Schmiedickeanus*-Gruppe. *Mitteilungen der Turbinicarpus-Gruppe* 1.  
 Lechner, P., ed. (2000): *Turbinicarpus* im Bild. *Mitteilungen der Turbinicarpus-Gruppe* 9.  
 Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.

# Turbinicarpus schmiedickeanus ssp. bonatzii

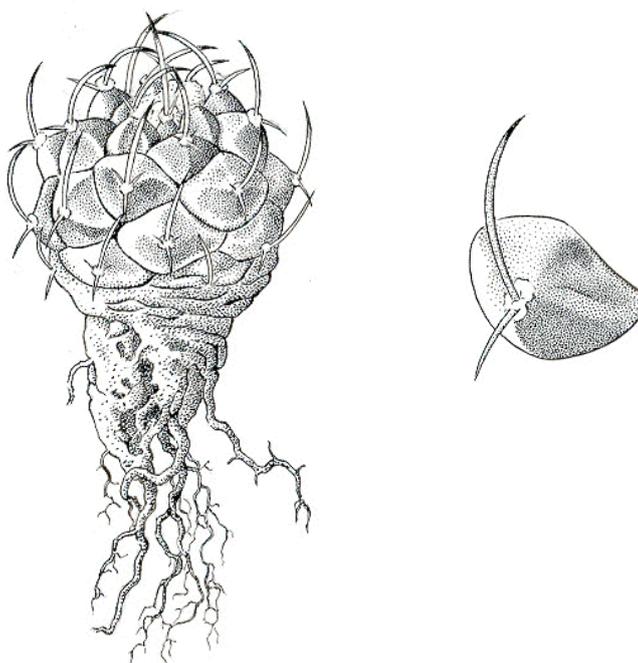
(G. Frank) Panarotto 1999



**Common names:** engl.: Cerritos turbinicarpus

**Scientific synonyms:** = *Turbinicarpus bonatzii* G. Frank 1992  
= *Pediocactus bonatzii* (G. Frank) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



- Characteristics:** Dwarf, globular, distinctly tuberculate cactus with rather few, non-pungent spines, extremely cryptic in habitat.
- Roots:** Stem base and root forming a napiform unit.
- Stem:** Deep-seated, only the stem apex emerging above the substrate, solitary, depressed globose, 1.5-2.0 cm Ø, dull dark green, divided into tubercles, apex woolly, not covered by spines.
- Tubercles:** Quite prominent, elongated, rhomboidal at base, notably keeled below.
- Areoles:** With some white, dehiscent wool.
- Spines:** Typically 2 (-4), grey, flexible, non pungent, flattened, papery, the upper stronger, interpreted as central, ascending and curved towards the apex, 15-20 mm long, the lower interpreted as radial, distinctively descending, curved, weak and dehiscent, often soon shed, thin, 3-5 mm long. Rarely two additional, lateral spines, similar to the descending spine.
- Flowers:** Appearing in winter, from january-february from the centre of the stem apex, funnellform, 10 mm long, 12-15 mm Ø, white with a red centre. Style pink, stigma white.
- Fruits:** Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.
- Seeds:** Ca. 0.8-1 mm long, seedcoat black, tuberculate.

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**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Local endemic of the region of Cerritos, San Luis Potosí. First collected 1991 by the German cactophile H. J. Bonatz, for whom it was named. Highly in demand among collectors specialised in the genus, as a novelty. Already fairly well distributed in collections of specialists and observed in trade as artificially propagated seedlings. Population decimated by illegal collecting. Propagation from seeds quite fast and easy. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** The *T. schmidickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, “cardboard-like” or “paper-like”, spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers, flowering time and immature specimens may differ in the various subspecies (ssp. *schmidickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). Ssp. *bonatzii* is well characterised within the *T. schmidickeanus*-complex by one of the spines distinctively pointing downwards, as only observed here and in ssp. *flaviflorus*, but the lower and lateral (if present) spines are much weaker than in ssp. *flaviflorus*, where a cruciform arrangement of 4 rather strong spines is the rule. It is similar to ssp. *klinkerianus*, but geographically separated, its ascending spine is longer, its tubercles are slightly keeled, rhomboidal and it distinctively flowers in winter.

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): Turbinicarpus im Bild. Mitteilungen der Turbinicarpus-Gruppe 9.  
Zachar, M., R. Staník, A. Lux, I. Dráb (1996): Rod Turbinicarpus. Vydavatel'stvo Roman Stanik. Bratislava.

# Turbinicarpus schmiedickeanus ssp. flaviflorus

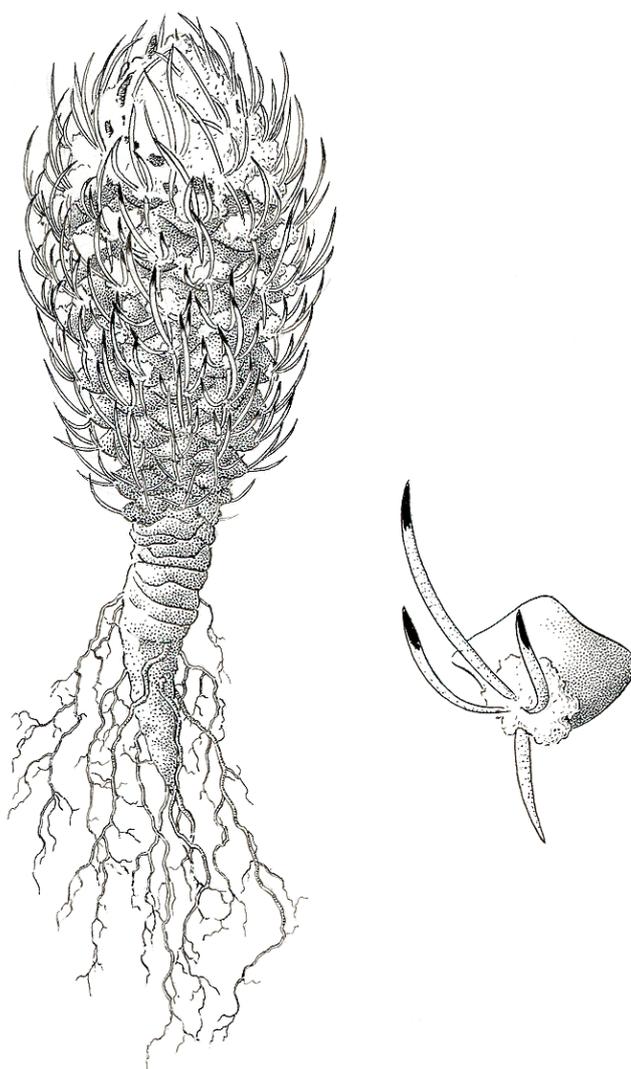
(G. Frank & Lau) Glass 1998



**Common names:** none

**Scientific synonyms:** = *Turbinicarpus flaviflorus* G. Frank & Lau 1979  
= *Turbinicarpus schmiedickeanus* var. *flaviflorus* (G. Frank & Lau) Glass & Foster 1979  
= *Neolloydia schmiedickeana* var. *flaviflora* (G. Frank & Lau) E. F. Anderson 1986  
= *Pediocactus schmiedickeanus* var. *flaviflorus* (Frank & Lau) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, club-shaped to much elongated cactus with globular, distinctly tuberculate stem apex, quite densely covered with non-pungent, grey spines with dark tips, cryptic in habitat. Grows in fissures of limestone outcroppings on hillsides in Chihuahuan desert vegetation.

**Roots:** Stem base and root forming an elongated napiform unit.  
**Stem:** Solitary, clubshaped, to 3 cm long, 1-2 cm Ø (to much elongated and decumbent in cultivated specimens), greenish grey, with white wool in the apex (cultivated specimens often covered with conspicuous amounts of white wool, hiding the tubercles).  
**Tubercles:** Rhomboid at base, conical, tapering rapidly toward the tip.  
**Areoles:** Round, with conspicuous amounts of white, dehiscent wool.  
**Spines:** 4 (-6), all interpreted as centrals, typically arranged in a cross, 1 of them shorter, descending, appressed, 2 laterals spreading horizontally and curved upwards, 1 (-3) upper ascending, curved inwards, longest, up to 30 mm, all cardboard-like, brown in new growth, becoming grey with age.  
**Flowers:** Appearing from the centre of the stem apex, funnellform, ca. 1.5 cm long, 1-1.5 mm Ø, pale greenish yellow.  
**Fruits:** Elongate-ovate, 1 cm long, dark green at the base, apex dark brown somewhat fleshy at maturity, opening by a longitudinal slit.  
**Seeds:** Ca. 1 mm long, seedcoat black, tuberculate.  
**Juvenile specimens:** Stem much elongated, slender, cylindrical, soon reaching a subadult spination with 4 short centrals, arranged in a cross. Spines later gradually reaching full length and stem apex reaching full diameter.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Discovered by the German collector Alfred Lau. Endemic to a very restricted region, known from a single locality in central San Luis Potosí, where it is not abundant and probably was driven to near extinction by unscrupulous collecting for international trade. Demand has been very high after publication in 1979, but since has dropped, as the taxon is well represented in collections today and propagation from seed is fast and easy. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The *T. schmiedickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, "cardboard-like" or "paper-like", spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers and immature specimens may look quite different in the various subspecies (ssp. *schmiedickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). Ssp. *flaviflorus* is very distinct, showing a crosswise arrangement of the spines with one spine always descending and ± appressed. The crosswise arrangement of the spines with a strong descending central is unique within the whole *T. schmiedickeanus*-complex. In ssp. *bonatzii*, the descending spine is very weak and the lateral spines are often missing. The much elongated stem of seedlings and adult individuals of ssp. *flaviflorus* is unique within this group. Similarly crosswise arranged, "cardboard-like" spines are found in the similar-sized, dwarf *Pediocactus peeblesianus* (Croizat) L. Benson, but here, the spines are white and relatively short (3-7 mm) and the stem is globular.

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* (4): 1-28.  
 Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
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 Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
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 Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.

# Turbinicarpus schmiedickeanus ssp. gracilis

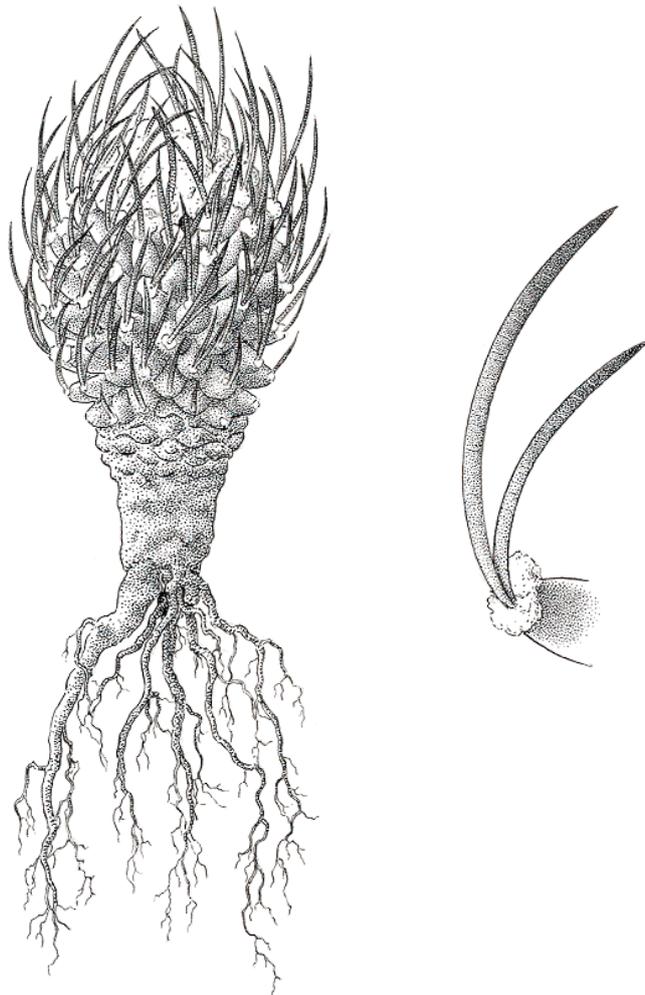
(Glass & Foster) Glass 1998



names: none

**Scientific synonyms:** = *Turbinicarpus gracilis* Glass & Foster 1976  
= *Turbinicarpus schmiedickeanus* var. *gracilis* (Glass & Foster) Glass & Foster 1977  
= *Neolloydia schmiedickeana* var. *gracilis* (Glass & Foster) E. F. Anderson 1986  
= *Pediocactus schmiedickeanus* var. *gracilis* (Glass & Foster) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, globular, distinctly tuberculate cactus, quite densely covered with non-pungent, grey spines, cryptic in habitat. Grows in fissures of bare limestone outcroppings.

Roots: Stem base and root forming a napiform unit.  
Stem: Solitary, 1.5-2.5 cm high, 1.5-3 cm Ø, dull greyish-green, with some white wool in the apex.  
Tubercles: Slender, elongated and tapering, ca. 7 mm long, 3-5 mm broad at base, ca. 1.8 mm Ø at tip, slightly angled, nearly terete.  
Areoles: Round, with white, dehiscent wool.  
Spines: 2-4 (-6), flattened, thin and papery, non pungent, flexible, 1 (-3) longer central spines ca 1.8-2.3 cm long 1 mm wide, grey, erect and curved, 1-3 additional, short, 2 mm long, white, deflexed spines in lower portion of areole, perpendicular to axis of tubercle.  
Flowers: Appearing from the centre of the stem apex, slender funnellform, 2 cm long, 1.8-2.8 cm Ø, white, outer perianth segments with greenish to pink mid-line.  
Fruits: Small, tan, globose, fleshy at maturity, dehiscent by a longitudinal slit.  
Seeds: Ca. 1 mm long, 0.5 mm Ø, seedcoat black, tuberculate.  
Juvenile specimens: Densely covered by ca. 8 horizontally radiating, white radial spines, gradually changing to adult spination by first producing additional central spines and later centrals only, lacking radials.

**Distribution:** State of Nuevo León, Mexico.



**Trade:** Discovered in February of 1971 by US trader Charles Glass in company of Seiichi Osada. Endemic of a very restricted region, known from a single locality in valley of Aramberri in southern Nuevo León, where it was strongly decimated by unscrupulous collecting for international trade after its discovery in 1971, when the demand was very high. Now, the natural population is reported to recover (Glass 1998) and the demand has dropped, as propagation from seed is quite fast and easy. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The *T. schmiedickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, “cardboard-like” or “paper-like”, spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers and immature specimens may look quite different in the various subspecies (ssp. *schmiedickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). Ssp. *gracilis* is quite distinct, having much more slender, elongated tubercles and narrower spines (hence the species name, meaning slender) than all other subspecies. It was compared in literature with its close geographical neighbour, just across the narrow valley, *Turbinicarpus dicksoniae* (Glass & Foster) Glass, but the latter retains the radial spines in adult stage and its central spines are not flattened in cross-section, making it quite distinct.

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Lechner, P., ed. (2000): *Turbinicarpus* im Bild. *Mitteilungen der Turbinicarpus-Gruppe* 9.  
Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.

# Turbinicarpus schmiedickeanus ssp. klinkerianus „schwarzii“

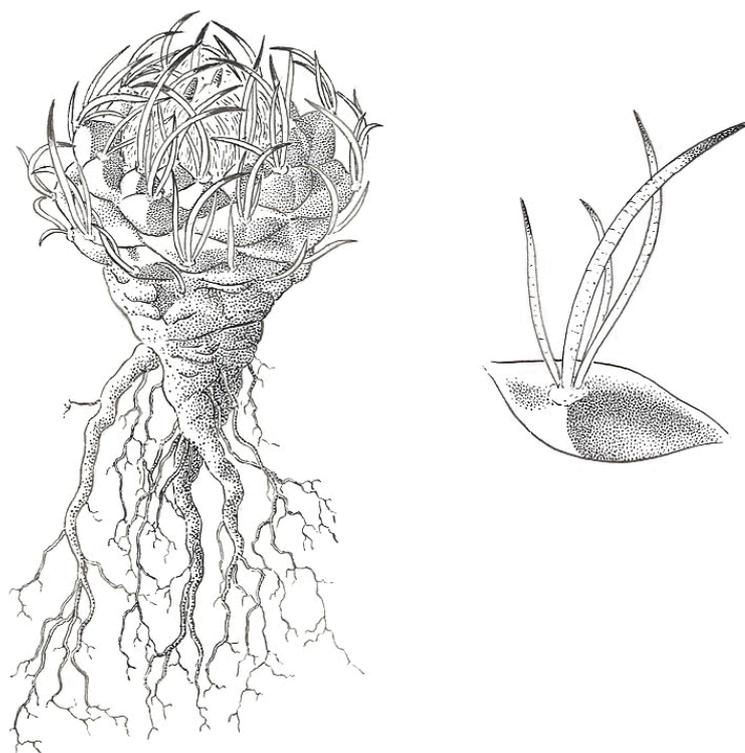


**Common names:** engl.: Schwarz's or Flat-tubercled Turbinicarpus

**Scientific synonyms:**

- = *Strombocactus schwarzii* Shurly 1948
- = *Toumeyia schwarzii* (Shurly) Bravo & W. T. Marshall 1957
- = *Turbinicarpus schwarzii* (Shurly) Backeberg 1951 (comb. nud.)
- = *Thelocactus macrochele* var. *schwarzii* (Shurly) Kladiwa 1976
- = *Turbinicarpus schmiedickeanus* var. *schwarzii* (Shurly) Glass & Foster 1977
- = *Neolloydia schmiedickeana* var. *schwarzii* (Shurly) E. F. Anderson 1986
- = *Pediocactus schmiedickeanus* var. *schwarzii* (Shurly) Halda 1998
- = *Turbinicarpus schmiedickeanus* ssp. *schwarzii* (Shurly) N. P. Taylor 1998
- = *Turbinicarpus schmiedickeanus* ssp. *klinkerianus* fa. *schwarzii* (Shurly) Panarotto 1999

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, globular, distinctly tuberculate cactus, quite cryptic in habitat, covered with curved, non-pungent, spines which typically are horn-coloured when fresh. Grows in fine limestone gravel, with which it blends very well, on gentle hills in open Chihuahuan desert vegetation.

**Roots:** Subterranean stem base and root forming a napiform unit.

**Stem:** Deep-seated, only the stem apex emerging above the substrate, solitary, depressed globose, turbinate, pale green, 3.5 cm Ø, divided into tubercles, apex with little wool, covered by spines.

**Tubercles:** Broadly rhomboidal at base, low, rounded, stumpy.  
**Areoles:** On the tip of the tubercles, with some white, dehiscent wool.  
**Spines:** Interpreted as centrals, 1-2 (-4), distinctively horn coloured when fresh (in the stem apex), later bleached and turning grey, the lower spine(s) if present 4-5 mm long, the upper one up to 20 mm long, ascending and curved towards the stem apex, flexible, non pungent, flattened, papery, later dehiscent.  
**Flowers:** Appearing in summer, from July to September, from the centre of the stem apex, funnellform, up to 3 cm long, 2.5-3.2 cm Ø, white, style faint purple, stigma white.  
**Fruits:** Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.  
**Seeds:** Ca. 1 mm long, seedcoat black, tuberculate.  
**Juvenile specimens:** Soon changing from a few white, horizontally radiating, plumose radial spines to 2 ascending, curved centrals and subsequently to adult spination.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Local endemic, thought to correspond with a population near Guadalcázar, San Luis Potosí (no type locality has originally been indicated). Widely distributed in cultivation for a long time. Demand moderate, propagation from seeds fast and not difficult. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The *T. schmiedickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, “cardboard-like” or “paper-like”, spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers and immature specimens may look quite different in the various subspecies (ssp. *schmiedickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). The “typical *schwarzii*” is characterised by flattened tubercles and typically 1-2 long (up to 20 mm), ascending and curved, distinctively horn coloured spines; it flowers in summer, from July to September. It is often confounded with *Turbinicarpus schmiedickeanus* ssp. *macrochele*, especially the southern “*polaskii*” form, for the flat, broad tubercles; “*polaskii*” however has usually only a single, shorter (up to 12 mm) spine per areole and flowers with very long, pink stigma lobes. The population described as *T. schwarzii* var. *rubriflorus* should rather be associated with ssp. *schmiedickeanus*, as it has red flowers which appear in winter. Its spines are even longer than in ssp. *schwarzii* (up to 25 mm), but typically not simply curved, but twisted back and forth or curled and the tubercles are more elongated. In fact, “*schwarzii*” seems to be very closely related to ssp. *klinkerianus*, the latter differing by typically more elongated and more distinctly angled tubercles and usually a single, rather short (up to 9 mm), ascending spine. Further, ssp. *rioverdensis* could be confounded for its equally flattened tubercles, but it has notably shorter (12 mm), irregularly twisted, variously oriented spines.

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 Jantschgi, G. & P. Lechner (1998): Das *Klinkerianus*–*Macrochele* Problem. *Mitteilungen der Turbinicarpus-Gruppe* 4.  
 Lechner, P., ed. (2000): *Turbinicarpen im Bild*. *Mitteilungen der Turbinicarpus-Gruppe* 9.  
 Zachar, M., R. Staník, A. Lux & I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Staník. Bratislava.

# Turbinicarpus schmiedickeanus ssp. klinkerianus

(Backb. &amp; Jacob.) Taylor 1998

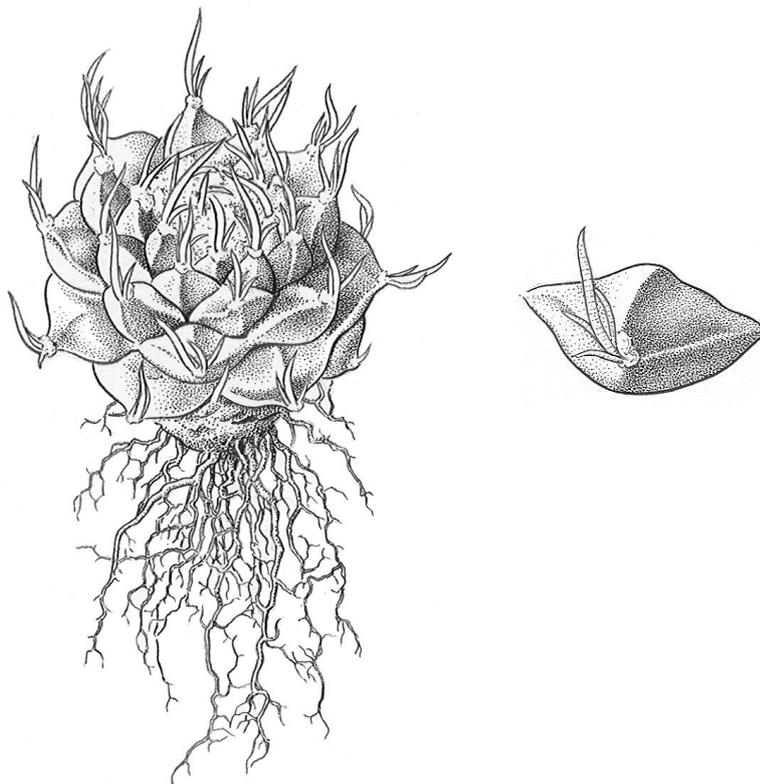


**Common names:** engl.: Huizache or Klinker's turbinicarpus

**Scientific synonyms:**

- = *Turbinicarpus klinkerianus* Backeberg & Jacobsen 1948
- = *Strombocactus klinkerianus* (Backeberg & Jacobson) Buining 1951
- = *Toumeyia klinkeriana* (Backeberg & Jacobson) Bravo & W. T. Marshall 1956
- = *Toumeyia schmiedickeana* var. *klinkeriana* (Backeberg & Jacobson) Krainz 1959
- = *Strombocactus schmiedickeanus* var. *klinkerianus* (Backeberg & Jacobson) Rowley 1974
- = *Turbinicarpus schmiedickeanus* var. *klinkerianus* (Backeberg & Jacobson) Glass & Foster 1977
- = *Neolloydia schmiedickeana* var. *klinkeriana* (Backeberg & Jacobson) E. F. Anderson 1986
- = *Pediocactus schmiedickeanus* var. *klinkerianus* (Backeberg & Jacobson) J. J. Halda 1998
- = *Turbinicarpus schmiedickeanus* ssp. *klinkerianus* (Backeberg & Jacobsen) P. Panarotto 1999

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.7.1983 (Prop. USA).



**Characteristics:** Dwarf, globular, distinctly tuberculate cactus with slightly angled tubercles, separated by a minute furrow and often with a single, quite short, ascending, non-pungent spine. Plants cryptic in habitat. Grows in fissures of limestone outcroppings on hillsides in Chihuahuan desert vegetation.

**Roots:** Stem base and root forming a napiform unit.

**Stem:** Deep-seated, only the stem apex emerging above the substrate, solitary, globose to depressed-globose, 2-3 cm high, 2-5 cm Ø, dull blue-green, sometimes becoming brownish, divided into tubercles, apex woolly, not obscured by spines.

**Tubercles:** Quite prominent, elongated near the apex, later flattened, broadly five- to sixangled at base, 5-10 x 3-6 mm, 5-8 mm high, conical with notably keeled edges.

**Areoles:** With some white, dehiscent wool.

**Spines:** All interpreted as centrals, typically 3, 1 lower, stronger, erect, 7-8 (-9) mm long, 2 upper-lateral, smaller, dehiscent, often soon shed, all ascending and curved towards the apex, grey with darker tip, flexible, non pungent, flattened, papery.

**Flowers:** Appearing in summer from the centre of the stem apex, funnellform, 1.5-2.3 cm long, 1-2.7 cm Ø, white to yellowish.

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Fruits: Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.  
Seeds: Ca. 1 mm long, seedcoat black, tuberculate.  
Juvenile specimens: Densely covered with numerous strongly plumose, white radial spines, ca. 8-12 per areole, horizontally spreading. Gradual change to adult spination by first producing one additional central spine and later centrals only, lacking radials.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Endemic to a rather extended region from Huizache in the north to Charco Blanco in the south and westward to La Negrita and the Sierras Los Lebrillos and Las Pilas in central San Luis Potosí. Classified as Low Risk/Potentially Threatened (Sotomayor & al. 2000). Well represented in collections and trade for a long time, demand moderate, artificial propagation from seeds fast and easy. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The *T. schmidickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, "cardboard-like" or "paper-like", spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers, flowering time and immature specimens may differ in the various subspecies (ssp. *schmidickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). The "typical" ssp. *klinkerianus* is characterised by a very short, erect, dominating central spine, often accompanied by 1-3 much smaller spines, not covering the stem apex and by somewhat angled, elongated tubercles. The popular "*schwarzii*", traditionally kept apart in horticulture, but of somewhat doubtful origin and position, is separately treated here, following horticultural tradition, but not at subspecies level. The population that has been identified in the field (no type locality has originally been indicated), lies within the range of ssp. *klinkerianus*. It differs by flattened tubercles and typically 1-2 long (up to 20 mm), curved, horn coloured spines. Ssp. *macrochele*, which shows much similar characters with flattened tubercles in its southern populations, known as "*polaskii*", is much confounded with "*schwarzii*", but has usually only a single, shorter (up to 12 mm) spine per areole and most significantly, a pink stigma with very long lobes; "*polaskii*" is also confounded with "typical" ssp. *klinkerianus*, but is different in its long stigma lobes. Three further taxa are quite similar. Ssp. *rioverdensis* is geographically separated and has typically 2 irregularly twisted and curved, short (max. 12 mm), distinctively appressed spines and flattened tubercles as well as a bigger flower, ssp. *bonatzii* is geographically separated and has one ascending and one rather weak, descending, curved spine, slightly keeled, rhomboidal tubercles and it flowers most distinctively in winter, from january-february. Further, *T. schmidickeanus* ssp. *andersonii* Mosco shows the same general aspect as ssp. *klinkerianus*, but has even shorter spines and most distinctively flowers in winter, showing a red-throated flower. It is therefore also known to collectors as "red flowering *klinkerianus*".

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
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Lechner, P., ed. (2000): Turbinicarpus im Bild. *Mitteilungen der Turbinicarpus-Gruppe* 9.  
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# Turbinicarpus schmiedickeanus ssp. macrochele

(Werdermann) N. P. Taylor 1998

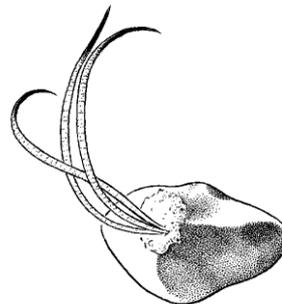
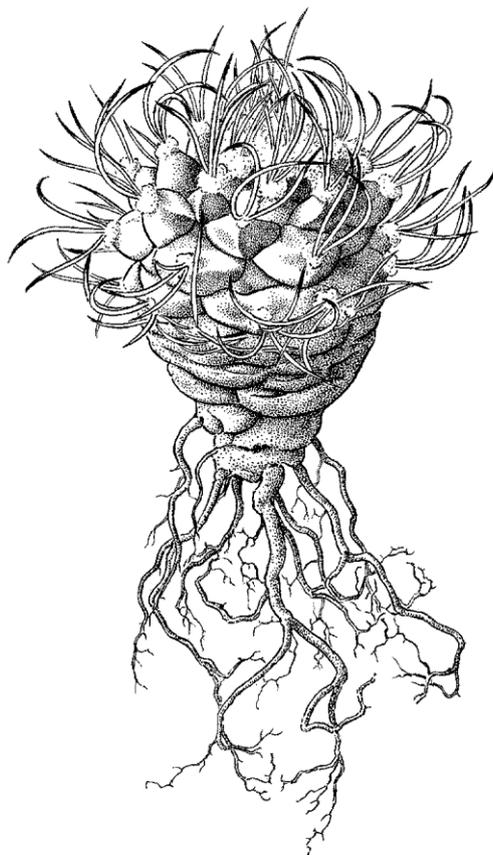


**Common names:** engl.: Long-spined or Matehuala turbinicarpus

**Scientific synonyms:**

- = *Echinocactus macrochele* Werdermann 1931
- = *Strombocactus macrochele* (Werdermann) Backeberg 1936
- = *Turbinicarpus macrochele* (Werdermann) Buxbaum & Backeberg 1937
- = *Toumeyia macrochele* (Werdermann) Marshall 1946
- = *Thelocactus macrochele* (Werdermann) Kladiwa, 1975
- = *Turbinicarpus schmiedickeanus* var. *macrochele* (Werdermann) Glass & Foster 1977
- = *Neolloydia schmiedickeana* var. *macrochele* (Werdermann) E. F. Anderson 1986
- = *Pediocactus schmiedickeanus* var. *macrochele* (Werdermann) J. J. Halda 1998
- = *Turbinicarpus schmiedickeanus* ssp. *macrochele* (Werdermann) P. Panarotto 1999
- ***Turbinicarpus polaskii* Backeberg 1961** (nom. inval.)
- = *Toumeyia schwarzii* var. *polaskii* (Backeberg) Kladiwa 1963 (nom. inval.)
- = *Strombocactus polaskii* (Backeberg) Hewitt 1975 (nom. inval.)
- = *Thelocactus macrochele* fa. *polaskii* (Backeberg) Kladiwa 1976 (nom. inval.)
- = *Turbinicarpis macrochele* var. *polaskii* P. Lechner & Jantschgi 1998
- ***Turbinicarpus macrochele* ssp. *frailensis* P. Lechner & Jantschgi 1998**

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.7.1983 (Prop. USA).



**Distribution:** State of San Luis Potosí, Mexico.



<b>Characteristics:</b>	Dwarf, globular, flattened, distinctly tuberculate cactus, densely covered with typically numerous long, non-pungent, curved, grey spines, extremely cryptic in habitat. Grows in fine limestone gravel, with which it blends very well, on gentle hills in open Chihuahuan desert vegetation.
Roots:	Stem base and root forming a napiform unit.
Stem:	Solitary, small, depressed-globose, 1.5-3 cm high, 2.5-4 cm Ø, dull bluish- to greyish-green, divided into tubercles, stem base shrunken and corky, apex slightly sunken and woolly.
Tubercles:	Rounded, broadly rhomboidal to sixangled at base, 6-12 (-18) mm x 4-8 mm, 2-4 mm long, slightly elongated, conical and slightly keeled below to strongly flattened (" <i>polaskii</i> ").
Areoles:	Oblong, ca. 2 mm long, with dirty white wool, later becoming naked.
Spines:	Commonly 3-4 but sometimes lacking or only 1-2, rarely up to 6, 20-27 (-40) mm long, all of about the same length, all porrect to ascending, irregularly curved and twisted, generally curved inwards, interwoven and hiding the stem apex, flexible, non pungent, yellowish in the stem apex, later turning grey, flattened, papery, with a minute adaxial furrow (spines lacking at the sides and base of the stem in wild collected specimens).
Flowers:	Appearing from (January-) March-September from the centre of the stem apex, 2.3-3.5 cm Ø, 2-2.6 cm long, pinkish-white. Stigma with long (-6.5 mm!) pink lobes (type and " <i>polaskii</i> ") or short (2-3.5 cm), white to yellowish lobes (ssp. <i>frailensis</i> ).
Fruits:	Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.
Seeds:	Ca. 1 mm long, seedcoat black, tuberculate.
Juvenile specimens:	Abruptly changing from 5-8 white, plumose, horizontally radiating radial spines to the non-plumose adult spination at a very early stage (much earlier than the very similar ssp. <i>klinkerianus</i> ).
<b>Trade:</b>	Endemic of the region of Matehuala, San Luis Potosí. The taxon is well distributed in collections. Artificial propagation from seeds is fast and easy and demand therefore is rather moderate. A more western population, which lacks the characteristic, long, pink stigma lobes and shows short, yellowish stigma lobes instead, has been described as <i>T. macrochele</i> ssp. <i>frailensis</i> P. Lechner & Jantschgi. This " <i>frailensis</i> " population has been known for a long time before its description and consequently is already represented in collections. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.
<b>Similar species:</b>	The <i>T. schmidickeanus</i> -complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, "cardboard-like" or "paper-like", spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers and immature specimens may look quite different in the various subspecies (ssp. <i>schmidickeanus</i> , ssp. <i>andersonii</i> , ssp. <i>bonatzii</i> , ssp. <i>flaviflorus</i> , ssp. <i>gracilis</i> , ssp. <i>klinkerianus</i> , ssp. <i>macrochele</i> , ssp. <i>rioverdensis</i> , ssp. <i>rubriflorus</i> ). Ssp. <i>macrochele</i> is characterised by equally strong, rather long spines, generally 3-4 per areole, ascending, curved and twisted (hence the species name, meaning "bearing long claws"), interwoven and covering the stem apex and further by a (pinkish-) white flower, often (type population and " <i>polaskii</i> ") with long, pink stigma lobes. Tubercles are rounded and vary between elongated to much flattened (" <i>polaskii</i> "). <i>T. schmidickeanus</i> ssp. <i>klinkerianus</i> (Backeberg & Jacobsen) Taylor in a broad sense (especially the " <i>schwarzii</i> " population) looks much alike and is often confounded. "Typical <i>klinkerianus</i> " however has rhomboidal, angled, somewhat elongated tubercles and one (to three) very short (7-9 mm), sharply ascending spine(s), "typical <i>schwarzii</i> " has slightly flattened tubercles and may look extremely similar, but has only 1-2 horn coloured spine(s). Ssp. <i>rioverdensis</i> has very similar, flattened tubercles but typically 2 very strongly curved, short (12 mm), appressed spines, ssp. <i>bonatzii</i> typically shows one ascending and quite distinctively, one rather weak, descending spine, both curved. Individual variation sometimes blurs the limits between the mentioned taxa and between them and <i>T. schmidickeanus</i> ssp. <i>macrochele</i> . Especially the southern, flat, weakly spined " <i>polaskii</i> " form of ssp. <i>macrochele</i> is often confounded with the " <i>schwarzii</i> " form of ssp. <i>klinkerianus</i> . The former can be identified by flowers with long, pink stigma lobes and usually only a single, shorter (up to 12 mm) spine per areole.
<b>Bibliography:</b>	Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK. Anderson, E. F. (1985): A revision of the genus Neolloydia B. & R. (Cactaceae). Bradleya (4): 1-28. Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): Las Cactáceas de México, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México. Hunt, D. (1999): CITES Cactaceae Checklist, 2 <sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK. Jantschgi, G. & P. Lechner (1998): Das Klinkerianus – Macrochele Problem. Mitteilungen der Turbinicarpus-Gruppe 4. Jantschgi, G. & P. Lechner (1998): Taxonomische Neuordnung des Macrochele-Aggregates und Beschreibung einer neuen Subspecies. Mitteilungen der Turbinicarpus-Gruppe 5. Lechner, P., ed. (2000): Turbinicarpus im Bild. Mitteilungen der Turbinicarpus-Gruppe 9. Zachar, M., R. Staník, A. Lux, I. Dráb (1996): Rod Turbinicarpus. Vydavatel'stvo Roman Staník. Bratislava.

# Turbinicarpus schmiedickeanus ssp. rioverdensis

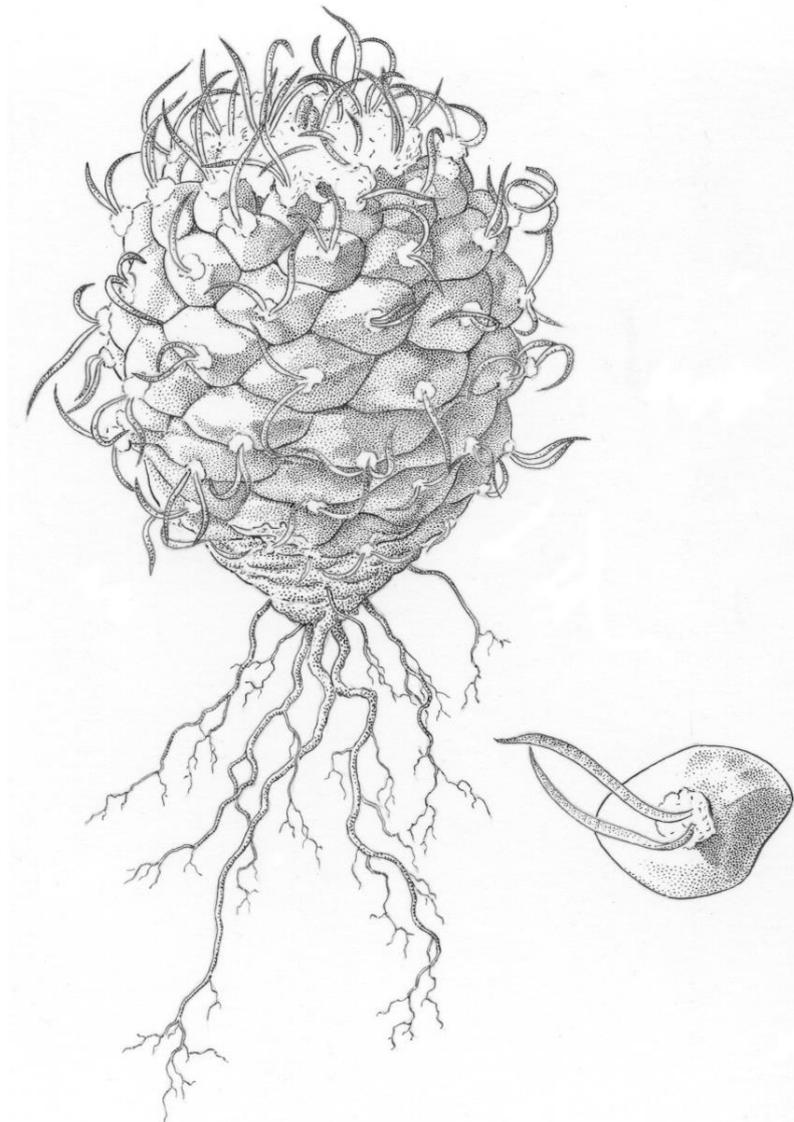
(G. Frank) J. Lüthy 1999



**Common names:** engl.: Rio Verde turbinicarpus

**Scientific synonyms:** = *Turbinicarpus rioverdensis* G. Frank 1992  
= *Pediocactus rioverdensis* (G. Frank) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Dwarf, globular, flattened, distinctly tuberculate cactus, sparsely covered with few irregularly curved and oriented, non-pungent, often appressed, grey spines, extremely cryptic in habitat. Grows in fine limestone gravel, with which it blends very well, on gentle hills in open spaces of quite dense vegetation dominated by rather high bushes.

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**Roots:** Stem base and root forming a napiform unit.  
**Stem:** Deep-seated, only the stem apex emerging above the substrate, solitary, depressed-globose, up to 3.5 cm Ø, pale green, divided into tubercles, apex woolly, not covered by spines.  
**Tubercles:** Broadly rhomboidal at base, low, rounded, stumpy.  
**Areoles:** With some white, dehiscent wool.  
**Spines:** All interpreted as centrals, (1-) 2 (-3), up to 12 mm long, grey, flexible, non pungent, flattened, papery, distinctively irregularly twisted and curved, variously oriented, rather appressed, resembling cut fingernails.  
**Flowers:** Appearing in summer from the centre of the stem apex, funnellform, 2.5 cm long and Ø, white. Style white with pale pink stigma lobes.  
**Fruits:** Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.  
**Seeds:** Ca. 1.2 mm long, 0.8 mm broad, seedcoat black, tuberculate.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** Local endemic of the region of Rio Verde, San Luis Potosí. The first reported collection was in 1989. Highly in demand as a novelty among collectors specialised in the genus. Fairly well distributed in collections of specialists and observed in trade as artificially propagated seedlings. Population decimated by illegal collecting. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** The *T. schmiedickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, “cardboard-like” or “paper-like”, spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers, flowering time and immature specimens may differ in the various subspecies (ssp. *schmiedickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). Ssp. *rioverdensis* is outstanding for the big size of its flowers. It is quite similar to ssp. *klinkerianus* (incl. “*schwarzii*”), the main difference being the irregularly twisted, variously oriented, rather appressed spines and the very large flower. Ssp. *rubriflorus* has also flattened tubercles and irregularly twisted spines, but the spines are notably longer (up to 25 mm) and ascending. The “*polaskii*” form of ssp. *macrochele* can look quite similar, but it has notably longer, distinctly ascending spines.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
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Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Jantschgi, G. & P. Lechner (1998): Das Klinkerianus-Macrochele Problem. In: Turbi-Now, Folge 4.  
Lechner, P., ed. (2000): Turbinicarpen im Bild. Mitteilungen der Turbinicarpus-Gruppe 9.  
Zachar, M., R. Staník, A. Lux & I. Dráb (1996): Rod Turbinicarpus. Vydavatel'stvo Roman Staník. Bratislava.

# Turbinicarpus schmiedickeanus ssp. rubriflorus

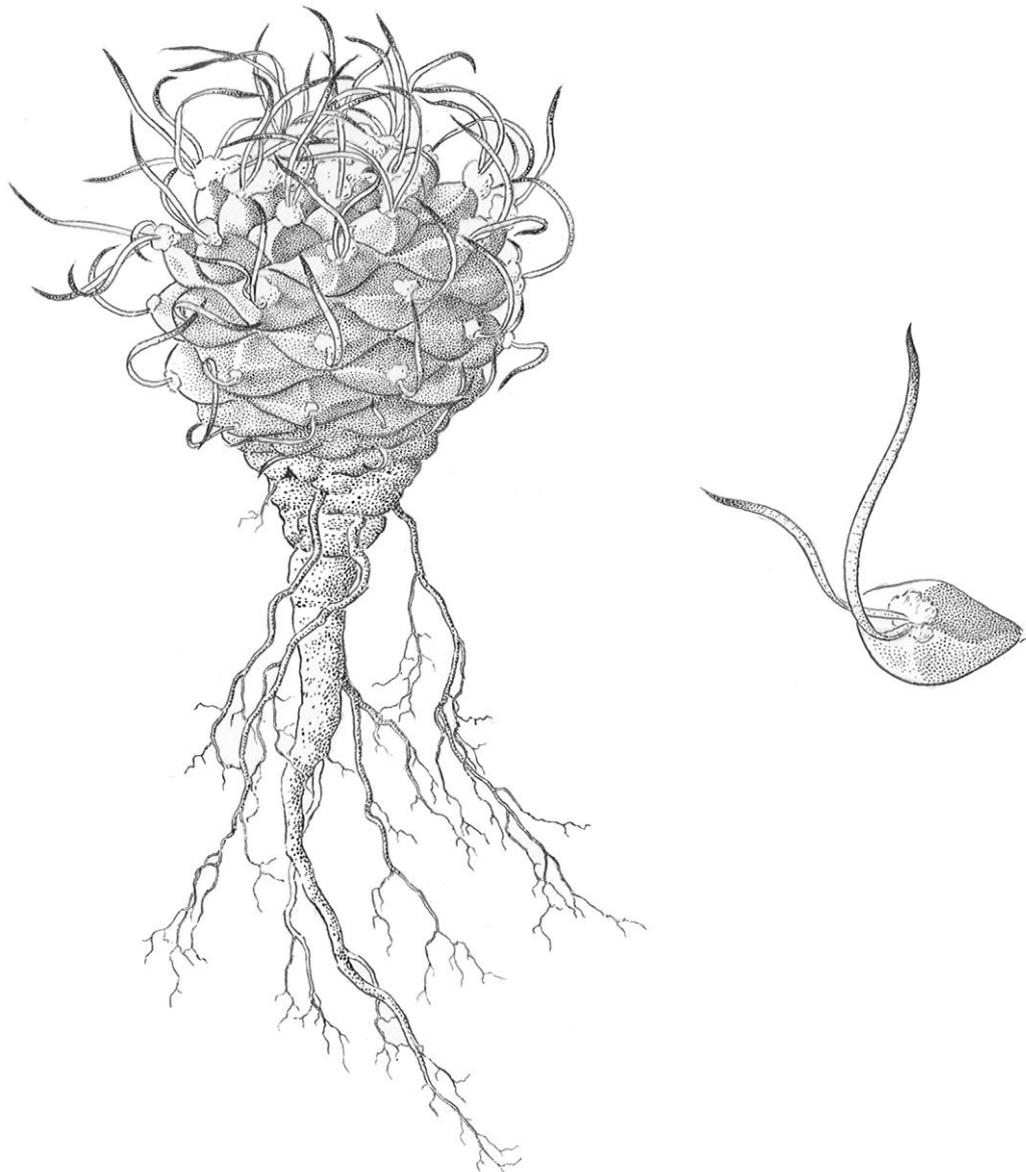
(G. Frank) P. Panarotto 1999



**Common names:** none

**Scientific synonyms:** *Turbinicarpus schwarzii* var. *rubriflorus* G. Frank 1993  
*Pediocactus schmiedickeanus* var. *rubriflorus*(G. Frank) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Dwarf, globular, distinctly tuberculate cactus, covered with quite long, strongly curved to curled, non-pungent spines, quite cryptic in habitat. Grows in fine limestone gravel, with which it blends very well, on gentle hills in open Chihuahuan desert vegetation.

**Roots:** Stembase and root forming a napiform unit.  
**Stem:** Solitary, globose to flattened-globose, up to 3.5 cm Ø (cultivated specimens may be considerably bigger), divided into tubercles, pale green, with some white wool in the apex.  
**Tubercles:** Rhomboidal at base, broad and stumpy with apical areole, axil naked.  
**Areoles:** Round, 2-3 mm Ø, with white, dehiscent wool.  
**Spines:** 1-2 (-3), all interpreted as central spines, the lower one the longest and broadest, up to 25 mm, ascending, irregularly and strongly twisted and curved to curled (sometimes back and forth), interwoven in the stem apex, light reddish brown, turning grey with age.  
**Flowers:** Appearing from november-february from the centre of the stem apex, funnelform, 3 cm long, pink, the perianth segments pink or white with a darker pink midvein and base.  
**Fruits:** Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.  
**Seeds:** Ca. 1 mm long, seedcoat black, tuberculate.  
**Juvenile specimens:** Gradually changing from ca. 7 white, horizontally radiating, plumose radial spines to the adult spination by first producing additional central spines and later centrals only, lacking radials.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** In quite some demand by collectors of the genus. The taxon is known from a few sites in a small region only, between Mier y Noriega and Santa Rita and probably never has been very abundant. It has been heavily exploited and has become quite rare. It is in cultivation in Europe as “purple *schwarzii*”, introduced by the US trader Charles Glass, who collected it in 1974. Propagation from seeds is fairly easy. However, as this taxon flowers in winter, seed-production is more difficult than in other subspecies and seed is less readily obtained. Nurseries registered for artificial propagation: Czech Republic P-CZ-1001 (“*schwarzii* var. *rubriflorus*”), Switzerland P-CH-1001.

**Similar species:** The *T. schmidickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, “cardboard-like” or “paper-like”, spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers and immature specimens may look quite different in the various subspecies (ssp. *schmidickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). Ssp. *rubriflorus* is characterised by red throated flowers, appearing in winter, by rather flat, slightly angled tubercles and by 1-3 rather long (25 mm), thin, irregularly and strongly twisted and curved to curled, brown spines per areole. It is compared in literature with ssp. *macrochele* and ssp. *klinkerianus* “*schwarzii*”. It differs from both by the red throated flowers, appearing in winter. From “*schwarzii*” it differs further by longer spines (25 vs. 20 mm), that are typically often curved forth and back. From ssp. *macrochele* it differs by having one strong and 1 (-2) weaker spines per areole, whereas the former has all spines of about the same shape. There are two more closely related taxa with red throated flowers. Ssp. *andersonii* has only 1 short spine per areole, ssp. *schmidickeanus* has broader, strictly ascending and only slightly curved spines and more elongated tubercles.

**Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
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 Lechner, P., ed. (2000): *Turbinicarpus* im Bild. *Mitteilungen der Turbinicarpus-Gruppe* 9.  
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# Turbinicarpus schmiedickeanus

## ssp. schmiedickeanus

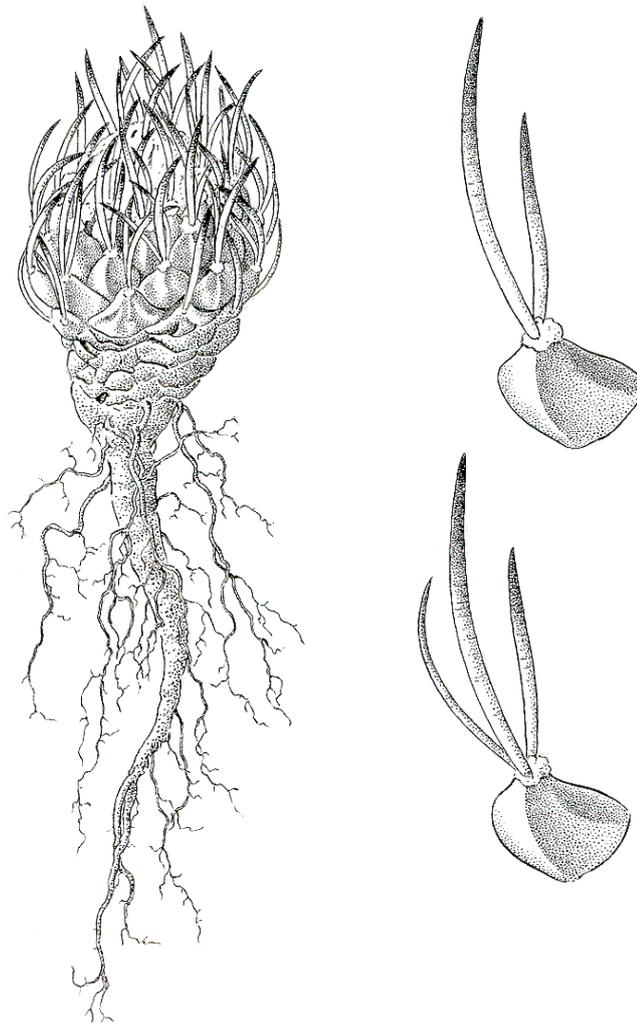
(Bödeker) F. Buxb. &amp; Backeb. 1937



**Common names:** none

**Scientific synonyms:** = *Echinocactus schmiedickeanus* Bödeker 1928  
 = *Strombocactus schmiedickeanus* (Bödeker) Berger 1929  
 = *Toumeyia schmiedickeana* (Bödeker) Bravo & Marshall 1956  
 = *Neolloydia schmiedickeana* (Bödeker) E. F. Anderson 1986  
 = *Pediocactus schmiedickeanus* (Bödeker) J. J. Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, globular, distinctly tuberculate cactus, densely covered with non-pungent, grey, ascending spines, extremely cryptic in habitat. Grows in fine limestone gravel, with which it blends very well, on gentle hills in open Chihuahuan desert vegetation.

**Roots:** Stembase and root forming a napiform unit.

**Stem:** Solitary, globose to flattened-globose, 1-3 cm high, 1.5-3 cm Ø (cultivated specimens may be considerably bigger), divided into tubercles, dull-green, with some white wool in the new growth (in cultivated specimens, the apex may be covered with abundant white wool, hiding the tubercles,

- and even lateral areoles retain some wool, whereas in habitat, the areoles are usually naked).
- Tubercles:** Conical, rhomboidal at base, about 3-4 x 5 mm, slightly longer than broad, 7 mm long, slightly ascending, turning corky with age (at the stem base), with apical areole, axil naked.
- Areoles:** Round, 2-3 mm  $\varnothing$ , with abundant white, dehiscent wool.
- Spines:** (2-) 3 (-4), all interpreted as central spines, the lower one the longest and broadest, 1 x 25 mm, strongly ascending (covering the stem apex), usually 2 laterals 0.5 x 15 mm, one uppermost even shorter or often missing. All spines evenly broadened until near the tip, grey, with dark, microscopic, transversal fissures, unevenly (mostly upwards) curved, often channelled above, shed at the stem base.
- Flowers:** Appearing from november-february from the centre of the stem apex, funnellform, 2-2.7 cm long, 1.8-2.8 cm  $\varnothing$ , whitish or pink, the perianth segments with a darker magenta midvein.
- Fruits:** Rounded, greenish, somewhat fleshy at maturity, opening by a longitudinal slit.
- Seeds:** 1-1.5 mm long, 0.7-1 mm  $\varnothing$ , seedcoat black, tuberculate.
- Juvenile specimens:** Gradually changing from ca. 7 white, horizontally radiating, plumose radial spines to the adult spination by first producing additional central spines and later centrals only, lacking radials.

**Distribution:** State of Tamaulipas, Mexico.



**Trade:** Endemic to a rather small region in southern Tamaulipas. Thousands of specimens have reportedly been taken from the habitat for international trade. The species has become extremely sparse in the "classic" locality. Unnecessarily, because propagation from seeds is fast and easy. However, as this taxon flowers in winter, seed-production is more difficult than in other subspecies and seed is less readily obtained. It is well distributed in collections, demand is rather moderate. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** The *T. schmidickeanus*-complex is characterised by broad, flattened, curved or twisted, flexible and non pungent, "cardboard-like" or "paper-like", spongy, characteristically minutely transversally fissured spines in adult specimens, whereas stems, tubercles, flowers and immature specimens may look quite different in the various subspecies (ssp. *schmidickeanus*, ssp. *andersonii*, ssp. *bonatzii*, ssp. *flaviflorus*, ssp. *gracilis*, ssp. *klinkerianus*, ssp. *macrochele*, ssp. *rioverdensis*, ssp. *rubriflorus*). Ssp. *schmidickeanus* is characterised by red throated flowers, appearing in winter, by rather elongated, ascending, angled tubercles and by generally 3 rather long, moderately curved, rather vertically ascending spines per areole, the central one broader and longer than the lateral ones. *T. schmidickeanus* ssp. *schmidickeanus* may be confounded especially with ssp. *macrochele*, which has broader than long, more rounded and obtuse tubercles and all spines of equal length and width. Ssp. *klinkerianus* typically has shorter spines (7-9 mm, but "*schwarzii*" up to 20 mm, however horn coloured and stems with more rounded tubercles); Ssp. *rubriflorus* typically has somewhat curly spines, but like ssp. *schmidickeanus* flowers in winter and shows a red-throated flower.

- Bibliography:** Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.
- Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* (4): 1-28.
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- Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.
- Lechner, P. & H. Perndl (1996): Rotschlundige Winterblüher – die *Schmidickeanus*-Gruppe. *Mitteilungen der Turbinicarpus-Gruppe* 1.
- Lechner, P., ed. (2000): *Turbinicarpus im Bild*. *Mitteilungen der Turbinicarpus-Gruppe* 9.
- Zachar, M., R. Staník, A. Lux, I. Dráb (1996): *Rod Turbinicarpus*. Vydavatel'stvo Roman Stanik. Bratislava.



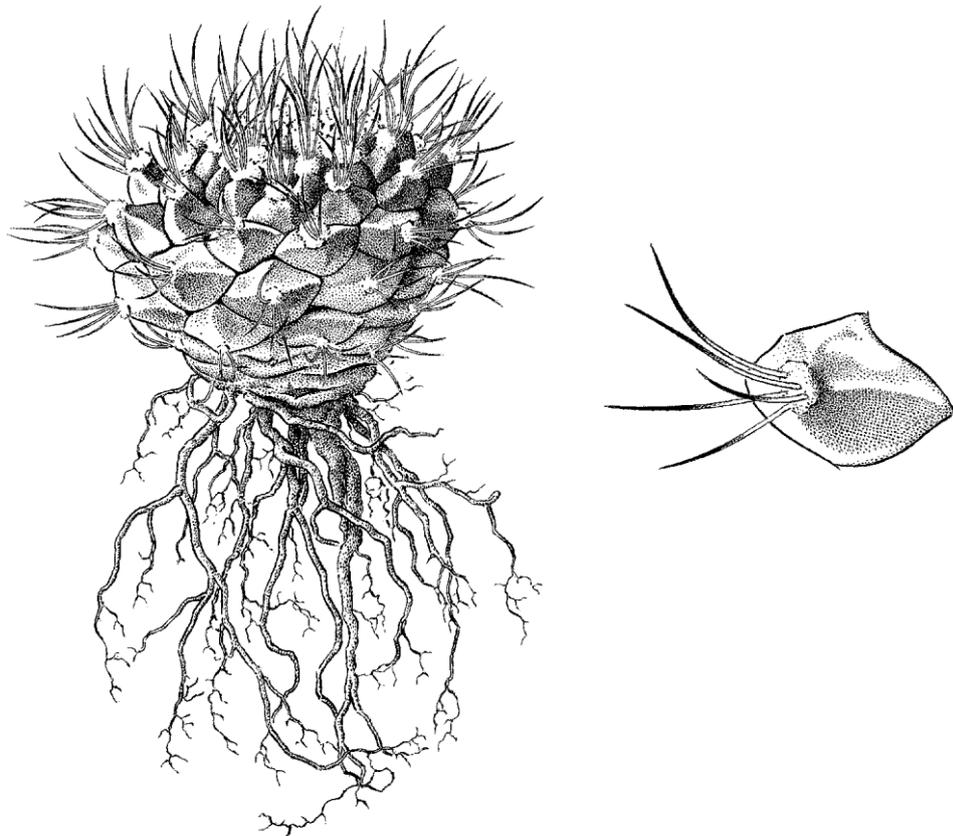
# Turbinicarpus swobodaе

L. Diers 1987

**Common names:** none

**Scientific synonyms:** = *Pediocactus swobodaе* (L. Diers) J. J. Halda, 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Small, globular, bluish-green to brownish cactus with notably angled tubercles and finely acicular, curved, dark tipped spines. Grows in fissures of steep limestone cliffs.

**Roots:** Fibrous.

**Stem:** Solitary, globose to flattened, up to 3 cm high and 5 cm  $\varnothing$ , glaucous, often with a brownish tinge if exposed to the sun, apex with some white, dehiscent wool.

**Tubercles:** Slightly elongated, 3-5 mm high, 4 mm broad, notably 5- to 6-angled, with faintly convex upper

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sides.

**Areoles:** Oblong, 1.2-3 mm long, 1-2 mm broad, young areoles with some white wool.

**Spines:** 4-6, of which 1 lower, slightly descending, 2 lateral, 2 upper and, if present, 1 ± central, the 3 lowest the shortest, about 4-7 mm long, the upper about 5-13 mm long. All spines thin, bristly, ± stiff, mostly curved upwards, rarely somewhat tortuous, round in cross section, occasionally slightly flattened, bulbous at the base, almost totally black or black in the upper part and light grey towards the base, becoming grey in age.

**Flowers:** From the centre of the stem apex, rather small, funnelform, 10-16 mm long, 13-22 mm Ø, creamy white to light yellow with a distinctive, thin violet-reddish midstripe on perianth segments.

**Fruits:** 5-7 mm long, 3.5-4 mm Ø, greenish, drying and opening by a longitudinal slit.

**Seeds:** 1.2-1.3 mm long, 0.8-0.9 mm broad, 1.1-1.2 mm thick, with dark brown to black, finely tuberculate surface.

**Distribution:** State of Nuevo León, Mexico.



**Trade:** Local endemic of the valley of Rayones, known from a single mountain, where it has been discovered by the German collector Alfred Lau in 1984 and subsequently collected and illegally commercialised in big numbers by the Austrian trader Swoboda, for whom it was named. The actual status of the population is unknown, the habitat is very remote, partly inaccessible and little visited. The demand for this novelty has been very high, especially among collectors focused on the genus *Turbinicarpus*. As it is quite fast and easy to propagate from seeds and flowers readily in cultivation, it is widespread already in collections. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** Some other taxa of *Turbinicarpus* show similar, finely acicular spination and could be confounded, especially if flowers are lacking. *Turbinicarpus hoferi* J. Lüthy & Lau (stem usually much more flattened, with a greyish tinge, flower much bigger and white), *Turbinicarpus lophophoroides* (Werdermann) Buxbaum & Backeberg (tubercles rounded, flower much bigger and white), *Turbinicarpus laui* Glass & Foster (tubercles more rounded, stem glossy green, spines spreading, regularly radiating, slightly recurved, flower much bigger, pink). *T. swoboda* is probably most closely related to *T. hoferi*, as the small, similarly rather brown than black seeds suggest, but the habitats, seedlings and flowers of the two species are quite distinct.

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): Turbinicarpen im Bild. Mitteilungen der Turbinicarpus-Gruppe 9.  
Zachar, M., R. Staník, A. Lux, I. Dráb (1996): Rod Turbinicarpus. Vydavatel'stvo Roman Staník. Bratislava.



# Turbinicarpus valdezianus

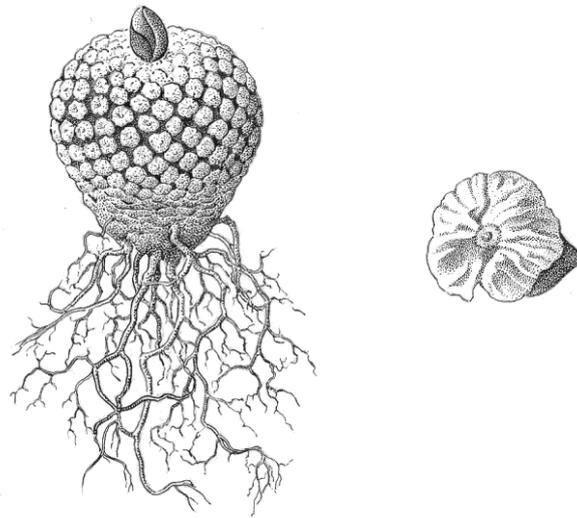
(H. Möller) Glass &amp; Foster 1977

**Common names:** none

**Scientific synonyms:**

- = *Pelecypora valdeziana* H. Möller 1930
- = *Echinocactus valdezianus* (H. Möller) Bödeker 1930
- = *Thelocactus valdezianus* (H. Möller) Bravo 1937
- = *Gymnocactus valdezianus* (H. Möller) Backeberg 1966
- = *Normanbokea valdeziana* (H. Möller) Kladiwa & Buxbaum 1969
- = *Neolloydia valdeziana* (H. Möller) E. F. Anderson 1986
- = *Pediocactus valdezianus* (Möller) J. J. Halda 1998
- *Pelecypora valdeziana* var. *albiflora* Pazout 1960
- = *Echinocactus valdezianus* var. *albiflorus* (Pazout) Backeberg 1962
- = *Gymnocactus valdezianus* var. *albiflorus* (Pazout) Backeberg 1966
- *Pelecypora plumosa* Bödeker & Ritter 1930

**CITES category:** Appendix II since 01.07.1975, Appendix I since 29.07.1983 (Prop. USA).



**Characteristics:** Dwarf, globular, extremely cryptic cactus, densely covered by non-pungent, white, radiating, strongly plumose and interwoven spines, which form little umbrellas on the tips of the tubercles. Grows in fine limestone gravel, with which it blends extremely well, on hilltops and gentle slopes in open Chihuahuan desert vegetation.

**Roots:** Fibrous from elongated subterranean stem base.

**Stem:** Solitary, depressed-globose to cylindrical, rarely arising above ground level, with elongated underground stem base, 1-2.5 cm high, 1-2.5 cm  $\varnothing$ , green, bluish green, completely covered by spines.

- Tubercles:  $\pm$  4-angled, 2-3 mm long, 1-2 mm broad, 2-3 mm high.  
Areoles: Apical, 1.5-2 mm  $\varnothing$ .  
Spines: Central spines absent, 30 or more radial spines, 1.5-2 mm long, fine, hair-like, feathery, horizontally spreading, white.  
Flowers: From the centre of the stem apex, funnellform, 18-20 mm long, 2.5 cm  $\varnothing$ , white or pink and with strong pink midstripe on perianth segments.  
Fruits: Shiny brownish red, naked, 7-8 mm long, 6-7 mm  $\varnothing$ , somewhat fleshy at maturity, opening by longitudinal slit.  
Seeds: Kidney-shaped, 1-1.4 mm long, 0.7-1 mm  $\varnothing$ , with black, finely tuberculate surface.

**Distribution:** States of Coahuila, Zacatecas, Nuevo León and San Luis Potosí, Mexico.



**Trade:** Distributed over a large area, but restricted to special habitats. Has been heavily exploited for international trade in the 1960s and 1970s, but is locally still abundant, though not easy to detect. Not only threatened through collecting, but also through road constructions. The species is much appreciated and well represented in collections. Often plants of different locations are maintained separately in cultivation, e.g. from Saltillo or from Monclova. Propagation from seeds is quite fast and easy. Nurseries registered for artificial propagation: Germany P-DE-1001, Spain P-ES-1001, Czech Republic P-CZ-1001, P-CZ-1002, P-CZ-1003, Switzerland P-CH-1001.

**Similar species:** May be confounded with other small, globular cactus species with a dense, white, spreading and plumose spination, such as the more plumosely spined forms of *Mammillaria lasiacantha* Engelm. or *Mammillaria theresae* Cutak or *Mammillaria sanchez-mejoradae* R. Gonzalez G. Has also been confounded in literature with *Mammillaria luethyi* G. S. Hinton. The best character for differentiation from *Mammillaria* spp., also not always available, is the apical position of the flower of *T. valdezianus* vs. lateral in *Mammillaria*. The strictly horizontally spreading spines, connected among each other through long, interwoven hairs and forming quite a compact umbrella, is only approached by *M. theresae*, which has much longer tubercles (4-6 mm) and *M. sanchez-mejoradae*, which has a distinctly pectinate spine arrangement and elongated, linear areoles. The closely related and superficially somewhat similar *Turbinicarpus pseudopectinatus* (Backeberg) Glass & Foster has a distinctly pectinate spine arrangement.

- Bibliography:**
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# Turbinicarpus viereckii

## ssp. major

(Glass &amp; Foster) Glass, 1998

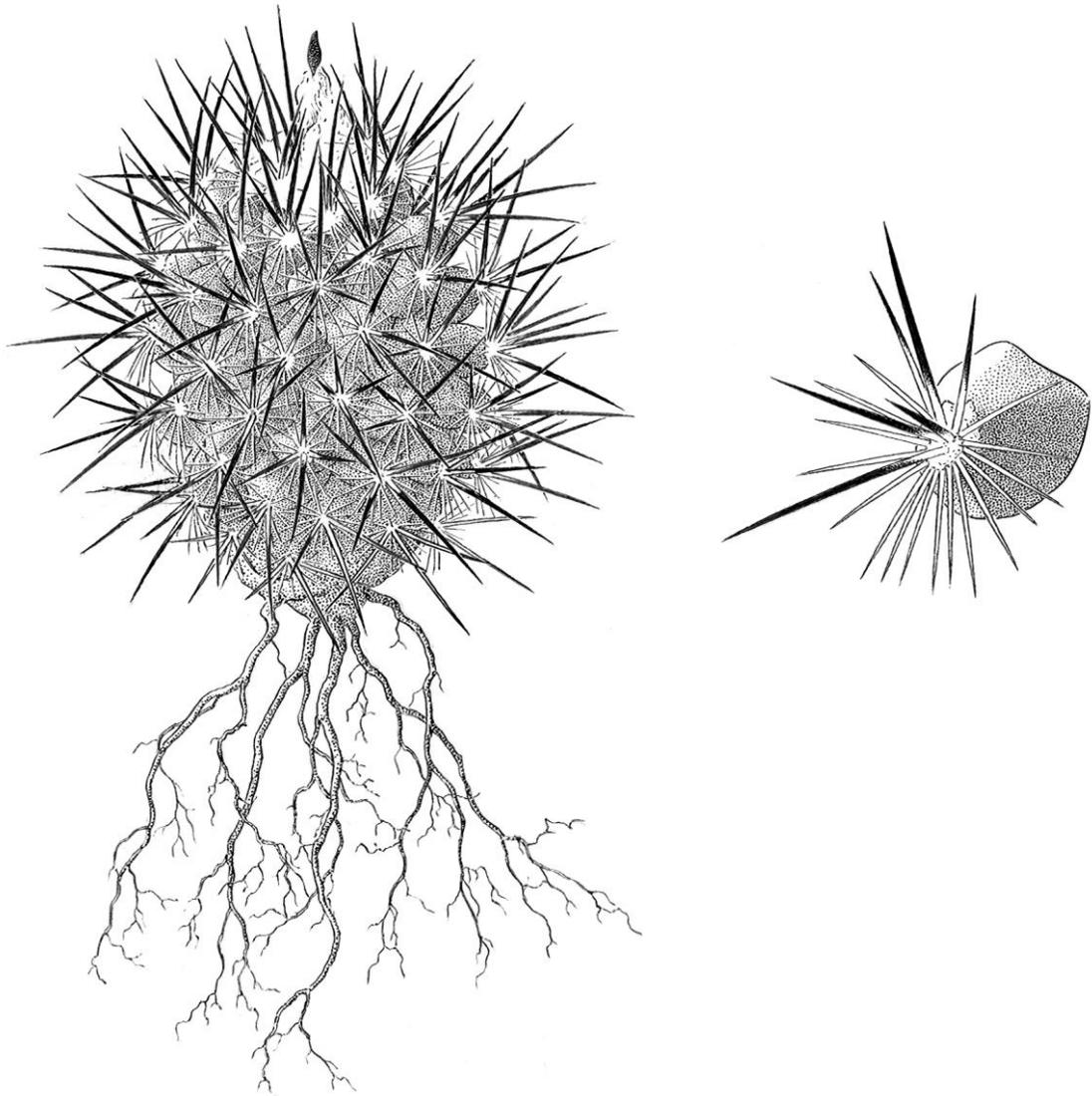


**Common names:** none

**Scientific synonyms:**

- = *Gymnocactus viereckii* var. *major* Glass & Foster, 1978
- = *Thelocactus viereckii* var. *major* (Glass & Foster) Bravo, 1980
- = *Turbinicarpus viereckii* var. *major* (Glass & Foster) John & Riha, 1983
- = *Neolloydia viereckii* var. *major* (Glass & Foster) E. F. Anderson, 1986
- = *Pediocactus viereckii* var. *major* (Glass & Foster) J. J. Halda, 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:**

Globular, tuberculate cactus, solitary to clustering from the base, with glaucous, rounded tubercles, densely covered, but not completely obscured by radiating, acicular, glassy-white radial spines and notably stronger, contrasting, nearly entirely black, protruding, somewhat irregularly radiating central spines, lending the spination a slightly unordered aspect. Grows on limestone cliffs in Chihuahuan desert vegetation.

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Roots: Fibrous.  
Stem: Solitary to sparingly cespitose, globose to elongate, 6-7 cm high, 4-6.5 cm Ø, apex abundantly white woolly.  
Tubercles: 13-15 mm Ø at base, ca. 7 mm high, 15-18 mm apart, dull bluish green.  
Areoles: First with abundant white wool, later naked.  
Spines:  
    Radial spines: 13-16, acicular, strong, 6-10(-12) mm long, the lower longer than the upper in the areole, white to slightly glassy.  
    Central spines: 4-5, irregularly radiating, protruding, the lowest ca. 25-27 mm long, deflexed, straight to very slightly curved, rigid, laterals ca. 15 mm long, the upper ± incurved, 18-22 mm long, black when young, the lower half becoming white to grey, additionally 2-4 upper subcentral spines, consistently present, 5-8 mm long, darker and thinner than the radials.  
Flowers: From the centre of the stem apex, funnelform, 2-3.5 cm Ø, 2-3 cm long, white.  
Fruits: Greenish to tan, hidden in apical wool, dehiscent by a longitudinal slit.  
Seeds: 1.2 mm long, 0.9 mm thick, black with a finely tuberculate surface.

**Distribution:** State of Nuevo León, Mexico.



**Trade:** First collected by US trader Charles Glass in 1974 between Mier y Noriega and Santa Rita. A smaller form with white flowers has been found by the German collector Alfred Lau north of Presa de Guadalupe in the State of San Luis Potosí. First in great demand, being an unexpected novelty, now quite well introduced and popular in horticulture. Easy to propagate, usually from seeds. Cultivation is quite easy, the taxon flowers freely. Demand therefore is rather moderate. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** The two subspecies of *T. viereckii* are mainly differentiated by the flower colour. *Ssp. major* further differs by larger stem size, less cespitose habit and heavier spination. Its distribution lies well to the south-west of *ssp. viereckii*. The quite dense, glassy white, partly black tipped spines are somewhat reminiscent of *T. mandragora ssp. bequini*, which however never clusters and usually has 1 ascending and 1 descending central spine, white with a black tip. Further, *T. saueri* could be confounded, but it has a less protruding spination with usually a solitary, ascending central spine and it is not clustering. *T. roseiflorus* is similar, but grows solitary and has distinctively shorter radial spines (5 mm).

**Bibliography:** Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* (4): 1-28.  
Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): *Las Cactáceas de México*, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
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Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.

# Turbinicarpus viereckii

## ssp. viereckii

(Werdermann) John & Riha 1983

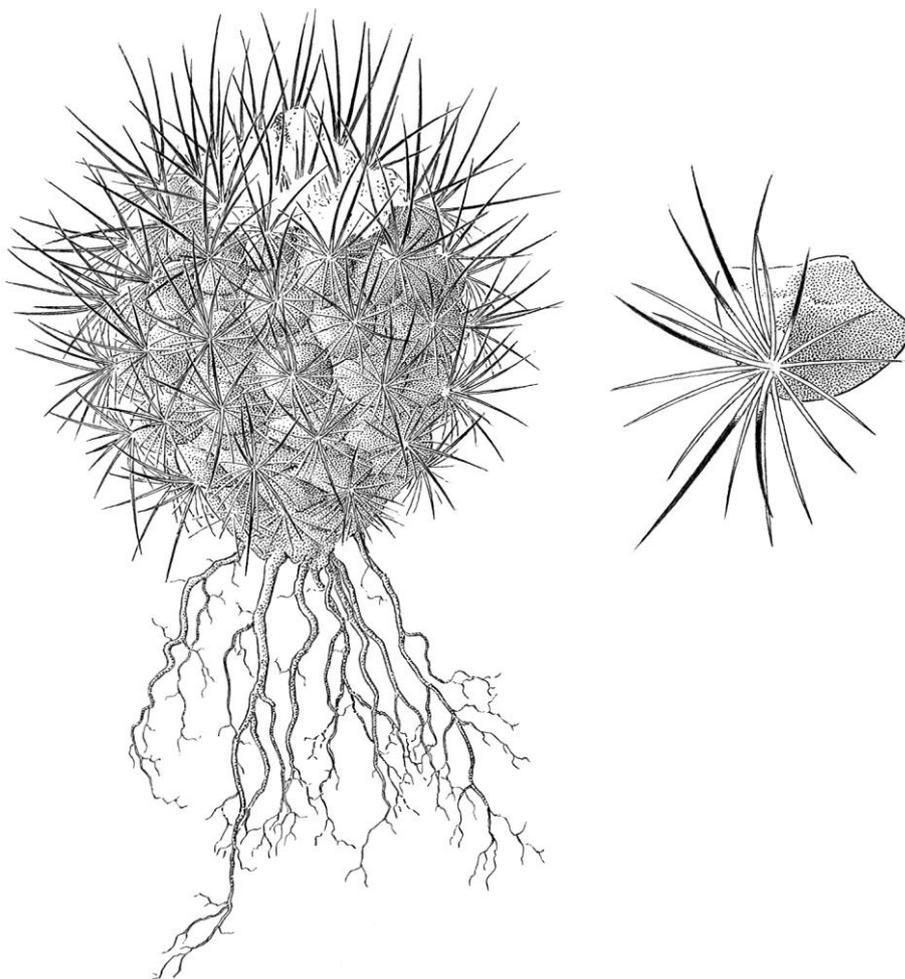


**Common names:** none

**Scientific synonyms:**

- = *Echinocactus viereckii* Werdermann 1931
- = *Neolloydia viereckii* (Werdermann) Knuth 1935
- = *Thelocactus viereckii* (Werdermann) Bravo 1937
- = *Gymnocactus viereckii* (Werdermann) Backeberg 1951
- = *Pediocactus viereckii* (Werdermann) Halda 1998

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. USA).



**Characteristics:** Globular, tuberculate cactus, solitary or often clustering from the base, with glaucous, rounded tubercles, densely covered, but not completely obscured by thin, acicular, glassy-white, partly black tipped, protruding, somewhat irregularly arranged spines, lending the spination a slightly unordered aspect. Grows on limestone cliffs in Chihuahuan desert vegetation.

**Roots:** Fibrous.  
**Stem:** Solitary or clustering from the base, globose to globose-cylindrical, blue green, 2-7 cm high, up to 4 cm Ø, apex white woolly.  
**Tubercles:** ± conical, 4-6 mm long x 8-15 mm broad at base, 5-6 mm high.  
**Areoles:** 3-5 mm Ø, 7-9 mm apart, first with abundant white wool, later naked.  
**Spines:**  
     **Radial spines:** 13-22, 8-13 cm long, the lower longer than the upper in the areole, straight, glassy white, somewhat irregularly radiating and slightly protruding, acicular.  
     **Central spines:** 3-5, 15-20 mm long, slender, straight, black with a white base, acicular, irregularly radiating, protruding.  
**Flowers:** From the centre of the stem apex, funnelform, 3-5 cm Ø, 1.5-3 cm long, magenta with white throat.  
**Fruits:** Brownish-green, slightly elongate, 5-8 mm long, 4-5 mm Ø, opening by a longitudinal slit.  
**Seeds:** 1.1-1.4 mm long, 0.5-0.9 mm Ø, black with a finely tuberculate surface.

**Distribution:** State of Tamaulipas, Mexico.



**Trade:** Named for its discoverer, the German collector H. W. Viereck, who lived in Jaumave. Well introduced and quite popular in horticulture. Easy to propagate, usually from seeds. Cultivation is quite easy, the taxon flowers freely. Demand therefore is rather moderate. Nurseries registered for artificial propagation: Germany P-DE-1001, Switzerland P-CH-1001.

**Similar species:** The two subspecies of *T. viereckii* are mainly differentiated by the flower colour. Ssp. *major* differs further by larger stem size, less caespitose habit and heavier spination. Its distribution lies well to the south-west of ssp. *viereckii*. The quite dense, glassy white, partly black tipped spines are somewhat reminiscent of *T. mandragora* ssp. *beguinii*, which however never clusters and usually has 1 ascending and 1 descending central spine, white with a black tip. Further, *T. saueri* could be confounded, but has a less protruding spination with usually a solitary, ascending central spine. It is not clustering. *T. roseiflorus* is similar, but grows solitary and has distinctively shorter radial spines (5 mm).

**Bibliography:**  
 Anderson, E. F., S. Arias & N. P. Taylor (1994): Threatened Cacti of Mexico. Succulent Plant Research, Vol. 2. Royal Botanic Gardens Kew, UK.  
 Anderson, E. F. (1985): A revision of the genus *Neolloydia* B. & R. (Cactaceae). *Bradleya* (4): 1-28.  
 Bravo-Hollis, H. & H. Sanchez-Mejorada (1991): Las Cactáceas de México, ed. 2 (vols. 2 and 3). Mexico City: Universidad Nacional Autónoma de México.  
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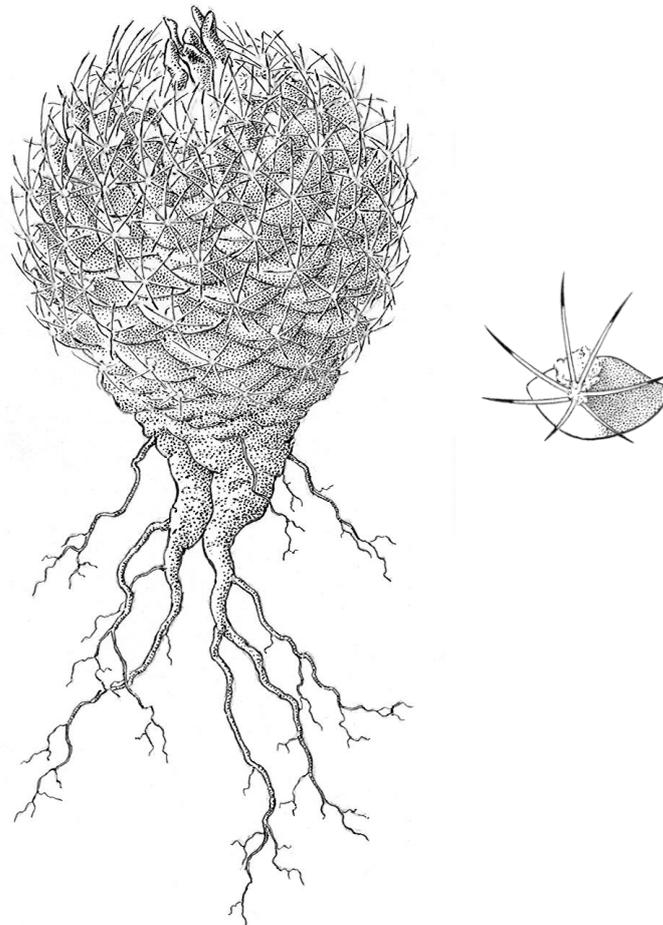
# Turbinicarpus x mombergeri

Riha 1996

**Common names:** none

**Scientific synonyms:** *Turbinicarpus pseudopectinatus* x *loui*, natural hybrid

**CITES category:** Appendix II since 01.07.1975, transferred to Appendix I in 11.06.1992.



**Characteristics:** Small, globular, tuberculate, grey-green cactus, covered with white, radiating spines. Spines notably more numerous and distinctly pectinately arranged in juvenile specimens. Found in very few places, where *Turbinicarpus pseudopectinatus* and *Turbinicarpus laui* grow together.

**Roots:** Fibrous, fleshy.

**Stem:** Flattened, semi-globose to globose with a conical base, about 4-5 cm high, up to 5 cm Ø, dull, grey green, apex covered with white wool.

- 
- Tubercles:** Four-angled at the base, 5 mm long and 3-5 x 4 mm at the base, in the upper part sometimes laterally flattened to variable extent, axe-shaped (as in *T. pseudopectinatus*).
- Areoles:** Elliptic, 2-3 mm long, 0.8-1 mm broad, first covered with white wool, soon becoming naked.
- Spines:** 8-12, radiating, 5-8 mm long, the upper in the areole longest, glassy white, some with a darker tip, sometimes slightly pectinately arranged (as in *T. pseudopectinatus*).
- Flowers:** In early spring from the centre of the stem apex, already in specimens with juvenile spination and ca. 1 cm Ø; up to 32 mm long, funnelform, pale-pink, often with a darker midstripe on the perianth segments.
- Fruits:** Urn-shaped, up to 5 mm long, dehiscent by a longitudinal slit, becoming dry.
- Seeds:** Ca. 1 mm long, black with a finely tuberculate surface.
- Juvenile plants:** Stem globose to cylindrical, 14-20 radiating spines, ca. 3-4 mm long, strongly pectinate, glassy white.

**Distribution:** State of San Luis Potosí, Mexico.



**Trade:** This very rare natural hybrid originates from a small area near Cerritos on gentle hills, where the ranges of *Turbinicarpus pseudopectinatus* and *Turbinicarpus laui* overlap. It was first reported to be numerous (Riha 1997) but has subsequently been collected nearly to extinction for commercial trade. Wild-collected plants are illustrated in Riha (1997). Named for the German trader Peter Momberger. It remains to hope, that this taxon is newly produced by natural cross-breeding of its parents. Nursery registered for artificial propagation: Switzerland P-CH-1001.

**Similar species:** *Turbinicarpus x mombergeri* is intermediate between *Turbinicarpus pseudopectinatus* and *Turbinicarpus laui*. It shows considerable variation, related to the age of individuals. Juvenile specimens usually show a strongly pectinate spination and more numerous spines, thus rather resembling *T. pseudopectinatus*, while old, adult specimens have less and rather regularly radiating spines and are closer to *T. laui* (see illustrated specimen).

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Lechner, P., ed. (2000): Turbinicarpus im Bild. Mitteilungen der Turbinicarpus-Gruppe 9.  
Riha, J. (1997): *Turbinicarpus mombergeri* Riha, eine neue Art aus San Luis Potosí (Mexiko). Die Kaktusblüte (14): 15-19.



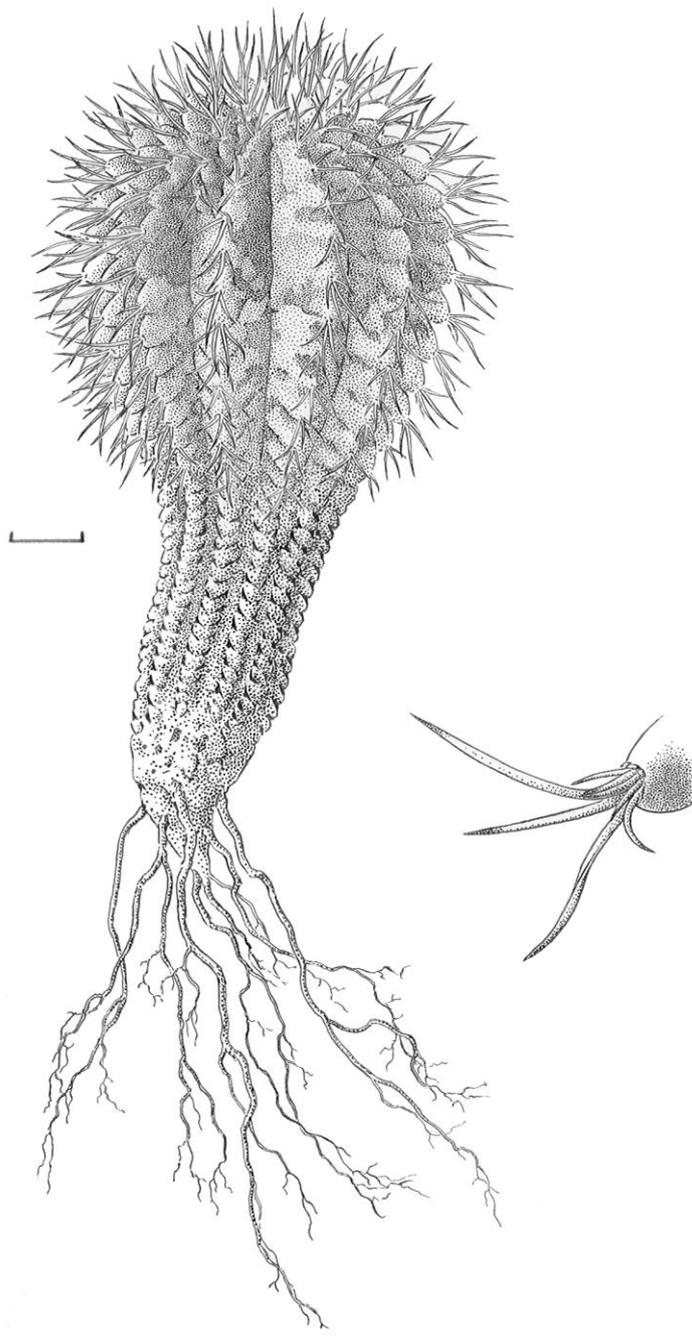
# Uebelmannia buiningii

Donald 1968

**Common names:** bras.: quiaba da lapa

**Scientific synonyms:** none

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Characteristics:** Rather small, delicate, globular to elongated, ribbed and slightly tuberculate (tubercles downward curved), usually brownish but sometimes dull green cactus with few rather weak, non-pungent, slightly twisted, greyish spines and a strange, minutely bumpy surface relief of the stem. Growing in fine quartz gravel of sand-pockets on rock slabs in habitat.

**Roots:** Fibrous, from the stem base, horizontally spreading and close to the surface in habitat.

**Stem:** Solitary, globular to sub-columnar, 8-12 cm high, 6-8 cm  $\varnothing$ , apex somewhat depressed, with sparse greyish wool, stem surface dull green to reddish brown, epidermis very hard (stem with

- some scattered mucilage cells in the outer part of the stems, but lacking mucilage ducts). Stem base rather rounded in wild-collected specimens, not as elongated as illustrated here.
- Ribs / tubercles:** 15-18 (-22), 6 mm broad, 8 mm high, partly dissolved into somewhat confluent, distinctly downward curved tubercles.
- Areoles:** Small, on the tips of the tubercles, sparsely woolly.
- Spines:** (2-) 4, arranged cross-wise, often slightly curved, spreading, 10-18 cm long, first yellowish brown, later whitish grey, occasionally supplemented by 2-4 very short minor spines that point upwards.
- Flowers:** Sub-apical, widely opening, 20-25 mm long, 20-25 mm Ø, bright yellow.
- Fruits:** Globular or slightly elongate, 5-6 mm long, 4-5 mm Ø, yellowish, thin-walled and dry at maturity, few-seeded (up to 30 seeds).
- Seeds:** 1.2-1.4 mm long, 0.8-0.9 mm wide, surface shiny black to red brown.

**Distribution:** State of Minas Gerais, Brazil



**Trade:** *U. buiningii* is restricted to only a few localities within a very small region of the Serra Negra, some of these localities only with very few adult individuals. It has been very heavily collected, especially at the type locality, which is reported to be nearly completely devastated. Thousands of specimens must have been collected. Furthermore, the local residents are gathering seeds from the plants, to sell them to traders and additionally, commercial traders are independently gathering seeds (Braun 1988, Schulz & Machado 2000). Consequently, *U. buiningii* is regarded as one of the most threatened cacti of Brazil (Nyffeler 1998). The demand is rather stimulated by the rarity of the species than by attractiveness. Generally, *Uebelmannia* spp. are not as easy to cultivate and hence as popular and well distributed in horticulture as other cacti, *U. pectinifera* in a strict sense being by far the most popular and most frequently found in trade. All species are usually grafted to provide faster growth and better survival. Wild-collected specimens often bear lichens on the stem. 1984-1986 3'040 plants of *Uebelmannia* spp. were exported from Brazil. These exports included all species. Nearly all such exports were declared as artificially propagated material, but during this same period two Brazilian shipments of wild-collected *Uebelmannia* have been confiscated by Dutch customs officials. These shipments had been declared as artificially propagated, but contained many 100s of wild-collected individuals. One Swiss nursery company is known to have imported wild-collected *Uebelmannia* during the 1970s and early 1980s. In the 1980s wild-collected specimens of *Uebelmannia* were regularly offered for sale in the Netherlands, Belgium and Germany. Two nurseries in Brazil hold stocks of illegally collected specimens of *Uebelmannia*, one more than 1000 specimens (supporting statement for App. I-listing, 1992). *U. buiningii* is artificially propagated to some extent today, but not often found in collections. There are some collectors focusing on Brazilian cacti, or rarities in general, who create a certain demand. Nurseries registered for artificial propagation: Germany P-DE-1001, Czech Republic P-CZ-1001, Switzerland P-CH-1001.

**Similar species:** *Uebelmannia gummifera*, especially its ssp. *meninensis* with the reddish "rubra" form, originating from the same region, looks very similar to *U. buiningii*. *U. gummifera* has commonly >26 ribs and a napiform taproot (and distinct mucilage ducts in the stem). Ssp. *meninensis* usually has only 2 spines per areole and pronounced tubercles, ssp. *gummifera* has small, strongly confluent tubercles, forming ribs. The very distinctive *U. pectinifera* looks rather different, with very acute ribs and strong, acicular spines. The genus *Uebelmannia* can be identified quite easily for the hard epidermis and the very strange, minutely foveolate surface relief of the stem, which is well visible without magnification and gives the plants a nearly metallic aspect.

**Bibliography:** Braun, P. (1988): *Uebelmannia buiningii* Donald – Eine bald ausgerottete Art! Kakt. and. Sukk. 39 (1): 2-3.  
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 Schulz, R. & M. Machado (2000): *Uebelmannia* and their Environment. Schulz Publishing, Teesdale, Australia.  
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# Uebelmannia gummifera

## ssp. gummifera

(Backeberg & Voll) Buining 1967

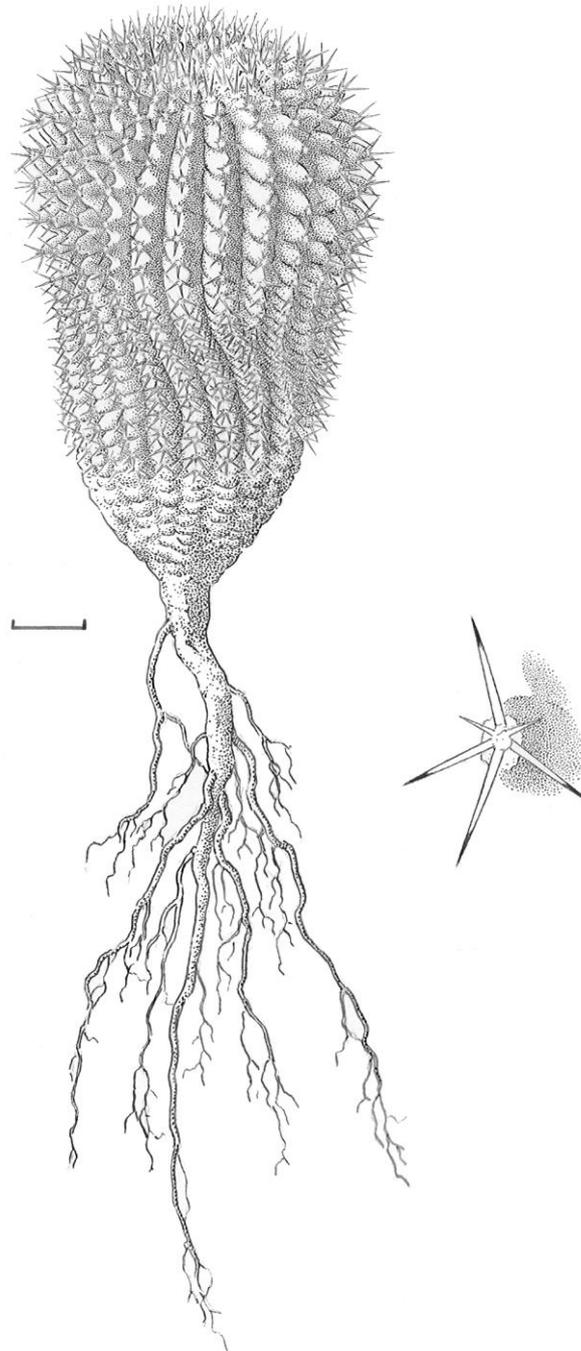


**Common names:** bras.: quiaba da lapa

**Scientific synonyms:** = *Parodia gummifera* Backeberg & Voll 1949  
→ *Uebelmannia gummifera* f. *cristata* Buining 1969 (nom. inval.)

**Excluded:** → *Echinocactus centeterius* Pfeiffer 1837  
= *Uebelmannia centeteria* (Pfeiffer) Schnabel 1971

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Characteristics:** Middle-sized, (globular to) columnar, finely ribbed and only very slightly tuberculate, dull green cactus with few short, non-pungent, rather weak spines and a strange, minutely bumpy surface relief of the stem. Growing in fine quartz gravel in habitat.

- Roots: Fibrous, branching from a napiform main root.
- Stem: Solitary, globular to distinctly columnar, 10-60 cm high, 10-18 cm Ø, apex large, densely covered with brownish white wool, epidermis pale greyish green to dull green, very hard (stem with large mucilage ducts in the outer part of the stem).
- Ribs / tubercles: (22-) 26-42, dissolved into distinct or slightly confluent, straight tubercles.
- Areoles: Small, on the tips of the tubercles, first with quite some wool, later sparsely woolly.
- Spines: 2-5, often slightly flattened, either pointing up- and downwards or cross-wise, straight or slightly curved, spreading or patent, 10-20 mm long, first dark brown, later greyish, partly with 2-4 additional short, upward pointing, minor spines.
- Flowers: 20-25 mm long, 20-35 mm Ø, widely opening, bright yellow.
- Fruits: Globular or slightly elongate, 6-8 mm long, 4-6 mm Ø, yellowish or greenish, few-seeded (up to 30 seeds).
- Seeds: 1.1-1.3 mm long, 0.8-0.9 mm wide, surface black or rarely dark reddish brown, slightly bumpy.

**Distribution:** State of Minas Gerais, Brazil



**Trade:** *U. gummifera* (incl. ssp. *meninensis*) is restricted to the Serra Negra, where it is more common than *U. buiningii* (Nyffeler 1998). Generally, *Uebelmannia* spp. are not as easy to cultivate and hence as popular and well distributed in horticulture as other cacti, *U. pectinifera* in a strict sense being by far the most popular and most frequently found in trade. All species are usually grafted to provide faster growth and better survival. Wild-collected specimens often bear lichens on the stem. 1984-1986 3'040 plants of *Uebelmannia* spp. were exported from Brazil. These exports included all species. Nearly all such exports were declared as artificially propagated material, but during this same period two Brazilian shipments of wild-collected *Uebelmannia* were confiscated by Dutch customs officials. These shipments had been declared as artificially propagated, but contained many 100s of wild-collected individuals. One Swiss nursery company is known to have imported wild-collected *Uebelmannia* during the 1970s and early 1980s. In the 1980s wild-collected specimens of *Uebelmannia* were regularly offered for sale in the Netherlands, Belgium and Germany. Two nurseries in Brazil hold stocks of illegally collected specimens of *Uebelmannia*, one nursery more than 1000 specimens (supporting statement for App. I-listing, 1992). *U. gummifera* is artificially propagated to some extent today, but not often found in collections. There are some collectors focusing on Brazilian cacti, or rarities in general, who create a certain demand. Nurseries registered for artificial propagation: Germany P-DE-1001, Switzerland P-CH-1001.

**Similar species:** *Uebelmannia buiningii*, originating from the same region, looks similar but it has commonly <20 ribs, a smaller maximum size, lacks a napiform taproot (and also distinct mucilage ducts in the stem). *U. gummifera* ssp. *meninensis* has larger tubercles, not as distinctly confluent into ribs, and often only 2 major central spines. The very distinctive *U. pectinifera* looks rather different, with very acute ribs and strong, acicular spines. The genus *Uebelmannia* can be identified quite easily for the hard epidermis and the very strange, minutely foveolate surface relief of the stem, which is well visible without magnification and gives the plants a nearly metallic aspect.

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
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 Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

# Uebelmannia gummifera ssp. meninensis

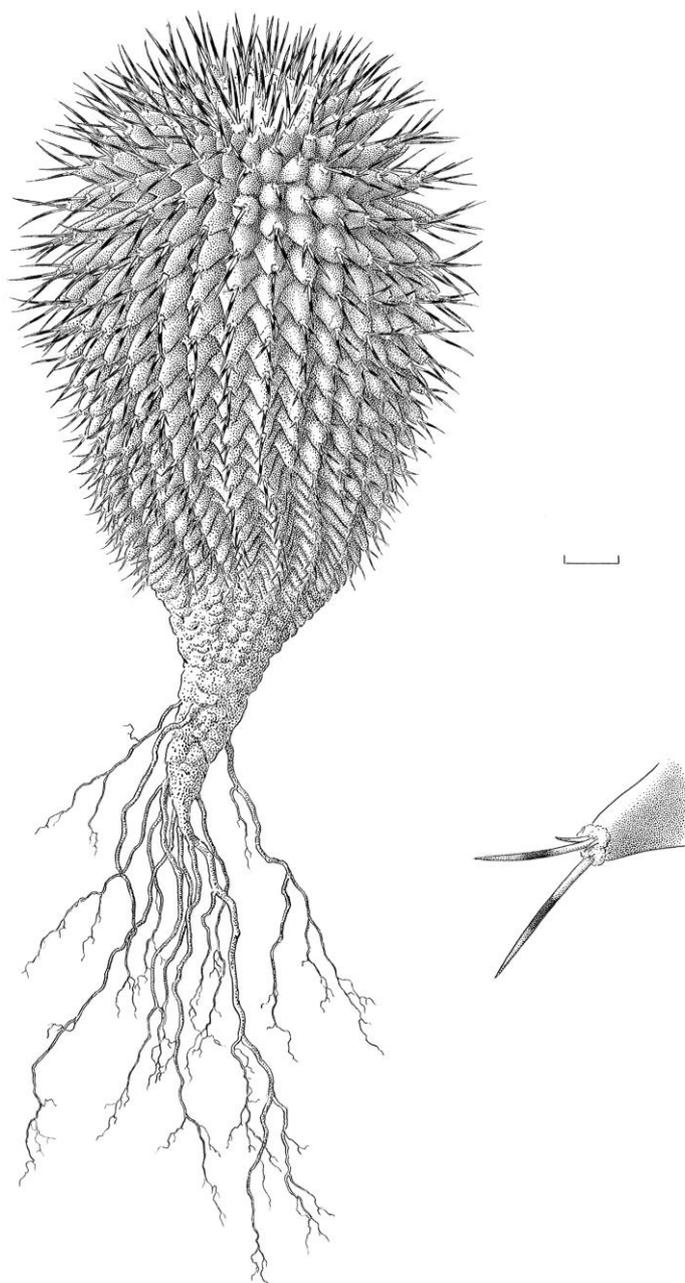
(Buining) P. J. Braun & E. Esteves 1995



**Common names:** bras.: quiaba da lapa

**Scientific synonyms:** = *Uebelmannia meninensis* Buining 1968  
= *Uebelmannia gummifera* var. *meninensis* (Buining) P.J. Braun & E. Esteves 1995  
→ *Uebelmannia meninensis* var. *rubra* Buining & Brederoo 1974  
= *Uebelmannia gummifera* var. *rubra* (Buining & Brederoo) P.J. Braun & E. Esteves 1995

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Characteristics:** Middle-sized, (globular to) columnar, distinctly tuberculate (tubercles downward curved), dull green cactus with usually only two non-pungent, spreading, rather weak spines per areole and a strange, minutely bumpy surface relief of the stem. Growing in fine quartz gravel in habitat.

- Roots: Fibrous, branching from a napiform main root.
- Stem: Solitary, globular to distinctly columnar, up to 50 cm high and 10 cm Ø, apex large, densely covered with a brownish white lanate indumentum, epidermis very hard, pale greyish green to dull green, rarely reddish brown: var. *rubra* (stem with large mucilage ducts in the outer part).
- Ribs / tubercles: up to 40, strongly dissolved into elongated, rounded, distinctly downward curved tubercles, up to 8 mm long, 5-10 mm apart on the ribs (much larger than in ssp. *gummifera*).
- Areoles: Small, on the tips of the tubercles, first with quite some wool, later sparsely woolly.
- Spines: Only 2 long central spines, often slightly flattened, pointing up- and downwards, straight or slightly curved, spreading, 10-20 (-35) mm long, first dark brown, later greyish, sometimes with a few additional short, minor spines.
- Flowers: 22-35 mm long, 20-30 mm Ø, widely opening, bright yellow.
- Fruits: Globular or slightly elongate, 8 mm long, 6 mm Ø, yellowish or greenish, few-seeded (up to 30 seeds).
- Seeds: 1.3 mm long, 0.8 mm wide, testa black or rarely dark reddish brown, slightly bumpy.

**Distribution:** State of Minas Gerais, Brazil



**Trade:** *U. gummifera* (incl. ssp. *meninensis*) is restricted to the Serra Negra, where it is more common and wide spread than *U. buiningii* (Nyffeler 1998). Ssp. *meninensis* was first reported from near Pedra Menina, hence the name. One population of ssp. *meninensis* is known in horticulture as var. *rubra*, the name referring to the reddish stem colour, but in cultivation, it can be green as well (stem up to 15 cm, 11 cm Ø, ribs 30). Generally, *Uebelmannia* spp. are not as easy to cultivate and hence as popular and well distributed in horticulture as other cacti, *U. pectinifera* in a strict sense being by far the most popular and most frequently found in trade. All species are usually grafted to provide faster growth and better survival. Wild-collected specimens often bear lichens on the stem. 1984-1986 3'040 plants of *Uebelmannia* spp. were exported from Brazil. These exports included all species. Nearly all such exports were declared as artificially propagated material, but during this same period two Brazilian shipments of wild-collected *Uebelmannia* were confiscated by Dutch customs officials. These shipments had been declared as artificially propagated, but contained many 100s of wild-collected individuals. One Swiss nursery company is known to have imported wild-collected *Uebelmannia* during the 1970s and early 1980s. In the 1980s wild-collected specimens of *Uebelmannia* were regularly offered for sale in the Netherlands, Belgium and Germany. Two nurseries in Brazil hold stocks of illegally collected specimens of *Uebelmannia*, one more than 1000 specimens (supporting statement for App. I-listing, 1992). *U. gummifera* is artificially propagated to some extent today, but not often found in collections. There are some collectors focusing on Brazilian cacti, or rarities in general, who create a certain demand. Nurseries registered for artificial propagation: Czech Republic P-CZ-1001, Switzerland P-CH-1001 (also "rubra").

**Similar species:** *Uebelmannia buiningii*, originating from the same region, looks very similar to *U. gummifera* ssp. *meninensis*, especially young plants, but it has commonly <20 ribs, a smaller maximum size and lacks a napiform taproot (and also distinct mucilage ducts in the stem). *U. gummifera* ssp. *gummifera* has smaller tubercles than ssp. *meninensis*, and they are strongly confluent into ribs, further it has usually 4 central spines. The very distinctive *U. pectinifera* has very acute ribs and strong, acicular spines. The genus *Uebelmannia* can be identified quite easily for the hard epidermis and the very strange, minutely foveolate surface relief of the stem, which is well visible without magnification and gives the plants a nearly metallic aspect..

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Nyffeler, R. (1998): The genus *Uebelmannia* Buining (Cactaceae: Cactoidea). Bot. Jahrb. Syst. 120 (2): 145-163.  
 Krainz, H. (ed.), (1973): Die Kakteen, 3. XII, C VI e.  
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 Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

# Uebelmannia gummifera

## ssp. gummifera

(Backeberg & Voll) Buining 1967

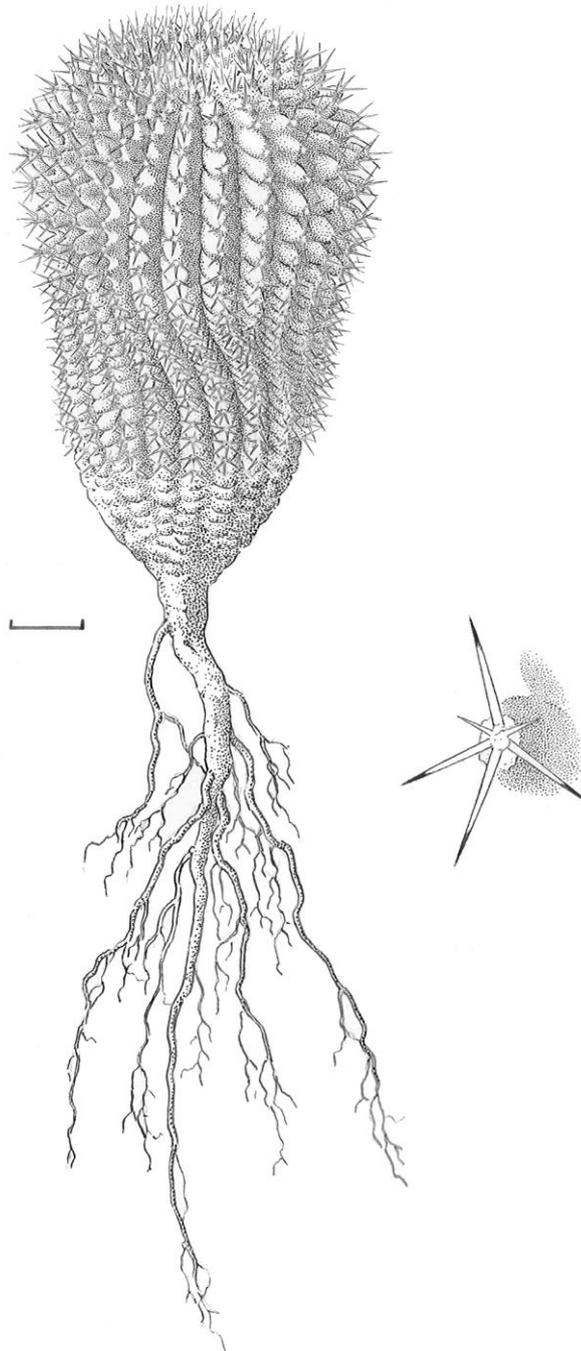


**Common names:** bras.: quiaba da lapa

**Scientific synonyms:** = *Parodia gummifera* Backeberg & Voll 1949  
→ *Uebelmannia gummifera* f. *cristata* Buining 1969 (nom. inval.)

**Excluded:** → *Echinocactus centeterius* Pfeiffer 1837  
= *Uebelmannia centeteria* (Pfeiffer) Schnabel 1971

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



bar = 1 cm

**Characteristics:** Middle-sized, (globular to) columnar, finely ribbed and only very slightly tuberculate, dull green cactus with few short, non-pungent, rather weak spines and a strange, minutely bumpy surface relief of the stem. Growing in fine quartz gravel in habitat.

- Roots: Fibrous, branching from a napiform main root.
- Stem: Solitary, globular to distinctly columnar, 10-60 cm high, 10-18 cm Ø, apex large, densely covered with brownish white wool, epidermis pale greyish green to dull green, very hard (stem with large mucilage ducts in the outer part of the stem).
- Ribs / tubercles: (22-) 26-42, dissolved into distinct or slightly confluent, straight tubercles.
- Areoles: Small, on the tips of the tubercles, first with quite some wool, later sparsely woolly.
- Spines: 2-5, often slightly flattened, either pointing up- and downwards or cross-wise, straight or slightly curved, spreading or patent, 10-20 mm long, first dark brown, later greyish, partly with 2-4 additional short, upward pointing, minor spines.
- Flowers: 20-25 mm long, 20-35 mm Ø, widely opening, bright yellow.
- Fruits: Globular or slightly elongate, 6-8 mm long, 4-6 mm Ø, yellowish or greenish, few-seeded (up to 30 seeds).
- Seeds: 1.1-1.3 mm long, 0.8-0.9 mm wide, surface black or rarely dark reddish brown, slightly bumpy.

**Distribution:** State of Minas Gerais, Brazil



**Trade:** *U. gummifera* (incl. ssp. *meninensis*) is restricted to the Serra Negra, where it is more common than *U. buiningii* (Nyffeler 1998). Generally, *Uebelmannia* spp. are not as easy to cultivate and hence as popular and well distributed in horticulture as other cacti, *U. pectinifera* in a strict sense being by far the most popular and most frequently found in trade. All species are usually grafted to provide faster growth and better survival. Wild-collected specimens often bear lichens on the stem. 1984-1986 3'040 plants of *Uebelmannia* spp. were exported from Brazil. These exports included all species. Nearly all such exports were declared as artificially propagated material, but during this same period two Brazilian shipments of wild-collected *Uebelmannia* were confiscated by Dutch customs officials. These shipments had been declared as artificially propagated, but contained many 100s of wild-collected individuals. One Swiss nursery company is known to have imported wild-collected *Uebelmannia* during the 1970s and early 1980s. In the 1980s wild-collected specimens of *Uebelmannia* were regularly offered for sale in the Netherlands, Belgium and Germany. Two nurseries in Brazil hold stocks of illegally collected specimens of *Uebelmannia*, one nursery more than 1000 specimens (supporting statement for App. I-listing, 1992). *U. gummifera* is artificially propagated to some extent today, but not often found in collections. There are some collectors focusing on Brazilian cacti, or rarities in general, who create a certain demand. Nurseries registered for artificial propagation: Germany P-DE-1001, Switzerland P-CH-1001.

**Similar species:** *Uebelmannia buiningii*, originating from the same region, looks similar but it has commonly <20 ribs, a smaller maximum size, lacks a napiform taproot (and also distinct mucilage ducts in the stem). *U. gummifera* ssp. *meninensis* has larger tubercles, not as distinctly confluent into ribs, and often only 2 major central spines. The very distinctive *U. pectinifera* looks rather different, with very acute ribs and strong, acicular spines. The genus *Uebelmannia* can be identified quite easily for the hard epidermis and the very strange, minutely foveolate surface relief of the stem, which is well visible without magnification and gives the plants a nearly metallic aspect.

**Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
 Nyffeler, R. (1998): The genus *Uebelmannia* Buining (Cactaceae: Cactoidea). Bot. Jahrb. Syst. 120 (2): 145-163.  
 Schulz, R. & M. Machado (2000): *Uebelmannia* and their Environment. Schulz Publishing, Teesdale, Australia.  
 Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

# Uebelmannia pectinifera

## ssp. flavispina

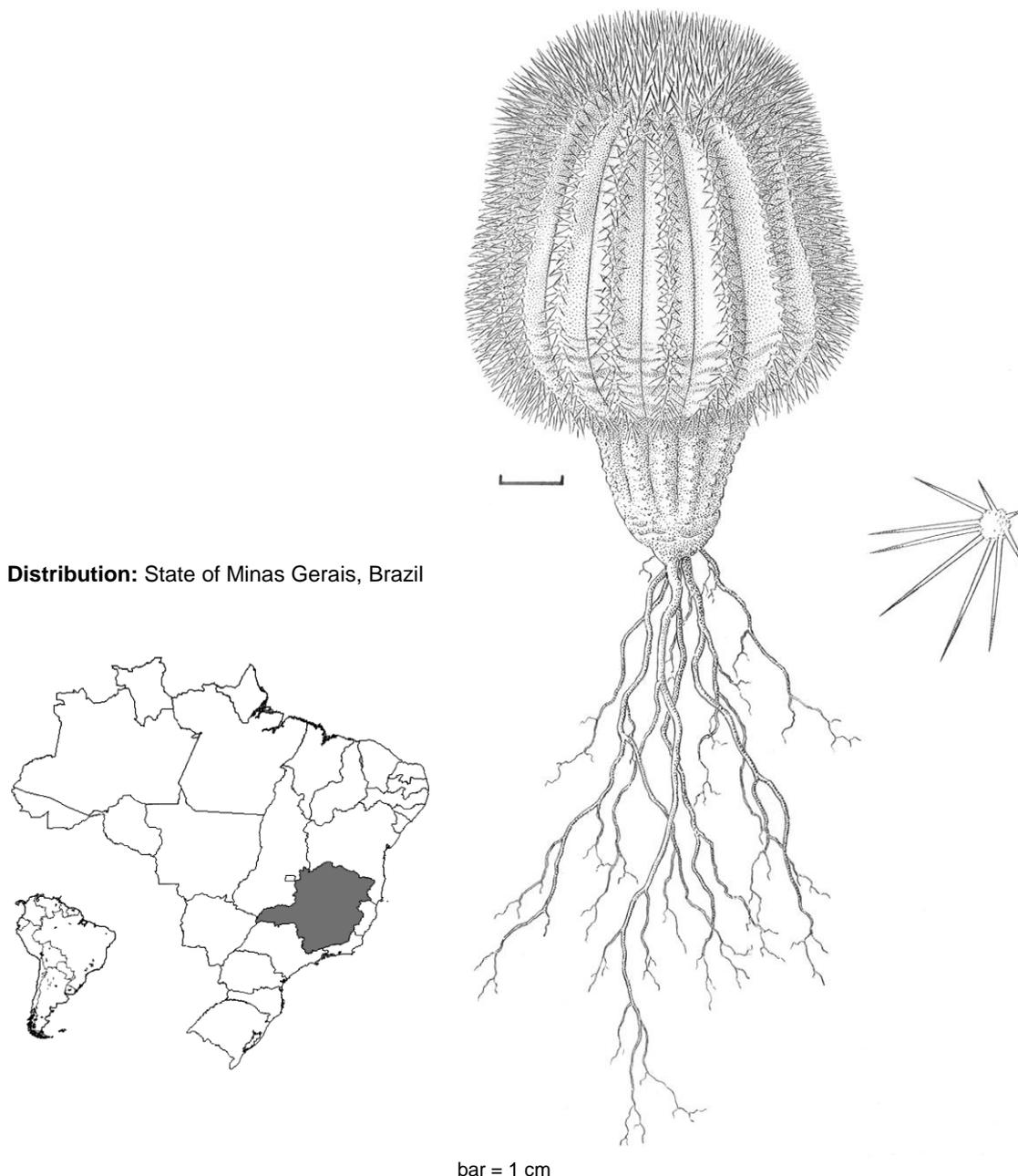
(Buin. &amp; Brederoo) Braun &amp; Esteves 1995



**Common names:** bras.: quiaba da lapa

**Scientific synonyms:** = *Uebelmannia flavispina* Buining & Brederoo 1973  
 → *Uebelmannia pectinifera* var. *crebispina* Strecker 1994 (nom. inval.)  
 → *Uebelmannia warasii* Ritter (nom. nud.)

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).



**Distribution:** State of Minas Gerais, Brazil

**Characteristics:** Very distinctive, regularly and acutely ribbed, globular to columnar, green cactus, with densely arranged, confluent areoles along the edges of the ribs, short, yellow, spreading spines and a strange, minutely bumpy surface relief of the stem. Growing in level, rocky places in plains, on open crystalline rock.

**Roots:** Fibrous, from the stem base.

**Stem:** Solitary, upright, globular to distinctly columnar, to 35 (45) cm high and 11 cm  $\varnothing$ ; apex with a

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- yellowish wool; epidermis light green to yellowish (with some often quite large mucilage cells in the outer part of the stem).
- Ribs:** 19-26, fairly sharp, vertical, relatively narrow and low, 4-7 mm high, 10 mm wide, 1-1.4 cm apart, not dissolved into tubercles.
- Areoles:** 1-1.5 mm Ø, 0-1 mm apart, very close to each other and nearly confluent forming a continuous band, with greyish white wool.
- Spines:** 1-3 per areole, 18 (-35) mm long, erect and in a comb-like arrangement, yellow to orange in new growth, turning dark grey.
- Flowers:** Subapical, thin funnellform, 18 mm long, 7 mm Ø, pale yellow.
- Fruits:** Elongate, somewhat obovoid, 14 mm long, 6 mm Ø, reddish, slightly covered with tufts of hairs.
- Seeds:** 1.3-1.4 mm long, 1,4-1.5 mm wide, often with a dorsal keel; testa shiny black to reddish brown, completely flat.
- Juvenile specimens:** Aspect quite different for numerous short, spreading spines and separated, non-confluent areoles. Stem green, 12-17 ribs, 10-11 spines per areole, 3-4 mm long, spread (see illustrated specimen).
- Trade:** *U. pectinifera* is widely distributed in the mountain range of Serro do Espinhaço and is a very variable species. Several subspecific taxa have been described, but are not recognised by Nyffeler (1998), because the differentiating characters can be found in various combinations in the many known populations. The two ssp. *flavisipina* and ssp. *horrida* are however well introduced in horticulture, morphologically less diffuse, probably geographically not overlapping and therefore treated separately here (according to Braun 2001 in lit. however, "*U. pectinifera* var. *crebispina*" nom. nud. is an intermediate form). Ssp. *flavisipina* has a different habitat: It grows in level, open rocky places in grassy plains and not in rock crevices on mountain slopes, like the other ssp. It can be distinguished by yellowish wool in the apex, orange spine colour in new growth and a yellowish stem with a relatively high number of low, narrow ribs. It occurs in numerous localities west of Diamantina. Commercial collecting on large scale is reported up to 1996, with thousands of plants removed and populations left heavily impacted. Another unfavourable factor is cattle grazing (Schulz & Machado 2000). Braun (2001 in lit.) reports also traditional collecting with big baskets by local residents for human consumption (observed in 1983). Generally, *Uebelmannia* spp. are not as easy to cultivate and hence not as popular and well distributed in horticulture as other cacti, *U. pectinifera* in a strict sense being by far the most popular and most frequently found in trade. All species are usually grafted to provide faster growth and better survival. Wild-collected specimens often bear lichens on the stem. 1984-1986 3'040 plants of *Uebelmannia* spp. were exported from Brazil. These exports included all species. Nearly all such exports were declared as artificially propagated material, but during this same period two Brazilian shipments of wild-collected *Uebelmannia* were confiscated by Dutch customs officials. These shipments had been declared as artificially propagated, but contained many 100s of wild-collected individuals. One Swiss nursery company is known to have imported wild-collected *Uebelmannia* during the 1970s and early 1980s. In the 1980s wild-collected specimens of *Uebelmannia* were regularly offered for sale in the Netherlands, Belgium and Germany. Two nurseries in Brazil hold stocks of illegally collected specimens of *Uebelmannia*, one of these more than 1000 specimens (supporting statement for App. I-listing, 1992). *U. pectinifera* caused a big sensation and accordingly a great demand after its discovery, stimulated by subsequent descriptions of further new varieties. Today it is artificially propagated to quite some extent, and relatively well introduced in horticulture, it is not restricted to specialised collections of Brazilian cacti. Nurseries registered for artificial propagation: Germany P-DE-1001 (ssp. *pectinifera*, ssp. *flavisipina*), Spain P-ES-1001 (ssp. *pectinifera*, var. *pseudopectinifera*), Czech Republic P-CZ-1001 (ssp. *pectinifera*, ssp. *flavisipina*), Switzerland P-CH-1001 (ssp. *pectinifera* incl. "multicostata", *pseudopectinifera* and "Inhai", ssp. *flavisipina* incl. "crebispina" and "longispina", ssp. *horrida*).
- Similar species:** The genus *Uebelmannia* can be identified quite easily for the very strange, minutely foveolate surface relief of the stem, which is well visible without magnification and gives the plants a nearly metallic aspect. Within the genus, *U. pectinifera* has pronounced ribs and strong, acicular spines. Ssp. *flavisipina* has distinctively yellow spines in the new growth, later turning grey, ssp. *pectinifera* has rather few, pronounced, broad and high ribs, a remarkable white-waxy cover and a red epidermis in juvenile plants and ssp. *horrida* has distinctively longer (up to 4 cm), spread spines and more wool in the apex.
- Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Nyffeler, R. (1998): The genus *Uebelmannia* Buining (Cactaceae: Cactoidea). Bot. Jahrb. Syst. 120 (2): 145-163.  
Krainz, H. (ed.), (1973): Die Kakteen, 3. XII, C VI e.  
Schulz, R. & M. Machado (2000): *Uebelmannia* and their Environment. Schulz Publishing, Teesdale, Australia.  
Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

# Uebelmannia pectinifera ssp. horrida

(P. J. Braun) Braun & E. Esteves 1995

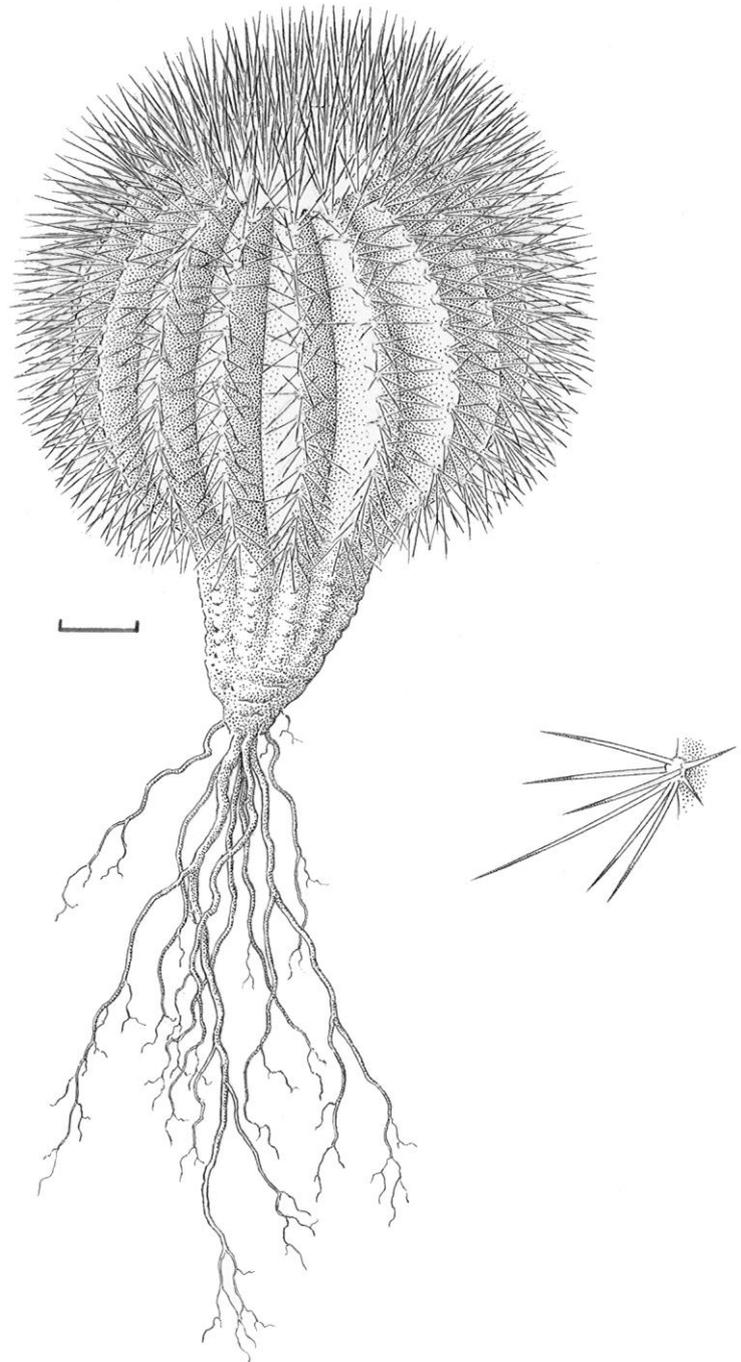


**Common names:** bras.: quiaba da lapa

**Scientific synonyms:** = *Uebelmannia pectinifera* var. *horrida* P. J. Braun 1984

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).

**Distribution:** State of Minas Gerais, Brasil



bar = 1 cm

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- Characteristics:** Very distinctive, regularly and acutely ribbed, globular to columnar, green to greyish cactus, with densely arranged, confluent areoles along the edges of the ribs, relatively long, spreading spines and a strange, minutely bumpy surface relief of the stem. Growing in crevices and on surfaces of crystalline rocks and cliffs on mountain slopes.
- Roots:** Fibrous, from the stem base.
- Stem:** Solitary, upright, globular to distinctly columnar, up to 1 m high and 17 cm Ø; apex with abundant greyish white wool, epidermis very hard, dull green or greyish (stem with some often quite large mucilage cells in the outer part).
- Ribs:** (18-) 23 (-27), 6-11 (-15) mm high, 17 mm wide, vertical, not dissolved into tubercles.
- Areoles:** Very close to each other and nearly confluent, forming a continuous band, with greyish white wool.
- Spines:** (2-) 3-4 (-6), distinctly spreading, straight, 20-40 mm long, first black, later turning greyish with a darker tip.
- Flowers:** Subapical, thin funnelform, 8-16 mm long, 6-10 mm Ø, pale yellow, often with a greenish or reddish hue.
- Fruits:** Elongate, somewhat obovoid, 15-25 mm long, 6-8 mm wide, reddish, slightly covered with tufts of hairs.
- Seeds:** 2.1 mm long, 2 mm wide, often with a dorsal keel; surface shiny black to reddish brown, completely flat.
- Juvenile specimens:** Aspect quite different for numerous short, spreading spines and separated, non-confluent areoles. Stem reddish, 19 ribs, 9-10 spines per areole, 5-8 mm long, spread.
- Trade:** *U. pectinifera* is widely distributed in the mountain range of Serra do Espinhaço and is a very variable species. Several subspecific taxa have been described, but are not recognised by Nyffeler (1998), because the differentiating characters can be found in various combinations in the many known populations. The two ssp. *flavispina* and ssp. *horrida* are however well introduced in horticulture, morphologically less diffuse, probably geographically not overlapping and therefore treated separately here (according to Braun 2001 in lit. however, "*U. pectinifera* var. *crebispina*" nom. nud. is an intermediate form). Ssp. *horrida* from the Serra Mineira is separated by 60 km from other populations of *U. pectinifera* and regarded as not endangered by Schulz & Machado (2000) because of inaccessibility and lack of human population. Generally, *Uebelmannia* spp. are not as easy to cultivate and hence not as popular and well distributed in horticulture as other cacti, *U. pectinifera* in a strict sense being by far the most popular and most frequently found in trade. All species are usually grafted to provide faster growth and better survival. Wild-collected specimens often bear lichens on the stem. 1984-1986 3'040 plants of *Uebelmannia* spp. were exported from Brazil. These exports included all species. Nearly all such exports were declared as artificially propagated material, but during this same period two Brazilian shipments of wild-collected *Uebelmannia* were confiscated by Dutch customs officials. These shipments had been declared as artificially propagated, but contained many 100s of wild-collected individuals. One Swiss nursery company is known to have imported wild-collected *Uebelmannia* during the 1970s and early 1980s. In the 1980s wild-collected specimens of *Uebelmannia* were regularly offered for sale in the Netherlands, Belgium and Germany. Two nurseries in Brazil hold stocks of illegally collected specimens of *Uebelmannia*, one of these more than 1000 specimens (supporting statement for App. I-listing, 1992). *U. pectinifera* caused a big sensation and accordingly a great demand after its discovery, stimulated by subsequent descriptions of further new varieties. Today it is artificially propagated to quite some extent, and relatively well introduced in horticulture, it is not restricted to specialised collections of Brazilian cacti. Nurseries registered for artificial propagation: Germany P-DE-1001 (ssp. *pectinifera*, ssp. *flavispina*), Spain P-ES-1001 (ssp. *pectinifera*, var. *pseudopectinifera*), Czech Republic P-CZ-1001 (ssp. *pectinifera*, ssp. *flavispina*), Switzerland P-CH-1001 (ssp. *pectinifera* incl. "multicostata", *pseudopectinifera* and "Inhai", ssp. *flavispina* incl. "crebispina" and "longispina", ssp. *horrida*).
- Similar species:** The genus *Uebelmannia* can be identified quite easily for the hard epidermis and the very strange, minutely foveolate surface relief of the stem, which is well visible without magnification and gives the plants a nearly metallic aspect. Within the genus, *U. pectinifera* has pronounced ribs and strong, acicular spines. Ssp. *flavispina* has distinctively yellow spines in the new growth, later turning grey, ssp. *pectinifera* has rather few, pronounced, broad and high ribs, a remarkable white-waxy cover and a red epidermis in juvenile plants and ssp. *horrida* has distinctively longer (up to 4 cm), spread spines and more wool in the apex.
- Bibliography:** Hunt, D. (1999): CITES Cactaceae Checklist, 2<sup>nd</sup> Edition. Royal Botanic Gardens Kew, UK.  
Nyffeler, R. (1998): The genus *Uebelmannia* Buining (Cactaceae: Cactoidea). Bot. Jahrb. Syst. 120 (2): 145-163.  
Schulz, R. & M. Machado (2000): *Uebelmannia* and their Environment. Schulz Publishing, Teesdale, Australia.  
Taylor, N. P. & D. Zappi (2001): Cacti of Eastern Brazil. Royal Botanic Gardens Kew, UK.

# Uebelmannia pectinifera

## ssp. pectinifera

Buining 1967

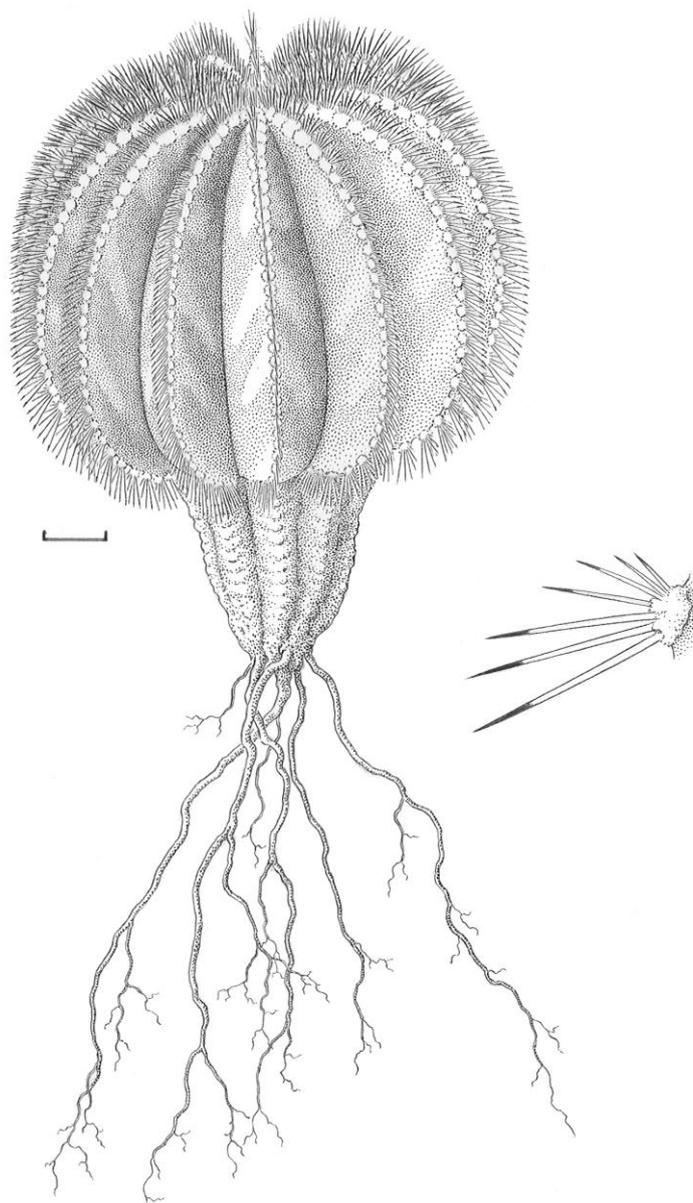


**Common names:** bras.: quiaba da lapa

**Scientific synonyms:** →*Uebelmannia pectinifera* var. *multicostata* Buining & Brederoo 1975  
→*Uebelmannia pectinifera* var. *pseudopectinifera* Buining 1972

**CITES category:** Appendix II since 01.07.1975, Appendix I since 11.06.1992 (Prop. Brazil).

**Distribution:** State of Minas Gerais, Brazil



bar = 1 cm

**Characteristics:**

One of the most distinctive cacti, regularly and acutely ribbed, globular to columnar, green to whitish, with densely arranged, confluent areoles along the edges of the ribs, spines arranged comb-like in a single plane (in adult specimens) and a strange, minutely bumpy surface relief of the stem. Growing in crevices and on surfaces of crystalline rocks and cliffs on mountain slopes.

**Roots:**

Fibrous, from the stem base.

**Stem:**

Solitary, upright, globular to distinctly columnar, 20-55 (-90) cm high, 10-17 cm Ø; apex with greyish white wool; stem surface whitish from a dense waxy coating (with some often quite large mucilage cells in the outer part of the stem).

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- Ribs:** Typically 13 (-18), 12 (5-13) mm high, 25 (13-17) mm wide, sharp-edged, vertical, not dissolved into tubercles.
- Areoles:** Very close to each other and nearly confluent, forming a continuous band, with greyish white wool.
- Spines:** Typically 5 (2-7), erect and in a comb-like arrangement (spread in vars. *multicostata* and *pseudopectinifera*), always straight, 7 (12-19) mm long, first black, later turning greyish with a darker tip.
- Flowers:** Subapical, thin funnellform, 14-18 mm long, 8-10 mm Ø, pale yellow, often with a greenish or reddish hue.
- Fruits:** Elongate, somewhat obovoid, 15-25 mm long, 8 mm Ø, red, slightly covered with tufts of hairs.
- Seeds:** 2-2.3 mm long, 1.6-1.8 mm wide, surface shiny black to reddish brown, completely flat.
- Juvenile specimens:** Aspect quite different for numerous short, spreading spines and separated, non-confluent areoles. Stem typically lilac to red, 11-12 (-18) ribs, (4-) 6-10 spines per areole, spreading, 4-6 (-10) mm.
- Trade:** *U. pectinifera* is widely distributed in the mountain range of Serro do Espinhaço and is a very variable species, fragmented into many isolated populations. Several subspecific taxa have been described, based on differences in number of ribs and spines etc. They are not recognised by Nyffeler (1998), because the differentiating characters can be found in various combinations. The two ssp. *flavispinga* and ssp. *horrida* are however well introduced in horticulture, morphologically less diffuse, probably geographically not overlapping and therefore treated separately here (according to Braun 2001 in lit. however, "*U. pectinifera* var. *crebispina*" nom. nud. is an intermediate form). Ssp. *pectinifera* in a very strict sense is known only from near Diamantina, to the north of the city. It has few broad, high ribs (13, 25 mm wide, 12 mm high), very densely packed areoles and usually a strongly white-waxy surface. Further included in ssp. *pectinifera* are the following varieties: Var. *pseudopectinifera*, is stated to differ by a green and more slender stem with low, narrow ribs (13 mm wide, 5-8 mm high), distant areoles (1-2 mm) and spreading spines. It is found south of Diamantina. Var. *multicostata* is found further north of Diamantina. It has 14-18 low, narrow ribs (5-13 mm high, 16 mm wide) and spreading spines. Schulz & Machado (2000) suggest a further variety from near Inhaí, with yellowish green stems, 15-23 ribs, 6-10 mm high and 13-15 mm wide and 1-3 spines per areole, 20-27 mm long. Generally, *Uebelmannia* spp. are not as easy to cultivate and hence not as popular and well distributed in horticulture as other cacti, *U. pectinifera* in a strict sense being by far the most popular and most frequently found in trade. All species are usually grafted to provide faster growth and better survival. Wild-collected specimens often bear lichens on the stem. 1984-1986 3'040 plants of *Uebelmannia* spp. were exported from Brazil. These exports included all species. Nearly all such exports were declared as artificially propagated material, but during this same period two Brazilian shipments of wild-collected *Uebelmannia* were confiscated by Dutch customs officials. These shipments had been declared as artificially propagated, but contained many 100s of wild-collected individuals. One Swiss nursery company is known to have imported wild-collected *Uebelmannia* during the 1970s and early 1980s. In the 1980s wild-collected specimens of *Uebelmannia* were regularly offered for sale in the Netherlands, Belgium and Germany. Two nurseries in Brazil hold stocks of illegally collected specimens of *Uebelmannia*, one of these more than 1000 specimens (supporting statement for App. I-listing, 1992). *U. pectinifera* caused a big sensation and accordingly a great demand after its discovery, stimulated by subsequent descriptions of further new varieties. Today it is artificially propagated to quite some extent, and relatively well introduced in horticulture; it is not restricted to specialised collections of Brazilian cacti. Nurseries registered for artificial propagation: Germany P-DE-1001 (ssp. *pectinifera*, ssp. *flavispinga*), Spain P-ES-1001 (ssp. *pectinifera*, var. *pseudopectinifera*), Czech Republic P-CZ-1001 (ssp. *pectinifera*, ssp. *flavispinga*), Switzerland P-CH-1001 (ssp. *pectinifera* incl. "*multicostata*", *pseudopectinifera*" and "Inhaí", ssp. *flavispinga* incl. "*crebispina*" and "*longispina*", ssp. *horrida*).
- Similar species:** The genus *Uebelmannia* can be identified quite easily for the hard epidermis and the very strange, minutely foveolate surface relief of the stem, which is well visible without magnification and gives the plants a nearly metallic aspect. Within the genus, *U. pectinifera* has pronounced ribs and strong, acicular spines. Ssp. *flavispinga* has distinctively yellow spines in the new growth, later turning grey, ssp. *pectinifera* has rather few, pronounced, broad and high ribs, a remarkable white-waxy cover and a red epidermis in juvenile plants and ssp. *horrida* has distinctively longer (up to 4 cm), spread spines and more wool in the apex.
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 Krainz, H. (ed.), (1973-1975): Die Kakteen, 3. XII, C VI e; 1. VII, C VI e.  
 Schulz, R. & M. Machado (2000): *Uebelmannia* and their Environment. Schulz Publishing, Teesdale, Australia.  
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