OPUNTIA MACROCENTRA ENG. AND OPUNTIA CHLOROTICA ENG. & BIG.

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Opuntia macrocentra is an attractive species which has, within the past 20 years, become taxonomically confused and associated with other clearly distinct opuntias. Most of this confusion has been caused by superficial similarity due to the presence of noticeable purple beta-cyanin pigments which strongly color the pads of several species of *Opuntia.* This pigmentation is most pronounced during dormancy and drought stress, and is one of the most prominent features of *O. macrocentra.*

The plants most often confused with *O. macrocentra* are those which go under the names *O. santa-rita* and *O. gosseliniana.* This confusion has been boosted by the placement of both names as varieties under *O. violacea* (=*macrocentra*) by L. Benson (1969). These names actually belong under *O. chlorotica.* The name *santa-rita* was originally published as a variety of *O. chlorotica,* and the name *gosseliniana* is here treated likewise.

Opuntia macrocentra Eng.

O. violacea Engelmann, 1848, in Emory, Notes Mil. Reconn. Ft. Leavenworth to San Diego, App. 2, p. 157, f. 8 (nom. inval., Art. 34.1 (b)). T.L.: approx. 4 mi. E of Solomon, Ariz.

O. macrocentra Eng., 1857 (preprint 1856), Proc. Amer. Acad. 3:292. T.L: sandhills, Rio Grande bottom, nr. El Paso, Tex.

O. violacea L. Benson, 1969, The Cacti of Ariz., 3rd ed., p. 21. Neotype: L. Benson 16632, April 22, 1966, "ne. of Solomon," Pom. Coll., Claremont, CA #311337.

These plants form spreading bushes up to 2 or rarely 3 ft tall (roughly 0.65–1 m), only rarely with a well defined trunk. Spines on old branches do not increase noticeably in number. Spines are dark blackish to reddish-brown, typically white apically due to epidermal coloration. Some individuals or occasionally whole populations may have the entire spine colored white (the basis of the name *castetteri*). When wet this white coloring disappears, temporarily allowing dark color to show through. It also disappears as the spine ages. The spines vary in number and distribution on the pad from 0 to 4 (rarely more) per areole and from absent in all areoles to present in all. There are typically 1–3 spines per areole in the upper ½ or fewer areoles of a pad. There are 1 or 2 upper projecting main spines which are nearly terete, and 3–6 cm long (occasionally to 12 cm or even longer) and up to 1.3 mm in diameter. The remaining lower spines are somewhat to quite flattened and vary in size from equal to the main spines to tiny; these are mostly somewhat deflexed. The glochids are tan to reddish-brown in color. Flower buds are apically narrow acute, with a slender ovary (see Benson, 1982, b/w fig. 466 and clr. fig. 45). The flowers are mostly about 6–7 cm in diameter, and open less widely than in many opuntias. The flowers are yellow with brilliant red centers. The stigma lobes are usually pale whitish or yellowish, varying on occasion to pale greenish. The fruit is mostly about 2.5–3.5 cm long, ovoid, and narrowed apically below the umbilicus, which is normally deeply concave. There are few areoles on the fruit, these mostly crowded toward the apex. The seeds are pale tan, and mostly about 4 mm in diameter.

There are two varieties in the U.S., plus a third puzzling type, which are discussed below. This species shows a close affinity to a complex of types mostly included (at least for now) under the name *O. phaeacantha* Eng.; however, much more similar are two Mexican species, and their relationship to *O. macrocentra* needs study. One of these is tentatively identified as *Opuntia horstii* W. Heinr.[1], which in Mexico is incorrectly considered to be *O. macrocentra.* It is found in the mountains of southwestern Chihuahua, Durango, and perhaps southwestern Zacatecas and southward. It is very similar to *O. macrocentra,* differing in traits of stem, often lacking the red center of the flower, and in being a summer rather than spring bloomer. The other Mexican species is *O. azurea* Rose, which differs from *O. macrocentra* mainly in having shorter spines, and in often developing a trunk. It is common, mostly in desert, from southeastern Chihuahua, northeastern Durango, and western Coahuila into Zacatecas and perhaps San Luis Potosi. These two have never been seen sympatrically with each other or with *O. macrocentra.* Instead, the three seem to replace each other.

[1] In the article "*Opuntia chisosensis* (Anthony) comb. nov.," Cact. & Succ. Jrnl. 59:3, May–June 1986, I incorrectly made the following statement on p. 126: ". . . and *Opuntia* sp. (?=*horstii,* a horticultural name of which the types were lost in World War II)." The plant was described as follows, *Opuntia horstii* W. Heinr., 1963, Descr. Cact. Nov. III:10. Holotype: in Botanical Garden of Leipzig University. Type locality: unknown. This information is from Backeberg (1976). I have not yet seen the original description, but Backeberg's description and photo almost certainly apply to the plant discussed here. It has been listed as one of Backeberg's numerous invalid names.

Fig. 1. *O. macrocentra* var. *minor,* showing flowers and narrowly pointed buds. Presidio, Presidio Co., TX. May 1986.

Fig. 3. *O. macrocentra* var. *macrocentra,* showing spreading growth form (about 4 dm tall). Solomon, Graham Co., AZ. April 1983.

Opuntia macrocentra is a very attractive species and makes an eye catching specimen in any garden. It does well in cultivation in the Southwest, in all but coastal areas. Variety *macrocentra* withstands extreme cold best, and will survive well as far north as the Denver area. The species does not appreciate excessive moisture, and will not grow well east of the Great Plains or near the coast, where it is quite rot prone.

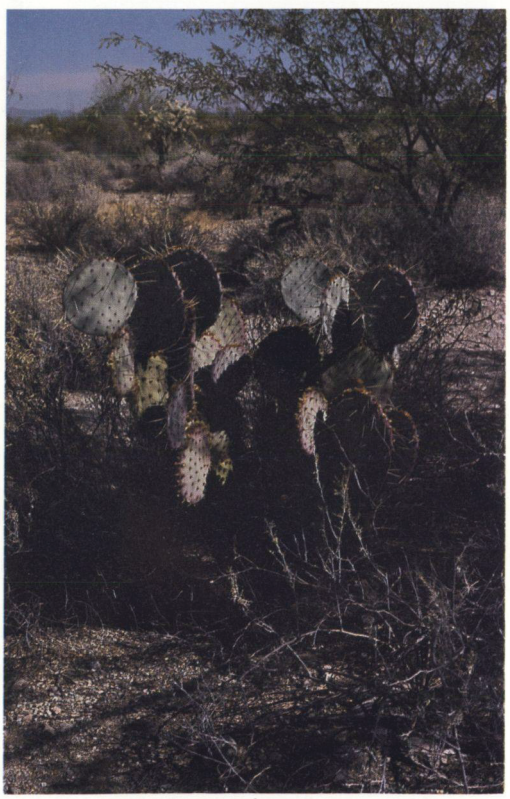

Fig. 2. *O. chlorotica* var. *gosseliniana.* Small plant showing upright growth form (about 6 dm tall). Near San Luisito, NW Sonora, Mexico. November 1986.

Opuntia macrocentra Eng. var. *macrocentra*

O. violacea L. Benson var. *macrocentra* L. Benson, 1969, The Cacti of Ariz., 3rd ed., p. 21.

O. violacea L. Benson var. *violacea* L. Benson, 1969, loc. cit., p. 92.

O. violacea L. Benson var. *castetteri* L. Benson, 1969, Cact. & Succ. Jrnl. 41:125. Type: July 11, 1955, Hueco Mtns., El Paso Co., Tex., L. & R. Benson #15433, Pomona College #284747 (2 sheets).

This variety is characterized by being typically of a dull dark green color. When the purplish pigment is strong, it is usually a dull purple. Areole density on the pads is high, with diagonal counts across the middle of normal pads typically 6–8. The fruit are typically a dull deep purplish-red when ripe, being purple inside.

This variety is widespread and common, ranging from Lea County, New Mexico and Pecos and Terrell counties, Texas westward into Gila, Pinal, and Pima counties, Arizona and into extreme NE Sonora, Mexico. In the Rio Grande Valley it ranges northward to Sandoval County, New Mexico, being very localized north of Socorro. It favors areas of gentle terrain, mostly on desert pavement with creosote bush (*Larrea tri-*

Fig. 4. *O. macrocentra* var. *macrocentra* in fruit. Notice the few fruit areoles and narrowed apex. Hillsboro, Sierra Co., NM. August 1984.

Fig. 5. *O.* aff. *macrocentra* (variety or species?) with green fruit. Las Cruces, Dona Ana Co., NM. June 1985.

dentata); however, it may also grow in desert grassland, and up onto rocky slopes.

Opuntia macrocentra var. *minor* Anthony, 1956, Amer. Midl. Nat. 55:244–245, fig. 21.

This variety is an extremely beautiful plant. The plants average somewhat more upright and larger, but this seems environmentally caused and is not consistent. The joints average smaller, being mostly about 10–15 cm long (vs. mostly about 15–20 cm in var. *macrocentra*). This also can vary considerably with environment. The joints are strongly glaucous, bluish-green, and when dormant or stressed the purple coloring is usually vivid and decidedly reddish. The spines are typically numerous and average very long. They are usually somewhat curving and twisted. The areole count is lower in this variety, adding to the distinctive appearance. Diagonal counts across the middle of pads are typically 5 or 6. The fruit is typically a bright pinkish-red, and greenish inside.

This variety is common in the Big Bend of Texas and adjacent Mexico. In the U.S. it occurs in Presidio and Brewster counties, Texas, where it blends northward with the typical variety. Its distribution in Mexico is yet uncertain. Variety *minor* favors rugged volcanic terrain, occurring most commonly on slopes of basalt or rhyolite.

Fig. 6. *O. chlorotica* var. *chlorotica* in bud in cultivation, from Pinaleno Mtns., Graham Co., AZ. May 1984.

Opuntia aff. *macrocentra* variety? (or species?)

Here is discussed a plant which is similar to *O. macrocentra* and is always sympatric with the typical variety, yet seems distinct. When first observed it was thought to be of hybrid origin, but it has since been found to be a fairly stable entity. It has been found sporadically from Eddy County, New Mexico and El Paso County, Texas, westward to Graham and Cochise counties, Arizona.

The differences from *O. macrocentra* are subtle, but are distinct enough to make the plants immediately recognizable. The plant grows basically the same as var. *macrocentra,* but the joints tend to be slightly larger. The plant blooms slightly later, and the fruit takes longer to ripen. Some of the traits are as in var. *minor,* such as a low areole count, and pads which are more glaucous, bluish-green than in var. *macrocentra,* and which tend to be more reddish when stressed. The spines are few, mostly limited to the upper edge areoles, and mostly 5 cm or less in length. They are more commonly reddish than blackish. They tend to point upward more than in var. *macrocentra.* The flowers average large, mostly about 7 to 8 cm in diameter. The fruit also average large, mostly about 4–4.5 cm long, and are usually red, greenish inside. The seeds are large, mostly about 5–6 mm in diameter.

This plant tends to grow much more rapidly and lush in cultivation than do the other varieties. The author suspects a difference in ploidy level, but this has not been checked as of yet. The plant needs further study to see how it relates to *O. macrocentra.* The author suspects specific distinction, but this will await further investigation.

Opuntia chlorotica Eng. & Big.

O. chlorotica Eng. & Big., 1857 (preprint 1856), Proc. Amer. Acad. 3:291. T.L.: Bill Williams Mtn., Ariz.

O. palmeri Eng., 1896, in Coulter, Contr. U.S. Natl. Herb. 3:323. T.L.: St. George, Utah.

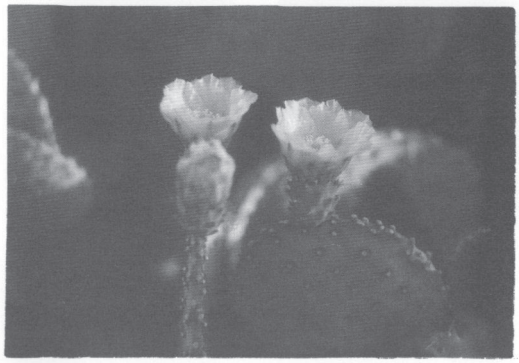

Fig. 7. *O. chlorotica* var. *santa-rita* in flower. Santa Rita Mtns., Pima Co., AZ. May 1985.

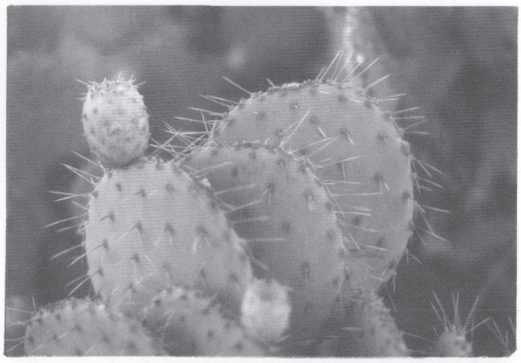

Fig. 8. *O. chlorotica* var. *santa-rita* in fruit. Notice the numerous fruit areoles. Peloncillo Mtns., Cochise Co., AZ. September 1984.

This species forms an upright treelike bush mostly about 2–6 ft (approx. 60–183 cm) tall with one to several trunklike main stems. The areoles on old stems become enlarged, with glochids and spines increasing greatly in number. The main branches and trunk are often completely clothed in a shaggy covering of spines. Young pads are bluish-green with or without noticeable purplish betacyanin pigments during stress or dormancy. The areole density on the pads is high, with diagonal areole counts on normal pads mostly 8–12.

The spines are arranged and shaped much as in *O. macrocentra,* but lower spines are mostly strongly deflexed. In young pads there may be 0–8 spines per areole, usually in most areoles, but sometimes only in upper areoles. The spines are yellow to rusty orange-red in color, usually lighter apically. They are usually under 3 cm in length, but in var. *gosseliniana* may be to 10 cm long. Glochids are yellow to rusty orange-red, usually lighter than or matching the spine color. Flower buds are stout and usually bluntly pointed apically. Flowers are yellow, sometimes with some orange suffusion near the center and base (mostly in var. *chlorotica*). The stigma lobes are rich green in var. *chlorotica,* changing gradually paler to the south and especially southwest in the other varieties. The flowers are mostly about 5–7.5 cm in diameter, averaging small to the north and east and larger to the southwest. The fruit are broadly ovoid to nearly cylindrical. The areoles are numerous and prominent, bearing numerous glochids, and often a few fine bristle-like spines. When ripe they are some shade of dull pinkish to purplish-red. The seeds are fairly small, but variable from place to place. They are pale tan and mostly about 2.5–4 mm in diameter.

Opuntia chlorotica Eng. & Big. var. *chlorotica*

This is the common northern variety most frequently seen in the U.S. It is characterized by tall growth, the lack of obvious purplish coloring in the pads, and by the yellow color of its spines. It normally has numerous, fairly short spines, but in some areas may be spineless. It has the least flamboyant flowers in the species, and often has orange suffusion or veining in the petals. The stigmas are nearly always rich green. This type of plant gives a distinctively green to yellowish-green impression from a distance. This is in strong contrast to the mostly bluish or purplish impression usually given by the other varieties.

Variety *chlorotica* is mostly a plant of mountainous areas, but in suitable areas it may be common in valleys on gentle slopes or even flat areas. Its distribution is mainly along the northern and western edges of the deserts in the U.S. More specifically from Catron, Sierra, and Luna counties, New Mexico westward across Arizona (south of the Mogollon Rim) to the Grand Canyon, Washington County, Utah, Clark County, Nevada, and into San Bernardino, Riverside, and San Diego counties, California. In Mexico it is apparently limited to extreme northern central Baja California Norte, northwestern Chihuahua, and extreme northeastern Sonora. In southeastern Arizona, extreme southwestern Hidalgo County, New Mexico, and the northern edge of adjacent Mexico it blends freely with var. *santa-rita.* Specimens like var. *chlorotica* with yellow spines and little or no purplish pigment occur occasionally southward throughout the range of var. *santa-rita.*

Opuntia chlorotica var. *santa-rita* Griffiths & Hare

O. chlorotica Eng. & Big. var. *santa-rita* Griff. & Hare, 1906, NM. Agr. Exp. Sta. Bull. No. 60: 64. Type: Oct. 8, 1905, Celero (Santa-Rita) Mtns., Pima Co., Ariz. #8157 D.G., U.S. Natl. Herb. #2607623.

O. santa-rita (G. & H.) Rose, 1908, Smiths. Misc. Coll. 52:195.

O. shreveana C. Z. Nelson, 1915, Galesburg Republ. Reg.; 1919, Trans. Ill. Acad. Sci. 12:121. T.L.: Tucson, Ariz.

O. gosseliniana Weber var. *santa-rita* (G. & H.) L. Benson, 1950, The Cacti of Ariz., 2nd ed., p. 65.

O. violacea L. Benson *santa-rita* (G. & H.) L. Benson, 1969, The Cacti of Ariz., 3rd ed., p. 21.

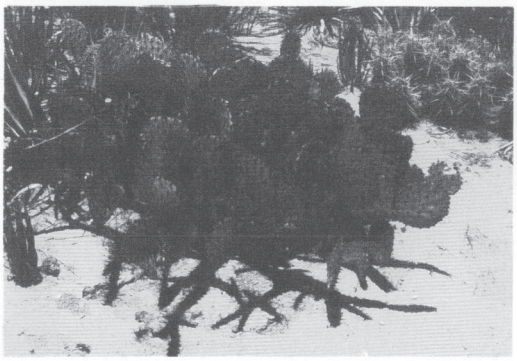

Fig. 9. *O. azurea.* Paila, Coahuila, Mexico. August 1985.

Fig. 10. *O.* aff. *horstii.* Chocolate, Durango, Mexico. August 1985.

This variety is very similar to var. *chlorotica.* It differs mainly in usually having fairly noticeable to very strong purple coloring in the pads. The spines are mostly orangey in color. It is the dominant eastern variety in Mexico, occurring through most of Chihuahua into Durango and in northeastern Sonora. It is common in southeastern Arizona in Cochise, Santa Cruz, and in eastern Pima counties. In New Mexico, it has been found only in Hidalgo County, where it intergrades with var. *chlorotica.* It is also reported by Del Weniger (1970) from southeast of Presidio, Texas. All other records from New Mexico and Texas, and many from Arizona are based on misdetermined spineless or nearly spineless *O. macrocentra.*

The name *santa-rita* has been traditionally applied to spineless specimens of anything with purplish pads, resulting in much confusion. Spineless individuals or groups of individuals occur occasionally in all the taxa discussed here. They are genetic forms, but do not make up taxonomic entities. Normally spineless individuals occur as aberrants among normal plants. The trait might be roughly compared to baldness in humans.

This variety has been much confused with variety *gosseliniana,* with which it intergrades to the west. The author has, until recently, made this mistake, and seeds have been distributed under that name.

Opuntia chlorotica var. **gosseliniana** (Weber) Ferguson, **comb. nov.**

O. gosseliniana Weber, 1902, Bull. Soc. Acclim. France 49:83. T.L.: coast of Sonora (not exactly defined).

O. violacea L. Benson var. *gosseliniana* (Weber) L. Benson, 1969, The Cacti of Ariz., 3rd ed., p. 21. Lectotype: designated by Benson, quoted from Benson, 1982. Roland-Gosselin *f. 309* in 1904 (two flowers), Museum d'Histoire Naturelle, Laboratoire de Phanerogamie, Paris, France.

This variety is superficially very similar to *O. macrocentra* var. *macrocentra,* with which it has been much confused. This has given rise to many inaccurate records for both where they do not occur. It has the growth form and reproductive structures of *O. chlorotica* and blends with var. *santa-rita.* It is distinguished from var. *santa-rita* by averaging smaller in plant size (though it occasionally becomes equally large), and by its spines. These are typically rusty colored (occasionally yellowish or dark reddish-brown) and pale apically. They are long on most plants, sometimes to 10 cm, and often curved, and somewhat flexible. This variety has the most showy flowers of the species, somewhat large, and usually brilliant yellow. The stigma lobes are usually pale cream to pale greenish.

Variety *gosseliniana* replaces var. *santa-rita* to the west of the mountains in Sonora, where it seems to prefer mostly valleys and plains. It has been so confused with other plants in Arizona that its true distribution is uncertain, but it appears to occur only in southwestern and central Pima County.

Opuntia chlorotica is a beautiful species in all its forms, and well worth its place in any southwestern garden. It is very difficult to grow elsewhere, and not so cold hardy as *O. macrocentra.* Young plants, especially, are susceptible to extreme heat and drought, and the species also tolerates poorly excessive moisture and shade. It is fairly hardy in climates such as Albuquerque, New Mexico and Las Vegas, Nevada or milder, but does poorly in colder areas. Although this sounds very negative, the species can be grown with a little proper protection, or in a suitable climate, without too much trouble. The species is occasionally available from cactus seed and plant dealers, or locally at southwestern nurseries. Plants should not be removed from nature, as it is hard on populations, mostly illegal, and the plants transplanted in this way will likely die anyway.

The above summary of these two species of *Opuntia* is hopefully a small contribution to straightening the taxonomic confusion and mis-

understanding which is so prevalent in *Opuntia* and related genera. These species still need more work to be completely understood. Cytological studies of properly identified material from many localities, and more field observation (esp. in Mexico) would seem especially important.

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CSSA RESEARCH COMMITTEE GRANTS FOR 1988

Joe Betzler, San Diego, $600.00 to assist him to study pollination mechanisms of Asclepiadaceae in South Africa. Joey has worked with Darrel Plowes on his collection log. He is a trained botanist and a well known grower of these plants. This will be his first trip to visit them in habitat.

Louise Bustard, $400.00 to assist in her travels in the U.S. during April and May. Louise is in charge of the cacti and succulent collection at Kew Gardens in England. She will be here to study plants in habitat and propagation techniques. Her tour should help to improve relations between Kew and growers and hobbyists in the U.S.

Conrad Fleming, St. Croix Botanical Gardens, V.I., $400.00 to assist him in his travels to Cuba, where he will study some of their endangered cacti. Conrad has received a previous grant from the CSSA to study cacti elsewhere in the Caribbean.

Richard May, Seabrook, Texas, $400.00 to continue his study of sclerocacti in Utah and Nevada. Dick May has received several CSSA grants in past years. The results of that work have been published in several articles in our *Journal.*

Dr. Barbara Phillips, Museum of Northern Arizona (Flagstaff), $500.00 to study *Pediocactus peeblesianus* and var. *fickeiseniae.* This work will include population and taxonomic studies. Dr. Phillips is also working on a possible recovery program for these rare cacti sponsored by the U.S. Fish and Wildlife Service.

Dr. Robert Wallace, University of Connecticut, $600.00 to assist him in his study of molecular systematic relationships in Cactaceae. Dr. Wallace received assistance from us in the past for his work on *Lithops* systematics. His work with DNA could help solve some taxonomic riddles.

Seymour Linden, Chairman, CSSA Research Committee
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