

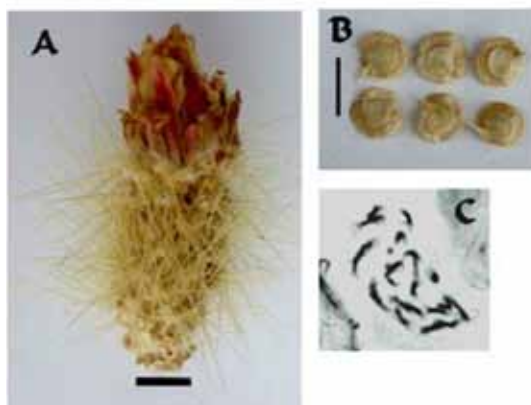
# A new species of *Opuntia* (Cactaceae) from Mojave Co, Arizona

*Opuntia diploursina* A.D. Stock, N. Hussey & M.D. Beckstrom, sp. nov. is described as a new species of diploid, dry-fruited, prickly pear from the Grapevine Mesa region in south central Mohave Co., Arizona. It grows on alluvial gravel covered soil associated with *Larrea tridentata* (DC.) Coville, *Yucca brevifolia* Engelm. var. *jaegeriana* McKelvey and *Yucca schidigera* Roezel ex Ortigies. *Opuntia diploursina* is most closely related to tetraploid *Opuntia erinacea* Engelm. & J.M. Bigelow, but differs in spine characteristics, larger fruit and seeds and diploid chromosome number.

Keywords: Cactaceae, diploid, dry-fruited prickly pear, *Opuntia*.

A new species of *Opuntia* is described from the Grapevine Mesa region near Meadview in Mohave County, Arizona. This distinctive prickly pear was discovered in the course of a study of the ploidy of *Opuntia* hybrids in southern Mohave Co., Arizona. It is similar to the related *Opuntia erinacea* Engelm. & J.M. Bigelow, but differs in minor spines more closely appressed to pad surface, spines smaller in diameter and more flexible, inter-areolar distance less, upright growth habit, larger fruit with longer, more flexible spines, larger seeds, and diploid chromosome number ( $2n=22$ ).

Chromosomes were analyzed from short, rapidly growing, root tips from field collected cladodes. The general methodology used was similar to that of Majure and Ribbens (2012), except that the cover slip was subsequently removed by freezing on dry ice. The slide was dried by gentle heating and then stained for 10 min. in 2% Giemsa stain (Gurr's R66), in distilled water, and air dried for analysis. At least 5 cells were analyzed per specimen and chromosomes were obtained from 10 individual plants. Metaphase cell images were digitally captured.



**1.** *Opuntia diploursina*. A. mature fruit, B. seeds, C. mitotic chromosomes from root tip ( $2n=22$ ). A. from A.D. Stock 1873 & N. Hussey; C. from A.D. Stock 1869 & N. Hussey. Scale bars = 10 mm.

## TAXONOMIC TREATMENT

*Opuntia diploursina* A.D. Stock, N. Hussey & M.D. Beckstrom, sp. nov. (Fig. 1). Type: USA, Arizona, Mohave Co., west slope of Grapevine Mesa near Meadview, 35° 50.532' N, 114° 07.623' W, 898.5 m (2948 ft) elevation, 28 April 2012, A.D. Stock 1869 & N. Hussey (holotype): UT.

Low shrubs to 53 cm tall, with mainly ascending branches of one to six cladodes. Stem segments narrowly obovate to elliptic, flat, 8.5–13 cm long, 6–9 cm wide, terminal segments persistent, not readily detached; areoles 7–8 per diagonal row across mid-stem segment, subcircular, 3–3.5 mm in diameter, wool white, about 5–10 mm apart; each with an apical glochid tuft and single major spine, when developed;

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2. *Opuntia diploursina*, details of mature, terminal cladode with curled major spines.



3. *Opuntia diploursina*, showing elongation of major spines on older cladodes.

glochids inconspicuous, seldom more than 2–3 mm, yellow to brown; major spine generally one per areole, often not developed in many areoles of blooming age cladodes, pale straw yellow, terete, flexible, 2–10 cm long on flowering segments; minor spines 17–20, and 7–23 mm long, overlapping between areoles, grading in size and orientation but generally appressed to pad surface. Flowers 6.0–7.5 cm long, inner tepals yellow with each segment having a pink blush at mid-rib resulting in overall peach yellow appearance; filaments white, style white, stigma lobes green. Fruit 3–4 cm long, dry; areoles 21–27; spines 10–18 per areole, 6–35 mm long, flexible, often curved, occurring in all areoles giving the appearance of a long spine burr. Seeds numerous, large, 8–10 mm in diameter; raphe 1.5–2.5 mm wide from embryo chamber to margin of seed, often with a beaked funicular margin. Chromosome number  $2n=22$ . The specific epithet is descriptive of a diploid taxon combined with the varietal name *ursina*, historically applied to an especially spiny morph of *Opuntia erinacea* noted for its long, wavy, hairlike spines.

Paratypes: USA, Arizona, Mohave Co., west slope of Grapevine Mesa near Meadview. 28 April 2012 A.D. Stock 1868 & N. Hussey (UT), 28 April 2012 A.D. Stock 1870 & N. Hussey (UT), 30 June 2012 A.D. Stock 1873 & N. Hussey, fruit only (UT).

The terms major spine and minor spines are as used by Parfitt (1991, 1997).

Major spine usually erect on all but basal cladodes, frequently not well developed in all areoles of younger, blooming age cladodes but occurring in some areoles. When a major spine is not developed, spines appear to be of one kind, grading in size. The single, sporadic, often curved or curled, hair-like major spine



4. The known range for *Opuntia diploursina* in northwestern Arizona (—). The range in Nevada is not yet well established.

projecting from areoles of flowering terminal cladodes (Fig. 2) is a distinctive characteristic compared to populations of *O. erinacea*. However, this characteristic is seen occasionally across the range of *O. erinacea*. As the cladode ages most major spines become elongated and older cladodes are usually very "hairy" in appearance due to elongation of major spines (Fig. 3).

## DISTRIBUTION, HABITAT AND PHENOLOGY

*Opuntia diploursina* occurs in scattered populations on the west side of Grapevine Mesa near, and extending a few miles to the west, north, and south of



5. *Opuntia diploursina*, in habitat near Meadview, AZ, with rocky, decomposed granite substrate and associated plants.

Meadview, Arizona (Fig. 4). Most of the population occurs west of Grapevine Mesa, Pierce Ferry Road and Meadview. The known range in Arizona is contained within a line along the slopes west of Pierce Ferry Road south of Meadview and the western edge of Grapevine Mesa; north to South Cove Road; west to South Bay of Lake Mead; the southern shore of Lake Mead to Gregg's Hideout; south along the eastern ridges of the White Hills west of Gregg's Hideout Road; south along Gregg's Hideout Road to a point just south of the type locality. It does not appear to be present on the west side of the White Hills. Most of this area is the drainage basin of Hualapai Wash. The southernmost plants were observed at the type locality. *Opuntia diploursina* also occurs north of Lake Mead in Clark Co., Nevada, in the Gold Butte area; from a few miles north of Gold Butte south to Gold Butte. Plants on sandy granitic soil at Gold Butte appeared to be typical *O. erinacea*, but a short distance south of Gold Butte and south to Bonelli Peak, *O. erinacea* is replaced by *O. diploursina*, which may also occur in other areas on the slopes north of Lake Mead and along the Grand Wash area. More field work is needed in Nevada. Some of the plants in the Nevada population appear to be somewhat introgressed with *O. basilaris*. It occurs at elevations of 466 m to at least 1100 m, on ridges and slopes in desert shrub-land (Fig. 5), in association with *Larrea tridentata* (DC.) Coville, *Yucca schidigera* Roezel ex Ortigies, and *Yucca*

*brevifolia* Engelm., var. *jaegeriana* McKelvey. The substrate is very rocky with alluvial surface accumulations of gravels derived largely from granite, with the addition of limestone in the northern and western part of the range. Flowering (Fig. 6) occurs in April-May, and fruit ripens in late May-June.

## RELATIONSHIPS

*Opuntia diploursina* has long been overlooked because of its isolated, limited range and lack of chromosome data. When collected or observed it has been identified as one of the many variable morphotypes included in Benson's (1982) concept of *O. erinacea*, and *O. ursina* Weber, and Parfitt's (1991) circumscription of *O. polyacantha* Haw., var. *erinacea* (Engelm. & J.M. Bigelow) Parfitt. *Opuntia diploursina* is closely related to and likely directly ancestral to tetraploid (Pinkava and Parfitt 1982) *O. erinacea*. *Opuntia diploursina* differs from the derived *O. erinacea* that occurs nearby in having minor spines generally closely appressed to the cladode surface (Fig. 7), denser in more closely set areoles, and all spines are thinner and more flexible. The microscopic, retrorse barbs on the spine tips of *O. diploursina* are greatly reduced in size and number in comparison with those of *O. erinacea*. This applies to the spines of both cladodes and fruit. This character has not been well studied in these species but may serve as an additional aid in identification. Glochids are fewer and shorter than those of *O.*





6. *Opuntia diploursina*, cultivated plant in flower showing unique peach yellow color.

*erinacea*. The minor spines of *O. diploursina* are more uniform in size and form a close, dense cover over the cladode, and are seldom elongated as they often are in *O. erinacea*. In *O. erinacea* the spines are often of one kind, grading in size. Elongated major spines of flowering cladodes of *O. erinacea*, when present, are usually straight, deflexed, or curved as opposed to the often curved or curled major spines of *O. diploursina*. The fruit are larger than those of *O. erinacea*, and with much longer, thinner spines (Fig. 8), and larger seeds. Spine color is pale yellow, as opposed to the gray to white mature spines found in most populations of *O. erinacea*. The growth habit of *O. diploursina* is upright with more or less vertical chains of cladodes. This growth habit is also seen in some populations of *O. erinacea* such as those in extreme southwestern Utah. Spine characteristics, fruit and seed size, and diploid chromosome number distinguish *O. diploursina* from all populations of *O. erinacea*, *O. hystericina* Engelm. & J.M. Bigelow, and *O. polyacantha*. As an ancient diploid, *O. diploursina* appears to be related to *O. trichophora* (Engelm. & J.M. Bigelow) Britton & Rose, which is also one of the diploid ancestral populations within the *O. polyacantha* complex (sensu Parfitt 1991, 1998).

*Opuntia diploursina* differs from *O. trichophora* by upright growth habit, more minor spines that are more closely appressed to pad surface, closer spaced areoles, yellow spine color as opposed to white or gray mature spines; more and longer spines on fruit. Both species have flexible, thin major spines that can be very long on mature cladodes but those of *O. trichophora* are seldom curled. *Opuntia trichophora* was not recognized by Parfitt (1991) but, like *O. diploursina*, it is an important diploid species in the phyletic



7. *Opuntia diploursina* terminal cladode showing dense cover of closely appressed minor spines.



8. Comparison of mature fruit of *Opuntia diploursina* from near Meadview, AZ. (left), and *O. erinacea* from Beaver Dam Slope, Washington Co., UT. (right).

history of the *O. polyacantha* complex. Parfitt viewed *O. trichophora*, as circumscribed by Benson (1988), to be a recurring morphotype and disregarded its distinctive spine morphology and diploid status throughout its range (Weedin and Powell 1978).

*Opuntia trichophora* was included within *O. polyacantha* var. *polyacantha* by Parfitt (1991) but it represents the most likely diploid ancestor of *O. polyacantha* (sensu stricto). *Opuntia diploursina* was previously overlooked within *O. erinacea* (*O. polyacantha* var. *erinacea* of Parfitt 1991) and represents the probable diploid ancestor of *O. erinacea*. Since *O. polyacantha* and *O. erinacea* now appear to be derived from different ancestral diploid species, they should not be considered conspecific. The distribution of allopatric populations of the *O. polyacantha* complex, with ploidy, and morphological differences over wide areas, suggests considerable time in development. The likely presence

of members of the complex in the Great Basin region during the late Pleistocene, more than 11,000 years ago (Rhode and Madsen, 1995), may indicate considerable antiquity of the *O. polyacantha* complex in western North America. It is highly unlikely that the species included in the complex are the result of Holocene evolution. Parfitt's (1991) circumscription of *O. polyacantha* includes, as varieties, several major, allopatric, populations, often with different chromosome numbers and often apparent allopolyploids. This arrangement changed the status (Parfitt 1998) of several taxa, which had been regarded as good biological species for decades, and did not reflect the derivation and dispersal of the complex from previous diploid ancestors. The discovery of this new diploid ancestor of *O. erinacea* suggests that the inclusion of *O. erinacea* within *O. polyacantha* may not be justified. The failure to recognize the ancient diploid, *O. trichophora*, further distorted both the range and post-glacial dispersal of *O. polyacantha*. Parfitt's (1991,1998) circumscription of *O. polyacantha* introduced the concept of a super-species, that ranges over much of North America, and includes diverse populations with chromosome numbers ranging from diploid to octoploid. If other *Opuntia* groups were treated in a similar fashion, fewer than a dozen species would be recognized north of Mexico. It appears likely that most, if not all, of the varieties of *O. polyacantha* (sensu Parfitt 1991, 1998, Pinkava 2003) represent good species with a history far older and more complex than indicated by Parfitt's (1991) circumscription of *O. polyacantha*.

*Opuntia diploursina* occurs with *O. basilaris* Engelm. & J.M. Bigelow throughout its range. In the area to the north and northwest of Meadview it has hybridized with diploid (Pinkava et al. 1977), *O. basilaris* and produced a distinct diploid hybrid population. Two different forms of *O. basilaris* occur in the area and each produces a distinctive hybrid morphology. Backcrosses are also evident, contributing to complex variation.

*Opuntia erinacea* occurs just to the south of the range of *O. diploursina* but the two species do not occur together at any locality. Gene flow between the two species would be greatly reduced due to ploidy differences. An apparently-rare pale yellow spine form of *O. erinacea* occurs in the Meridian Ranch Road area north of Dolan Springs. This may represent introgression from *O. diploursina*, but other than pale yellow spine color, fading to gray, they appear to be typical *O. erinacea*.

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