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MISCELLANEOUS CHROMOSOME NUMBERS IN OPUNTIEAE DC. (CACTACEAE) WITH A COMPILATION OF COUNTS FOR THE GROUP

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Abstract: Chromosome counts of members of the Opuntieae were carried out to further our understanding of ploidal levels, species boundaries, and evolutionary patterns within this group of stem succulents, which has been well-studied cytologically and is well known for hybridization and polyploidy. Here we counted chromosomes of 53 taxa in 4 genera (*Consolea* Lem.*, Nopalea* Salm-Dyck*, Opuntia* Mill., and *Tacinga* Britton & Rose). Thirty of these counts are the first for a given taxon, and six counts represent a different ploidy for a taxon than has been reported previously. We also present a review of chromosome counts reported for Opuntieae. Ploidy in these taxa ranged from diploid, $2n = 2x = 22$, to 20-ploid, $2n = 20x = 220$. Of the 164 species in the Opuntieae for which chromosome counts have been carried out, including our new counts, 26.2% are diploid, 13.4% are both diploid and polyploid, and 60.4% are polyploid reiterating that the frequency of genome duplication in the group is far more common than diploidy.

Resumen: Se llevaron a cabo conteos cromosomáticos de miembros de la Opuntieae para avanzar nuestro entendimiento de niveles de ploidía, delimitación de especies y patrones de evolución en este grupo de suculentas, el cual es bien conocido por presentar hibridización y poliploidía. Contamos los cromosomas de 53 taxa de cuatro géneros (*Consolea* Lem.*, Nopalea* Salm-Dyck*, Opuntia* Mill., y *Tacinga* Britton & Rose). Treinta de los conteos son los primeros realizados para esas especies y seis de los conteos representan un nivel de ploidía distinto al que ha sido reportado antes. También presentamos una revisión de los conteos de cromosomas reportados para Opuntieae anteriormente. El rango de ploidía en Opuntieae abarca desde diploide, $2n = 2x = 22$, hasta 20-ploide, $2n = 20x = 220$. De los 164 especies en Opuntieae con conteos cromosomáticos, incluyendo los nuestros, 26.2% son diploides, 13.4% son diploides y poliploides, y 60.4% son poliploides, lo cual demuestra que la frecuencia de poliploidía en este grupo es mucho más común que la de diploidía.

Key words: *Consolea, Nopalea, Opuntia,* Opuntieae, polyploidy, *Tacinga*.

INTRODUCTION

Tribe Opuntieae of Cactaceae, with certain members often referred to as the "platyopuntias," contain the genera *Brasiliopuntia* (K.Schum) A.Berger*, Consolea* Lem.*, Miqueliopuntia* Frič ex F.Ritter*, Nopalea* Salm-Dyck*, Opuntia* Mill.*, Salmiopuntia* Frič ex Guiggi*, Tacinga* Britton & Rose, and *Tunilla* D.R.Hunt & Iliff s.l. (Anderson 2001). Hybridization, polyploidy, and species delimitation using highly variable morphological characters are common issues (Rebman and Pinkava 2001; Pinkava 2002) in this clade (see Wallace and Dickie 2002; Griffith and Porter 2009; Majure et al. 2012b). Cytogenetic work has been carried out to help determine or better define species limits, detect hybridization and reticulate evolution, provide evidence for polyploid formation

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and dispersal, and provide information regarding the evolution of the clade (Pinkava and McLeod 1971; Pinkava et al. 1977; Weedin and Powell 1978; Grant and Grant 1982; Pinkava et al. 1973; Pinkava et al. 1985; Parfitt 1991; Pinkava et al. 1992; Baker 2002; Pinkava 2002; Powell and Weedin 2004; Negrón-Ortiz 2007; Segura et al. 2007; Majure and Ribbens 2012; Majure et al. 2012a-b). We report 53 new counts from throughout tribe Opuntieae, of the genera *Consolea, Nopalea, Opuntia*, and *Tacinga.* We also present a synopsis of chromosome numbers for the clade, based on our new counts and work published thus far, to understand the distribution of ploidy throughout the extent of the native range of this group of cacti in the Americas.

MATERIALS AND METHODS

Chromosomes were counted using the methods of Majure and Ribbens (2012) and Majure et al. (2012a) for root tips or Pinkava et al. (1971) for pollen mother cells. We counted chromosomes of a total of 53 taxa (57 individuals in total) in four genera (*Consolea, Nopalea, Opuntia*, *Tacinga*; Table 1). We also performed a literature review for all chromosome counts reported to date for tribe Opuntieae (Table 2). We include counts reported from cultivated material under the caveat that those counts should be used with caution when considering ploidy for a given species, since cultivated material is often grown in common gardens and could potentially be the product of "man-mediated" hybridization, possibly mislabeled, or overgrown and misplaced over the years.

RESULTS

New Counts. The base number in Cactaceae consistently has been recorded as $n = 11$ (Pinkava 2002), and no deviation from that number was found here. Thirty species were counted for the first time during this study, and six taxa analyzed here were of a different ploidy than previously recorded (*Consolea moniliformis*, *Opuntia atrispina, O. orbiculata, O. quitensis, O. repens*, and *O. pilifera*; see Appendix 1). Of the 53 taxa analyzed in this study, 21 were diploid and 32 were polyploid. *Consolea moniliformis* was counted as octoploid, accessions of *Nopalea* were either diploid or tetraploid, and *Opuntia* ranged in ploidy from diploid to octoploid. *Tacinga inamoena* and *T. saxatilis* were both tetraploid (see Fig. 1 for selected chromosome counts and Fig. 2 for representative examples of *Opuntia* included in this study).

Synopsis. Of the 164 species of Opuntieae with reported chromosome numbers including our new counts here, 43 (26.2%) are diploid, 99 (60.4%) are polyploid, and 22 (13.4%) are composed of diploid and polyploid cytotypes. *Miqueliopuntia* has the highest chromosome number in the tribe ($2n = 220$; Appendix 2), although only one count has been produced for this species (Yuasa et al. 1973). *Brasiliopuntia* has been recorded as diploid in all reports (see de Castro 2008). *Consolea* consists entirely of polyploid species, except for diploid counts for *C. rubescens* and *C. moniliformis* by Spencer (1955) from Puerto Rico. Counts by Spencer (1955) are suspect however, as other species that have been consistently recorded as polyploid (Negrón-Ortiz 2007; Majure et al. 2012a) were also reported to be diploid by Spencer (1955). *Opuntia* has been recorded as diploid to enneaploid ($2n = 9x = 99$) in those counts reported so far (Table 1 & 2). Only two *Nopalea* species have been recorded as tetraploid, *N. lutea* (this study) and *N. hondurensis* (Baker et al. 2009a). *Salmiopuntia salmiana* has been recorded as tetraploid, and pentaploid (see Table 2). *Tacinga* has been recorded as diploid, tetraploid (de Castro 2008; and this study), and hexaploid (Yuasa et al. 1973). The three species of *Tunilla* with recorded chromosome counts are polyploid (tetra- and hexaploid — see Table 2).

DISCUSSION

Polyploidy is common in Opuntieae with 60.4% of reported counts thus far pertaining to polyploid individuals and another 13.4% representing taxa with both diploid and polyploid cytotypes. Diploids in the group are far less common than polyploid taxa and are naturally restricted to dry regions of South America (the chaco of Argentina and Bolivia, the central Andean valleys of northern Perú, central Ecuador, the caatinga of eastern Brazil); dry parts of the Caribbean and Central America (Greater-Lesser Antilles and northern Venezuela, Guatemala, Honduras, Nicaragua); and North America (southern Mexico, Yucatán Peninsula, Baja California, the Chihuahuan and Sonoran deserts, and the southwestern and southeastern United States). The distributions of diploids are all known centers of Cactaceae diversity and/or endemism (Anderson 2001; Boyle and Anderson 2002), except for the southeastern U.S., suggesting that these areas played major roles in the production of polyploid taxa and the associated increase in species richness of the clade. Polyploid taxa are found virtually throughout the range of Opuntieae, from southern South America to Canada (Anderson 2001). However, many species still need to be investigated, and numerous individuals per species need to be analyzed to resolve diploid/polyploid distribution patterns on a finer scale.

Although Opuntieae are well studied cytologically, ample work is necessary regarding ploidy determinations for the remaining species that have no counts or for those species that may have been counted only once (e.g., *Miqueliopuntia miquelii*). Previous work has shown that many taxa have more than one ploidal level (Parfitt 1991; Pinkava 2002; Powell and Weedin 2004; Majure et al. 2012a), and this is further exemplified here with 13.4% of taxa reported demonstrating both diploid and polyploid levels. These different ploidal levels within taxa may in some cases be representative of cryptic species that go undiscovered based on morphological com-

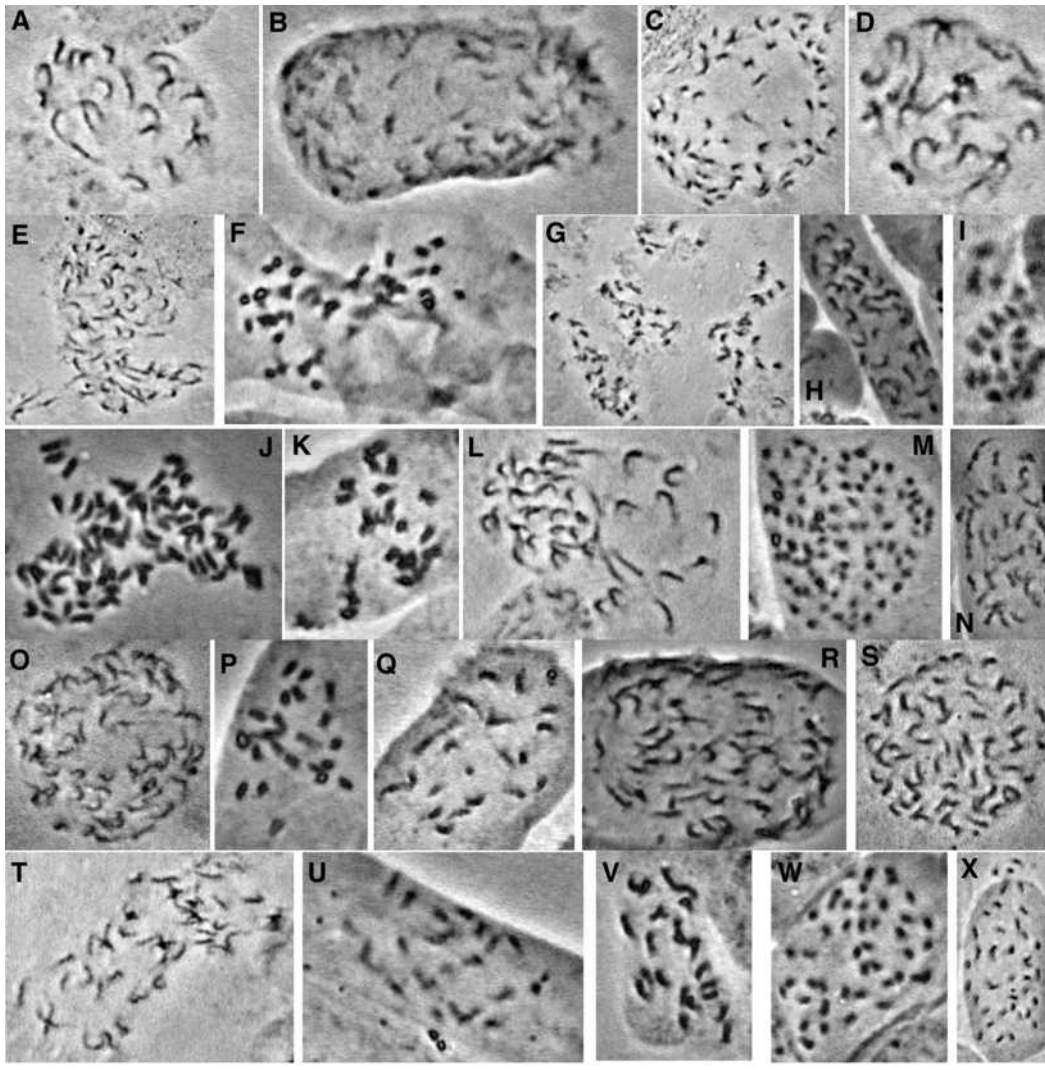

Figure 1. Selection of root tip mitotic chromosome squashes: **A)** *Opuntia* × *andersonii Puente 1239,* 2*n* = 22, **B)** *Opuntia bisetosa DBG 1997 0396,* 2*n* = 66, **C)** *Opuntia boldinghii DBG 1997 0391,* 2*n* = 66, **D)** *Opuntia caracassana Fleming s.n.,* 2*n* = 22, **E)** *Opuntia eichlamii Hamann s.n.,* 2*n* = 66, **F)** *Opuntia* cf. *assumptionis DBG 2011 0201,* 2*n* = 44, **G)** *Opuntia* × *bahamana DBG 1996 0298,* 2*n* = 66, **H)** *Opuntia quitensis DBG 1988 0262,* 2*n* = 44, **I)** *Opuntia* sp. nov. 1 *Puente 1615*, 2*n* = 22, **J)** *Opuntia megarhiza Puente 1884-A,* 2*n* = 66, **K)** *Opuntia guatemalensis Zimmerman 2609,* 2*n* = 22, **L)** *Opuntia orbiculata C. Hamann s.n.,* 2*n* = 44, **M)** *Opuntia pilifera DBG 1982 0346,* 2*n* = 88, **N)** *Opuntia repens Majure 3837,* 2*n* = 44, **O)** *Opuntia puberula DBG 1993 0887,* 2*n* = 66, **P)** *Opuntia pachyrrhiza Puente 1260,* 2*n* = 22, **Q)** *Opuntia sanguinea DBG 1996 0297,* 2*n* = 22, **R)** *Opuntia setispina Puente 3656,* 2*n* = 66, **S)** *Opuntia lilae Trujillo & Ponce 18643,* 2*n* = 66, **T)** *Opuntia pailana Puente 3371,* 2*n* = 44, **U)** *Opuntia jamaicensis DBG 1997 0357,* 2*n* = 22, **V)** *Opuntia excelsa DBG 1986 0546,* 2*n* = 22, **W)** *Tacinga inamoena Majure 3849,* 2*n* = 44, **X)** *Tacinga saxatilis Hamann s.n.,* 2*n* = 44. All counts presented here by L. C. Majure.

parisons alone, especially in a group that is difficult to study from often poorly prepared and under-collected herbarium specimens (Rebman and Pinkava 2001; Pinkava 2002; Reyes-Agüero et al. 2007). Also, understanding the full distribution of a species and associated cytotypes is essential for determining the evolutionary history of a given species complex (Babcock and Stebbins 1938; Stebbins 1950; Majure et al. 2012a).

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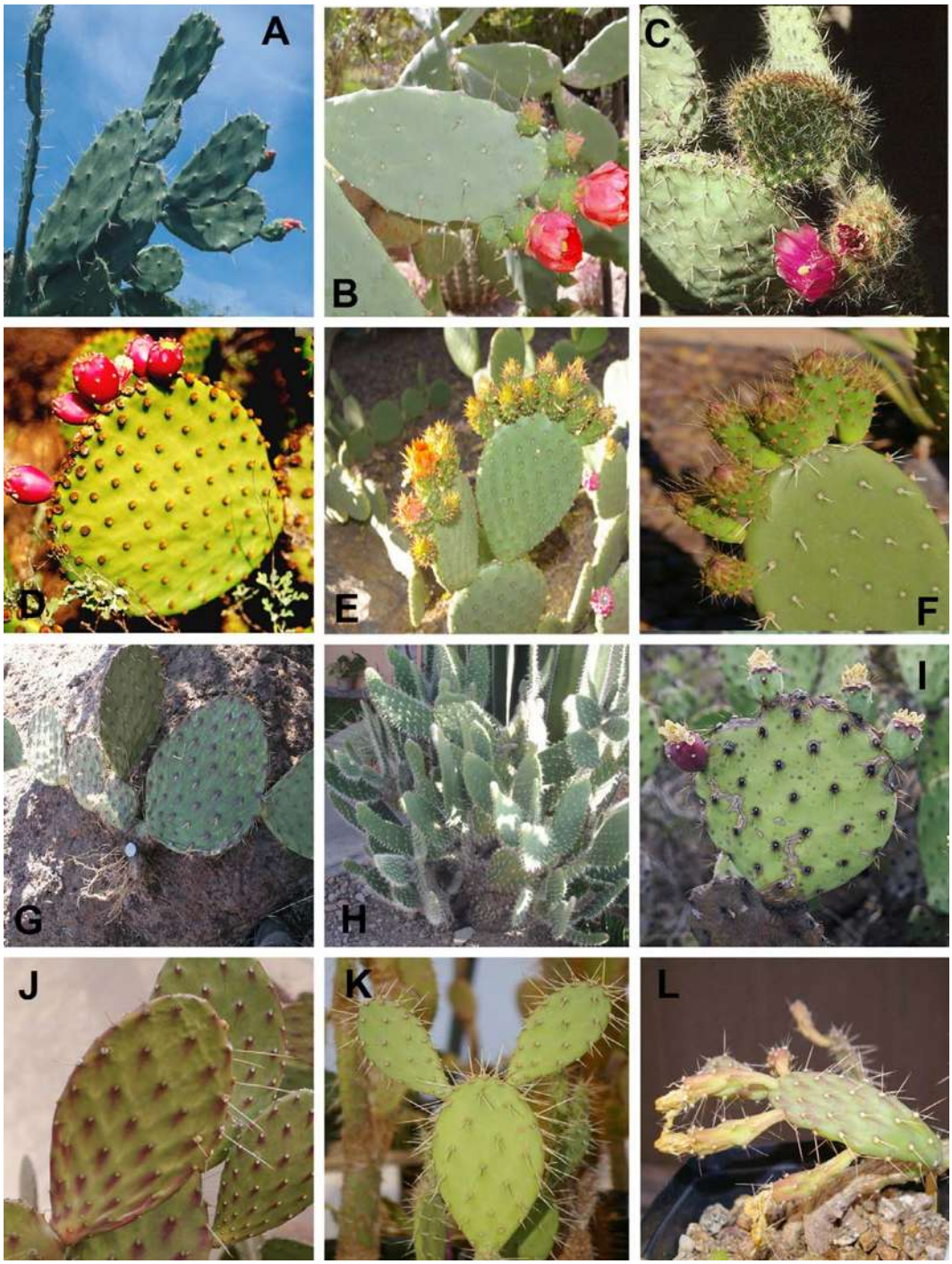

Figure 2. Selection of taxa counted or represented in synopsis: **A)** *Nopalea dejecta Puente 1614*, **B)** *Opuntia* sp. nov. 1 *Puente 1615*, **C)** *Opuntia pilifera DBG* 1982 0346, **D)** *Opuntia* × *andersonii Puente 1239*, **E)** *Opuntia* × *carstenii Puente 2901*, **F)** *Opuntia* sp. nov. *2. A.L. Reina 97-292*, **G)** *Opuntia setispina Puente 3656*, **H)** *Opuntia orbiculata Hamman s.n.*, **I)** *Opuntia pailana Puente 3371*, **J)** *Opuntia bravoana DBG 1939 0094*, **K)** *Opuntia caracassana DBG 1993 0667*, **L)** *Opuntia megarhiza Puente 1884-A*. Photos taken by R. Puente.

Arizona State University Herbarium (ASU) for use as repositories for many of the collections analyzed here. Financial support was partially provided by the Cactus and Succulent Society of America.

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APPENDIX 1.

Species investigated are listed, given with their chromosome number (*n* = counts from microspores and 2*n* = counts from root tips), locality, and repository when applicable (based on Thiers 2011). The acronym and accession is presented for taxa used from botanical gardens (e.g., DBG – Desert Botanical Garden). Taxa counted for the first time are delimited with an asterisk (*). Those found to have a different ploidy than previously reported are denoted with a plus sign (+). All counts were made by L. C. Majure unless cited with a different name in brackets at the end of an entry [e.g., R. Puente].

Consolea

+ *Consolea moniliformis* (L.) A. Berger, **2*n* = 88,** U.S.A, FL, Monroe Co., Long Key, *L.C. Majure 3909* (FLAS); cultivated.

Nopalea

Nopalea dejecta Salm-Dyck, ***n* = 11,** DBG 2002 0342 0101. Mexico, San Luis Potosi, *R. Puente 1614* (ASU) [R.Puente]. **Fig. 2A.**

*** *Nopalea gaumeri*** Britton & Rose, **2*n* = 22,** DBG 1997 0367 0101, Mexico, Yucatán.

*** *Nopalea lutea*** Rose, **2*n* = 44,** DBG 1997 0368 0102; cultivated.

Opuntia

*** *Opuntia* × *andersonii*** H.M.Hernandez, Gomez-Hin., Bárcenas (*O. microdasys* × *O. engelmannii*), **2*n* = 22,** Mexico, San Luis Potosi, *R. Puente 1239* (ASU, DES); **Figs. 1A & 2D.**

*** *Opuntia arechavalatae*** Spegazzini, **2*n* = 22,** DBG 2011 0200 01; cultivated.

*** *Opuntia*** cf. ***assumptionis*** K. Schumann, **2*n* = 44,** DBG 2011 0201 01; **Fig. 1F.**

+ *Opuntia atrispina* Griffiths, **2*n* = 44**, U.S.A, TX, Val Verde Co., *B.L. Snow 1083* (FLAS).

*** *Opuntia* × *bahamana*** Britton & Rose (*Consolea nashii* × *Opuntia dillenii*), **2*n* = 66,** DBG 1996 0298; Turks and Caicos Island. **Fig. 1G.**

Opuntia basilaris Engelm. & J.M. J.M. Bigelow var. ***basilaris,* 2*n* = 22,** U.S.A., CA, Inyo Co., *R. Altig s.n.* (FLAS).

*** *Opuntia bisetosa*** Pittier, **2*n* = 66,** DBG 1997 0396; Venezuela. **Fig. 1B.**

*** *Opuntia boldinghii*** Britton & Rose, **2*n* = 66,** DBG 1997 0391; Venezuela. **Fig. 1C.**

*** *Opuntia caracassana*** Salm-Dyck, **2*n* = 22,** DBG 1993 0667; Netherland Antilles, Curacao. *C. Fleming s.n.* **Figs. 1D & 2K.**

*** *Opuntia* × *carstenii*** R. Puente & C. Hamann (*O. microdasys* × *O. stenopetala*), ***n* = 11,** DBG; Mexico, Coahuila, *R. Puente 2901* (Holotype, DES) [R. Puente]. **Fig. 2E.**

*** *Opuntia cubensis*** s.s. Britton & Rose, **2*n* = 44,** Cuba, *Areces s.n.* (GBG).

*** *Opuntia eichlamii*** Rose, **2*n* = 66,** DBG 2011 0005 01; Guatemala, *C. Hamann s.n.;* **Fig. 1E.** [Not *O. eichlamii* of Pinkava et al. 1976, which was corrected to *Nopalea guatemalensis* Rose (Baker et al. 2009b)].

Opuntia ellisiana Griffiths, **2*n* = 22,** U.S.A., TX, Coryell Co., *B.L. Snow 1083* (FLAS).

*** *Opuntia excelsa*** Sánchez-Mejorada, **2*n* = 22,** DBG 1986 0546 1001; **Fig. 1V.**

*** *Opuntia guatemalensis*** Britton & Rose, **2*n* = 22,** DBG 1990 0534; Honduras, La Paz, *Zimmerman 2609* (DES); **Fig. 1K.**

*** *Opuntia jamaicensis*** Britton & Harris, **2*n* = 22,** DBG 1997 0357; Jamaica, Spanish Town. **Fig. 1U.**

*** *Opuntia keyensis*** Britton & Rose, **2n = 66,** U.S.A., FL, Monroe Co., *L.C. Majure 3910* (FLAS).

Opuntia leucotricha A.P. de Candolle, **2*n* = 44,** U.S.A., FL, Hillsborough Co., *L.C. Majure 3953* (FLAS); cultivated.

*** *Opuntia lilae*** Trujillo & Ponce, **2*n* = 66,** DBG 1997 0369 01, Venezuela, Sucre, *Trujillo & Ponce 18643* (MY, DES, FLAS); **Fig. 1S.**

*** *Opuntia* × *lucayana*** Britton (*Consolea nashii* × *Opuntia dillenii*), **2*n* = 44,** DBG 1997 0398; Bahamas.

*** *Opuntia macbridei*** Britton & Rose, **2*n* = 22,** 1) U.S.A., FL, Alachua Co., *L.C. Majure 3848,* cultivated (FLAS); 2) DBG 1990 0601; cultivated.

*** *Opuntia megarhiza*** Rose, **2*n* = 66,** Mexico, San Luis Potosi, Rio Verde, *R. Puente 1884-A* (ASU); **Figs. 1J & 2L.** [not "*O. megarhiza*" 2*n* = 22 (Baker et al. 2009a), corrected here to *O. pachyrrhiza*].

Opuntia monacantha (Willd.) Haw., **2*n* ~ 33,** U.S.A., FL, Alachua Co., *L.C. Majure 3847,* cultivated (FLAS).

+ *Opuntia orbiculata* Salm-Dyck ex Pfeiffer, **2*n* = 44,** DES 2011 0203 01; *C. Hamann s.n.,* cultivated (DES); **Figs. 1L & 2H.**

Opuntia pachyrrhiza H. M. Hernández, C. Gómez-Hinostrosa & R. T. Bárcenas, **2*n* = 22,** Mexico, Querétaro, *R. Puente 1260* (DES); **Fig. 1P.**

*** *Opuntia pailana*** Weingart, **2*n* = 44,** Mexico, Coahuila,

R. Puente 3371 (DES); **Figs. 1T & 2I.**

Opuntia phaeacantha Engelm., **2*n* = 66,** U.S.A., TN, Wilson Co., *J. Hill s.n.* (FLAS), likely escaped from cultivation.

+ *Opuntia pilifera* F.A.C. Weber, **2*n* = 88,** DBG 1982 0346 10-1; Mexico, Oaxaca; **Fig. 1M & 2C.**

Opuntia pinkavae B.D. Parfitt**, 2*n* = 88,** U.S.A., UT, Washington Co., *D. Woodruff 118A* (FLAS).

Opuntia polyacantha Engelm. var. ***arenaria*** (Engelm.) B.D. Parfitt, **2*n* = 22,** U.S.A., TX, El Paso Co., *R.D.Worthington 36390* (SRSC).

Opuntia polyacantha var. ***polyacantha,* 2*n* = 22,** U.S.A., NM, Socorro Co., *L.C. Majure 3526* (FLAS); **2*n* = 44,** U.S.A., WY, Carbon Co., *D.E. Soltis 2902* (FLAS).

*** *Opuntia puberula*** Pfeiffer, **2*n* = 66,** DBG 1993 0887 1003; Mexico, Jalisco; **Fig. 1O.**

*** *Opuntia pumila*** Rose, **2*n* ~ 33** Mexico, Oaxaca, *R. Puente 2297* (DES).

Opuntia quimilo K. Schumann, **2*n* = 22**, DBG 2003 0111 0101; Argentina, cultivated.

+ *Opuntia quitensis* F.A.C. Weber, **2*n* = 44,** DBG 1988 0262 0201; cultivated; **Fig. 1H.**

Opuntia rastrera F.A.C. Weber, **2*n* = 66,** DBG 1986 0549 1001; Mexico, San Luis Potosi.

+ *Opuntia repens* Bello, **2*n* = 44**, Puerto Rico *L.C. Majure 3838* (FLAS); Puerto Rico, *L.C. Majure 3839* (FLAS); **Fig. 1N,** St. Thomas, VI, *L.C. Majure 3837* (FLAS).

Opuntia rufida Engelm., **2*n* = 22,** U.S.A., **TX,** Brewster Co., ***P.*** *Manning s.n.,* cultivated in SRSU cactus garden (FLAS).

*** *Opuntia sanguinea*** Proctor, **2*n* = 22,** DBG 1996 0297 0101; Jamaica, St. Thomas. **Fig. 1Q.**

*** *Opuntia scheeri*** F.A.C. Weber, **2*n* = 22,** DBG 2011 0204 01; *R.Puente s.n.* cultivated.

Opuntia schickendantzii F.A.C. Weber, **2*n* = 22,** DBG 2010 0049 01; cultivated.

*** *Opuntia setispina*** Engelm. ex Salm-Dyck, **2*n* = 66,** Mexico, Chihuahua, Cosihuariachi, *R. Puente 3656* (DES); **Figs. 1R & 2G.**

Opuntia soederstromiana Britton & Rose, **2*n* = 88,** DBG 1985 0569 0101; Ecuador Imbabura.

*** *Opuntia* sp. nov. 1**, **2*n* = 22,** DBG 2003 0155 0102; Mexico, San Luis Potosi, Valles, *R. Puente 1615* (DES); **Figs. 1I & 2B.**

*** *Opuntia* sp. nov. 2**, **2*n* = 66**, Mexico, Sonora, *A.L. Reyna 97-292* (ASU, ARIZ). **Fig. 2F.**

Opuntia sulphurea G. Don, **2*n* = 66,** DBG 2011 0202 01; cultivated. [not *O. cochabambensis* Cárdenas as in Majure et al. (2012b)].

*** *Opuntia*** cf. ***wilcoxii*** Britton & Rose, **2*n* = 44,** Mexico, Sonora, Mesiaca, *S. Friedman 94-148* (ASU, ARIZ).

Tacinga

Tacinga inamoena (K. Schumann) Stuppy & Taylor, **2*n* = 44,** U.S.A., FL, Alachua Co., *L.C. Majure 3849,* cultivated (FLAS); **Fig. 1W.**

*** *Tacinga saxatilis*** (F. Ritter) Stuppy & Taylor, **2*n* = 44,** DBG 2011 0205 01; *C. Hamann s.n.,* cultivated; **Fig. 1X.**

APPENDIX 2.

Previously reported chromosome counts for taxa within the Opuntieae. Synonyms, misidentifications, and unresolved taxa are included in the list only for cross-referencing purposes so should not necessarily be interpreted as to how taxa should be treated taxonomically (e.g., *O. ammophila* Small is not synonymous with *O. humifusa* (Raf.) Raf. but can be found under the listing for *O. humifusa*).

Brasiliopuntia (K. Schum.) A. Berger

B. brasiliensis (Willd.) A. Berger 2*n* = 22 (Johansen 1933; Stockwell 1935; Yuasa et al. 1973, as *Opuntia brasiliensis*), (de Castro 2008).

Consolea Lem.

C. corallicola Small 2*n* = 66 (Austin et al. 1998, as *Opuntia corallicola*; same count more detail in Baker et al. 2009a), (Negrón-Ortiz 2007).

C. falcata (Grisebach) A. Berger 2*n* = 88 (Negrón-Ortiz 2007).

C. macracantha (Grisebach) A. Berger 2*n* = 66 (Negrón-Ortiz 2007).

C. millspaughii (Grisebach) A. Berger 2*n* = 66 (Yuasa et al. 1973, as *O. millspaughii*), *C. millspaughii* subsp. *caymenensis* Areces 2*n* = 66 (Negrón-Ortiz 2007).

C. moniliformis (L.) A. Berger 2*n* = 22 (Spencer 1955, as *O. moniliformis*), 2*n* = 66 (Negrón-Ortiz 2007).

C. nashii (Britton) A. Berger 2*n* = 66 (Negrón-Ortiz 2007).

C. picardae (Urban) Areces 2*n* = 66 (Negrón-Ortiz 2007).

C. rubescens (Salm-Dyck ex DC.) Lem. 2*n* = 22 (Spencer 1955, as *O. rubescens*) 2*n* = 88 (Negron-Ortiz 2007); 2*n* = 132 (Katagiri 1952, 1953; Yuasa et al. 1973, as *O. rubescens*), (Baker et al. 2009a).

C. spinosissima (P. Miller) Lem. 2*n* = 66 (Negrón-Ortiz 2007).

Miqueliopuntia Frič ex F. Ritter

M. miquelii (Monv.) F. Ritter 2*n* ~ 220 (Yuasa et al. 1973, as *O. miqueliopuntia*).

Nopalea Salm-Dyck

N. auberi (Pfeiffer) Salm-Dyck 2*n* = 22 (Pinkava et al. 1976, as *N. dejecta*).

N. cochenillifera (L.) Salm-Dyck 2*n* = 22 (Spencer 1955; Yuasa et al. 1973; Puente-Martinez 2006; Negrón-Ortiz 2007; de Castro 2008).

N. dejecta Salm-Dyck 2*n* = 22 (Yuasa et al. 1973), (Pinkava et al. 1976, corrected to *N. auberi* in Baker et al. 2009b), (Puente-Martinez 2006).

N. guatemalensis Rose 2*n* = 22 (Pinkava et al. 1976, as *O. eichlamii*, corrected to *N. guatemalensis* in Baker et al. 2009b).

N. hondurensis (Standley) R. Puente 2*n* = 44 (Baker et al. 2009b).

N. karwinskiana Salm-Dyck 2*n* = 22 (Yuasa et al. 1973).

Opuntia P. Miller

O. abjecta Small 2*n* = 22, 44 (Majure et al. 2012a).

O. acaulis Ekman & Werderm. 2*n* = 88 (Negrón-Ortiz 2007).

O. aciculata Griffiths 2*n* = 44 (Yuasa et al. 1973; Baker et al. 2009a).

O. × *aequitorialis* Britton & Rose (*O. pubescens* × *O. soederstromiana*) 2*n* = 66 (Baker 2002).

O. albicarpa Scheinvar 2*n* = 88 (Segura et al. 2007).

O. allairei Griffiths — see *O. humifusa*.

O. × *alta* Griffiths (*O. engelmannii* var. *lindheimeri* × *O. stricta*) 2*n* = 66 (Pinkava et al. 2001; Majure et al. 2012a).

O. amarilla Griffiths 2n = 88 (Segura et al. 2007).

O. ammophila Small — see *O. humifusa*.

O. amyclea Tenore — see *O. ficus-indica*

O. anacantha Speg. 2*n* = 22 (Yuasa et al. 1973, as *O. canina*).

O. antillana Britton & Rose 2*n* = 22 (Spencer 1955).

O. arenaria Engelm. — see *O. polyacantha* var. *arenaria*.

O. atrispina Griffiths 2*n* = 22 (Weedin et al. 1989; Powell & Weedin 2001, 2005).

O. auberi Pfeiffer — see *Nopalea auberi*.

O. aurantiaca Gilles ex Lindley 2*n* = 44 (Yuasa et al. 1973).

O. aurea E. Baxter 2*n* = 66 (Pinkava et al. 1973; 1992; Pinkava & Parfitt 1982; Baker et al. 2009b).

O. aureispina (Brack & Heil) Pinkava & B.D. Parfitt 2*n* = 22 (Powell & Weedin 2001), Note: this taxon is also treated as *O. azurea* var. *aureispina* (Brack & Heil) Powell & Weedin (see Powell & Weedin 2004).

O. austrina Small — see *O. humifusa*.

O. azurea Rose 2*n* = 22 (Pinkava et al. 1985, as *O.* aff. *lindheimeri*), 2*n* = 66 (Yuasa et al. 1973), *O azurea* var. *aureispina* — see *O. aureispina*. *O. azurea* var. *diplopurpurea* Powell & Weedin 2*n* = 22 (Weedin et al. 1989; Powell & Weedin 2005), *O. azurea* var. *discolor* Weedin 2*n* = 22 (Weedin & Powell 1978; Weedin et al. 1989; Powell & Weedin 2001), *O. azurea* var. *parva* Powell & Weedin (Powell & Weedin 2001, 2005).

O. × *bakeri* J.E. Madsen 2*n* = 99 (Baker 2002).

O. basilaris Engelm. & J.M. Bigelow 2*n* = 22 (without var.: Takagi 1938; Yuasa et al. 1973; Brandyopadhyay & Sharma 2000), *O. basilaris* var. *basilaris* 2*n* = 22 (Pinkava & McLeod 1971; Pinkava et al. 1973, 1977, 1998; Parfitt 1978; Baker et al. 2009b), *O. basilaris* var. *brachyclada* (Griffiths) Munz 2*n* = 22 (Pinkava et al. 1977, 1992), *O. basilaris* var. *longiareolata* (Clover & Jotter) L.D. Benson 2*n* = 22 (Pinkava et al. 1992, as *O. heilii*), *O. basilaris* var. *treleasii* (J.M. Coult.) J.M. Coult. ex Toumey 2*n* = 22 (Pinkava et al. 1977), 2*n* = 33 (Pinkava et al. 1977; 1992), *O. basilaris* var. *woodburyi* Earle — see *O. pinkavae*.

O. bonplandii (Kunth) F.A.C. Weber 2*n* = 88 (Baker 2002).

O. borinquensis Britton & Rose 2*n* = 22 (Spencer 1955).

O. brasiliensis (Willd.) Haw. — see *Brasiliopuntia brasiliensis*.

O. bravoana E. Baxter 2*n* = 66 (Yuasa et al. 1973). **Fig. 2J.**

O. camanchica Engelm. & J.M. Bigelow 2*n* = 66 (Powell & Weedin 2001, as *O.* cf. *camanchica*), (Powell & Weedin 2001, 2005), 2*n* ~ 66 (Powell & Weedin 2005).

O. canina Speg. — see *O. anacantha*.

O. cantabrigiensis Lynch — see *O. engelmannii* var. *cuija*.

O. cespitosa Raf. — see *O. humifusa*.

O. chaffeyi Rose 2*n* = 44 (Pinkava et al. 1992).

O. × *charlestonensis* Clokey (*O. phaeacantha* × *O. polyacantha*) 2*n* = 55 (Baker et al. 2009b).

O. chavena Griffiths 2*n* = 88 (Segura et al. 2007; note: same collection no., Mexu 6888, as used for *O. pachona*).

O. aff. *chihuahuensis* Rose 2*n* = 22 (Pinkava et al. 1985).

O. chisosensis (M. Anthony) Ferguson 2*n* = 22 (Weedin & Powell 1978, as *O. lindheimeri*, corrected in Weedin et al. 1989), (Powell & Weedin 2001).

O. chlorotica Engelm. & Bigelow 2*n* = 22 (Stockwell 1935; Reveal & Styler 1973; Pinkava et al. 1977, 1992; Parfitt 1978; Pinkava & Parfitt 1982; Baker et al. 2009b).

O. cochenillifera L. — see *Nopalea cochenillifera*.

O. cochinera Griffiths 2*n* = 88 (Heras et al. 1988; Palomina & Heras 2001; Segura et al. 2007).

O. × *columbiana* Griffiths (*O. fragilis* × *O. polyacantha*) 2*n* = 66 (Baker et al. 2009b).

O. comonduensis (J.M. Coult.) Britton & Rose 2*n* = 22 (Baker et al. 2009b).

O. compressa J.F. Macbr. — see *O. humifusa*.

O. corallicola (Small) Werderm. — see *Consolea corallicola*.

O. crassa Haw. 2*n* = 88 (Flores et al. 1988).

O. cretochaeta Griffiths 2*n* = 88 (Segura et al. 2007).

O. crinifera Pfeiffer 2*n* = 22 (Takagi 1938; Katagiri 1952, 1953).

O. × *curvospina* Griffiths (*O. chlorotica* × *O. phaeacantha*) 2*n* = 44 (Pinkava et al. 1973, 1977; Parfitt 1978; Pinkava & Parfitt 1982; Baker et al. 2009b).

O. cymochila Engelm. & J.M. Bigelow 2*n* = 66 (Powell & Weedin 2001), 2*n* ~ 66 (Powell & Weedin 2005).

O. decumana Haw. 2*n* = 88 (Mazzeola et al. 1988).

O. dejecta Salm-Dyck — see *Nopalea dejecta*.

O. dillenii (Ker-Gawler) Haw. — see *O. stricta*.

O. discata Griffiths — see *O. engelmannii* var. *engelmannii*.

O. drummondii Graham — see *O. pusilla*.

O. dulcis Engelm. 2*n* = 66, ~66 (Powell & Weedin 2001).

O. durangensis Britton & Rose 2*n* = 44 (Yuasa et al. 1973; Baker et al. 2009b).

O. echios J.T. Howell 2*n* ~ 66 (Helsen et al. 2009).

O. × *edwardsii* V. Grant & K. Grant (*O. engelmannii* var. *lindheimeri* × *O. macrorhiza*) 2*n* = 55, ~ 55 (Grant & Grant 1979, 1982; Pinkava et al. 2001; Powell & Weedin 2001).

O. elata Link & Otto ex Salm-Dyck 2*n* = 22 (Pinkava et al. 1976); 2*n* = 44 (Yuasa et al. 1973).

O. elatior P. Miller 2*n* = 22 (Yuasa et al. 1973), 2*n* = 44 (Sanjappa & Sathyananda 1979), 2*n* = 88 (Baker et al. 2009a).

O. elizondoana Sanchez & Villaseñor 2*n* = 44 (Segura et al. 2007).

O. ellisiana Griffiths 2*n* = 22 (Weedin & Powell 1978, as *O. ficus-indica*, corrected in Weedin et al. 1989).

O. engelmannii Salm-Dyck ex Engelm. 2*n* = 44 (without var.: Gallegos 1969), 2*n* = 66 (without var. Yuasa et al. 1973), *O. engelmannii* var. *cuija* Griffiths & Hare 2*n* = 22 (Pinkava et al. 1982, as *O. lindheimeri* var. *cuija*; Muñoz-Urias et al. 2008, as *O. cantabrigiensis*), 2*n* = 44, 66 (Yuasa

et al. 1973, as *O. cantabrigiensis*), *O. engelmannii* var. *engelmannii* 2*n* = 44, 66 (Grant & Grant 1979, as *O. discata*), 2*n* = 66 (Pinkava & McLeod 1971; Pinkava et al. 1973; Pinkava & Parfitt 1982; Weedin et al. 1989, as *O. phaeacantha* var. *discata*), 2*n* = 66 (Pinkava et al. 1992, 1998; Powell & Weedin 2001, 2005; Baker et al. 2009b), *O. engelmannii* var. *flavispina* (Benson) B.D. Parfitt & Pinkava 2*n* = 66 (Pinkava et al. 1973, as *O. phaeacantha* var. *discata* appr. var. *major*, corrected in Pinkava & Parfitt 1982; Pinkava et al. 1998), *O. engelmannii* var. *lindheimeri* (Engelm.) B.D. Parfitt & Pinkava 2*n* = 22 (Weedin & Powell 1978, as *O. lindheimeri* var. *lindheimeri*, corrected to *O. chisosensis* and *O.* aff. *violacea*), (Grant & Grant 1979, as *O. lindheimeri*); 2*n* = 44 (Yuasa et al. 1973, Grant & Grant 1979, as *O. lindheimeri*), 2*n* = 66 (Weedin & Powell 1978, Weedin et al. 1989, Powell & Weedin 2005, as *O. lindheimeri*). 2*n* ~ 66 (Conde 1975, Grant & Grant 1979, Weedin et al. 1989), *O. engelmannii* var. *linguiformis* (Griffiths) B.D. Parfitt & Pinkava 2*n* = 55 (Baker et al. 2009b), 2*n* = 66 (Weedin & Powell 1978, Pinkava & Parfitt 1982, as *O. lindheimeri* var. *linguiformis*). *O. engelmannii* var. *rastrera* (F.A.C. Weber) Pinkava 2*n* = 66 (Muñoz-Urias et al. 2008, as *O. rastrera*).

O. erinacea Engelm. & J.M. Bigelow — see *O. polyacantha* var. *erinacea*.

O. falcata Grisebach — see *Consolea falcata*.

O. ficus-barbarica A. Berger — see *O. ficus-indica*.

O. ficus-indica (L.) Mill. 2*n* = 22 (Spencer 1955; Weedin & Powell 1978 — see *O. ellisiana*), 2*n* = 55 (Bandyopadhyay 1999; Bandyopadhyay & Sharma 2000), 2*n* = 66 (Flores et al. 1988), 2*n* = 88 (Carpio 1952, as *O. amyclea*; Sosa & Acosta 1966, as *O. amyclea*; Flores et al. 1988 and Mazzola et al. 1988, including *O. amyclea, O. ficus-barbarica, O. ficus-indica, O. maxima*, *O. ficus-indica* vars. *mitraeformis, gymnocarpa,* as well as multiple hybrids and cultivars). Note: *O. megacantha* is also sometimes considered synonymous with *O. ficus-indica*, but see entry for *O. megacantha*.

O. fragilis Nutt. 2*n* = 66 (Bowden 1945; Pinkava et al. 1977; Löve & Löve 1982; Baker et al. 2009b; Majure & Ribbens 2012).

O. fuliginosa Griffiths 2*n* = 88 (Segura et al. 2007).

O. fusco-atra Engelm. — see *O. macrorhiza*.

O. galapageia Henslow 2*n* ~ 66 (Yuasa et al. 1973).

O. gosseliniana F.A.C. Weber 2*n* = 22 (Pinkava et al. 1972).

O. grandiflora Engelm. — see *O. macrorhiza*.

O. grandis Pfeiffer 2*n* = 22 (Yuasa et al. 1973).

O. guerrana Griffiths — see *O. robusta*.

O. heilii Welsh & Neese — see *O. basilaris* var. *longiareolata*.

O. heliabravoana Scheinvar 2*n* = 22 (Segura et al. 2007).

O. hondurensis Standley — see *Nopalea hondurensis*.

O. humifusa (Raf.) Raf. 2*n* = 22 (Bowden 1945; Baker et al. 2009a), (Majure et al. 2012a, including *O. ammophila, O. austrina, O. lata*), 2*n* = 44 (Bowden 1945; Doyle 1990), (Majure & Ribbens 2012; Majure et al. 2012a, including *O. allairei*, *O. cespitosa, O. humifusa s.s., O. nemoralis, O. pollardii*).

O. hyptiacantha F.A.C. Weber 2*n* = 66 (Heras 1988), 2*n* = 88 (Palomino & Heras 2000; Segura et al. 2007).

O. impedita Small — see *O. pusilla*.

O. inaequilateralis A. Berger 2*n* = 66 (Yuasa et al. 1973).

O. inamoena K. Schum. — see *Tacinga inamoena*.

O. incarnadilla Griffiths 2*n* = 66 (Segura et al. 2007).

O. joconostle F.A.C. Weber ex Diguet 2*n* = 88 (Segura et al. 2007).

O. karwinskiana Salm-Dyck — see *Nopalea karwinskiana*.

O. laevis J.M. Coult. — see *O. phaeacantha* var. *laevis*.

O. lanceolata Haw. 2*n* = 88 (Katagiri 1952, as *O. elongata*; 1953; Yuasa et al. 1973, as *O. cristata, O. elongata, O. lanceolata*).

O. larreyi F.A.C. Weber ex J.M. Coult. — see *O. robusta*.

O. lasiacantha Hort. Vindob. ex Pfeiffer 2*n* = 88 (Segura et al. 2007).

O. lata Small — see *O. humifusa.*

O. leucotricha DC. 2*n* = 44 (Takagi 1938; Katagiri 1952, 1953; Yuasa et al. 1973; Segura et al. 2007; Muñoz-Urias et al. 2008).

O. lindheimeri Engelm. — see *O. engelmannii* var. *lindheimeri.*

O. linguiformis Griffiths — see *O. engelmannii* var. *linguiformis.*

O. littoralis (Engelm.) Cockerell 2*n* = 66 (Philbrick 1963; Pinkava & McLeod 1971; Pinkava et al. 1985, 1992).

O. longispina DC. — see *Tunilla longispina*.

O. mackensenii Rose var. *mackensenii* 2*n* = 44, 55 (Powell & Weedin 2005), *O. mackensenii* var. *minor* (M.S. Anthony) Powell & Weedin — see *O. macrocentra* var. *minor*.

O. macracantha Grisebach — see *Consolea macracantha*.

O. macrocentra Engelm. 2*n* ~ 22 (Powell & Weedin 2001), 2*n* = 22 (Weedin & Powell 1978, as *O. violacea* vars. *macrocentra* and *castetteri*), (Pinkava & Parfitt 1982, as *O. violacea* var. *castetteri*), (Pinkava et al. 1985, as *O. violacea* var. *macrocentra*), (Weedin et al. 1989, corrected to *O. azurea* var. *diplopurpurea* – see Powell & Weedin 2004), (Powell & Weedin 2001; Powell & Turner 2005; Powell & Weedin 2005 — see *O. azurea* vars. *diplopurpurea* and *parva*), 2*n* = 44 (Pinkava & McLeod 1971; Pinkava et al. 1973, 1985; Ward 1984, as *O. violacea* var. *violacea*), (Pinkava et al. 1992, 1998, as *O. macrocentra*), (Powell and Weedin 2001; Baker et al. 2009b), *O. macrocentra* var. *minor* M.S. Anthony 2*n* = 44 (Weedin et al. 1989, as *O.* cf. *violacea*), (Powell & Weedin 2001; Powell & Weedin 2005, as *O. mackensenii* var. *minor*.

O. macrorhiza Engelm. 2*n* = 22 (Majure et al. 2012a, including *O. xanthoglochia*); 2*n* = 44 (Pinkava et al. 1971, 1973, 1977, 1992, 1998; Powell & Weedin 2001; Baker et al. 2009b; Majure & Ribbens 2012), (Majure et al. 2012a, including *O. fusco-atra, O. grandiflora, O. macrorhiza s.s.*), 2*n* ~ 44 (Powell & Weedin 2001).

O. macrorhiza var. *pottsii* (Salm-Dyck) L.D. Benson — see *O. pottsii*.

O. × *martiniana* (L. Benson) B.D. Parfitt (possibly *O. chlorotica* × *O. engelmannii*) 2*n* = 44 (Parfitt 1980; Pinkava & Parfitt 1982).

O. matudae Scheinvar 2*n* = 66 (Segura et al. 2007).

O. maxima P. Miller — see *O. ficus-indica*.

O. megacantha Salm-Dyck 2*n* = 66 (Yuasa et al. 1973; Flores et al. 1988), 2*n* = 77 (Flores et al. 1988), 2*n* = 88 (Carpio 1952; Sosa & Acosta 1966; Pinkava & McLeod 1971; Pinkava et al. 1973; Flores et al. 1988; Mazzola et al. 1988; Sajeva et al. 1988; Segura et al. 2007). Note: *O. megacantha* is often considered synonymous with *O. ficus-*

indica.

O. megarhiza Rose — see *O. pachyrrhiza*.

O. microdasys (Lehmann) Pfeiffer 2*n* = 22 (Katagiri 1952, 1953;Yuasa et al. 1973), Pinkava et al. 1977, as *O.* cf. *microdasys*, see *O. rufida*), Parfitt 1978; Bandyopadhyay 1999; Bandyopadhyay & Sharma 2000; including vars. *albispina* and *lutea*).

O. microdasys var. *rufida* — see *O. rufida*.

O. microdisca F.A.C. Weber — see *Tunilla corrugata*.

O. millspaughii Grisebach — see *Consolea millspaughii*.

O. miquelii Monv. — see *Miqueliopuntia miquelii.*

O. monacantha (Willd.) Haw. 2*n* = 22 (Spencer 1955, as *O. vulgaris*; Yuasa et al. 1973), 2*n* = = 32 (Sampathkumar & Navaneethum 1980a, 1980b), 2*n* = 33 (Katagiri 1952, as var. *variegata*; 1953, as variety *monacantha*), (Yuasa et al. 1973), 2*n* = 34 (Bandyopadhyay 1999; Bandyopadhyay & Sharma 2000, as var. *variegata*).

O. moniliformis L. — see *Consolea moniliformis*.

O. nashii Britton — see *Consolea nashii*.

O. nemoralis Griffiths — see *O. humifusa*.

O. nicholii L.D. Benson — see *O. polyacantha* var. *nicholii*.

O. × *occidentalis* Engelm. & J.M. Bigelow (*O. littoralis* × *O. engelmannii* × *O. phaeacantha*) 2*n* = 66 (Pinkava et al. 1973, as *O. occidentalis* – demissa "hybrid complex," sensu L.D. Benson 1969).

O. ochrocentra Small 2*n* = 55 (Majure et al. 2012a).

O. orbiculata Salm-Dyck 2*n* = 22 (Yuasa et al. 1973).

O. oligacantha Hort. Vindob. ex Pfeiffer 2*n* = 66 (Segura et al. 2007).

O. oricola Philbrick 2*n* = 33, a polyhaploid (Philbrick 1963), 2*n* = 66 (Philbrick 1963), (Pinkava et al. 1973; 1977, as *O. littoralis* var. *littoralis*), (Pinkava et al. 1992).

O. pachona Griffiths 2*n* = 88 (Segura et al. 2007, note: same collection no., Mexu 6888, as used for *O. chavena*).

O. pachyrrhiza H. M. Hernández, C. Gómez-Hinostrosa & R. T. Bárcenas 2*n* = 22 (Baker et al. 2009a; as *O. megarhiza,* corrected here; see note in Table 1 under *O. megarhiza*).

O. palmadora Britton & Rose — see *Tacinga palmadora*.

O. paraguayensis K. Schum. 2*n* = 44 (Yuasa et al. 1973), Note: this specimen is likely either referable to *O. elata* or *O. cardiosperma* (see Leuenberger 2001 for the misapplication of the name *O. paraguayensis*).

O. phaeacantha Engelm. sensu lato. This is an unresolved complex, including names as published not revised. As *O. phaeacantha* without vars./subsp.: 2*n* = 44 (Yuasa et al. 1973), 2*n* = 66 (Yuasa et al. 1973; Pinkava et al. 1992, 1998; Powell & Weedin 2001), 2*n* ~ 66 (Stockwell 1935, distinguished from *O. discata*), (Yuasa et al. 1973; Powell & Weedin 2001, 2005; Baker et al. 2009b), *O. phaeacantha* var. *laevis* (J.M. Coult.) L.D. Benson 2*n* = 22 (Yuasa et al. 1973, as *O. laevis*), 2*n* = 66 (Pinkava & McLeod 1971; Pinkava et al. 1973; Baker et al. 2009b, as spineless morphotype), *O. phaeacantha* var. *major* Engelm. 2*n* = 44 (Grant & Grant 1979), 2*n* = 66 (Pinkava & McLeod 1971; Pinkava et al. 1973, 1977, 1985, one as *O. phaeacantha* var. *nigricans*), (McLeod 1975; Weedin & Powell 1978, two reports of *O. atrispina*, corrected to *O. phaeacantha* in Weedin et al. 1989), (Parfitt 1978; Grant & Grant 1979, 1982; Pinkava & Parfitt 1982, one as approaching var. *discata*), (Weedin et al. 1989), *O. phaeacantha* var. *phaeacantha* 2*n* = 66 (Pinkava & McLeod 1971; Pinkava et al. 1973, 1985; Pinkava & Parfitt 1982; Weedin et al. 1989), 2*n* ~ 66 (Powell & Weedin 2005).

O. phaeacantha var. *camanchica* (Engelm. & J.M. Bigelow) L.D. Benson — see *O. camanchica*.

O. phaeacantha var. *discata* (Griffiths) L.D. Benson — see *O. engelmannii* var. *engelmannii*.

O. phaeacantha var. *flavispina* L.D. Benson — see *O. engelmannii* var. *flavispina*.

O. phaeacantha var. *spinosibacca* (M.S. Anthony) L.D. Benson — see *O.* × *spinosibacca*.

O. picardae Urban — see *Consolea picardae*.

O. pilifera F.A.C. Weber 2*n* = 22 (Katagiri 1952, 1953).

O. pinkavae B.D. Parfitt 2*n* = 88 (Pinkava & Parfitt 1982, as *O. basilaris* var. *woodburyi* Earle, and some as *O. erinacea* var. *utahensis* (Engelm.) L.D. Benson, corrected here), (Parfitt 1991; Baker et al. 2009b).

O. pollardii Britton & Rose — see *O. humifusa*.

O. polyacantha Haw. without vars. 2*n* = 22 (Matsura & Suto 1935), 2*n* ~ 44 (Stockwell 1935; Baker et al. 2009a), 2*n* ~ 66 (Stockwell 1935), *Opuntia polyacantha* var. *arenaria* (Engelm.) B.D. Parfitt 2*n* = 22 (Weedin & Powell 1978; Pinkava et al. 1985,1992; Weedin et al. 1989);*O. polyacantha* var. *erinacea* (Engelm. & J.M. Bigelow) B.D. Parfitt 2*n* = 22 (Yuasa et al. 1973, as *O. erinacea* and var. *longispina*), 2*n* = 44 (Pinkava et al. 1973, 1985; Pinkava & Parfitt 1982; Baker et al. 2009b), *O. polyacantha* var. *hystricina* (Engelm. & J.M. Bigelow) B.D. Parfitt 2*n* = 44 (Baker et al. 2009b), *O. polyacantha* var. *nicholii* (L. Benson) B.D. Parfitt 2*n* = 66 (Pinkava et al. 1977, 1992, as *O. nicholii*; Baker et al. 2009b); *O. polyacantha* var. *polyacantha* 2*n* = 22 (Yuasa et al. 1973; Weedin & Powell 1978; Weedin et al. 1989; Pinkava et al. 1992; Powell & Weedin 2005, all as *O. polyacantha* var. *trichophora* (Engelm. & J.M. Bigelow) Coulter), (Weedin & Powell 1978, as *O. polyacantha* var. *rufispina*), (Powell & Weedin 2001; Baker et al. 2009b), 2*n* = 44 (Pinkava et al. 1977; Baker et al. 2009b), 2*n* = 66 (Yuasa et al. 1973, as *O. polyacantha* var. *rufispina*).

O. polyacantha var. *rufispina* (Engelm. & J.M. Bigelow) L.D. Benson— see *O. polyacantha* var. *polyacantha*.

O. polyacantha var. *trichophora* (Engelm. & J.M. Bigelow) Coulter — see *O. polyacantha* var. *polyacantha*.

O. pottsii Salm-Dyck 2*n* = 44 (Weedin & Powell 1978; Pinkava et al. 1998, both as *O. macrorhiza* var. *pottsii*), (Powell & Weedin 2001; Baker et al. 2009b).

O. pubescens Wendl. ex Pfeiffer 2*n* = 44 (Yuasa et al. 1973, as *O. tayapayensis*), (Baker 2002).

O. pusilla (Haw.) Haw. 2*n* = 22, 33, 44 (Majure et al. 2012a), 2*n* = 44 (Bowden 1945, as *O. impedita*) (Yuasa et al. 1973, as *O. drummondii*).

O. pycnantha Engelm. 2*n* = 22 (Pinkava et al. 1998; Baker et al. 2009b).

O. quimilo K. Schum. 2*n* = 22 (Yuasa et al. 1973).

O. quitensis F.A.C. Weber 2*n* = 22 (Baker 2002).

O. rastrera F.A.C. Weber 2*n* = 66 (Muñoz-Urias et al. 2008).

O. repens Bello 2*n* = 22 (Bowden 1945, Spencer 1955, Parfitt et al. 1990).

O. robusta H.L. Wendl. ex Pfeiffer 2*n* = 22 (Sosa et al. 1966; Brandyopadhyay & Sharma 2000), 2*n* = 44 (Sosa & Acosta 1966, as *O. robusta* var. *larreyi*), (Pinkava et al. 1985, as *O.* aff. *robusta*), (Sajeva et al. 1988, as híbrido prince-

sa), (Segura et al. 2007, as var. *larreyi*), (Muñoz-Urias et al. 2008), 2*n* ~ 66 (Yuasa et al. 1973, as *O. guerrana*), 2*n* = 88 (*O. robusta* var.; Segura et al. 2007, as vars. *robusta* and *guerrana*).

O. rubescens Salm-Dyck ex DC. — see *Consolea rubescens*.

O. rufida Engelm. 2*n* = 22 (Katagiri 1952, 1953; Yuasa et al. 1973, as *O. microdasys* var. *rufida*; Pinkava et al. 1977, as var. *rufida*; 1992; Weedin & Powell 1978; Weedin et al. 1989, Baker et al. 2009b).

O. rzedowskii Scheinvar 2*n* = 88 (Segura et al. 2007).

O. santa-rita Griffiths & Hare 2*n* = 22 (Stockwell 1935; Pinkava et al. 1973; 1977; Yuasa et al. 1973; Weedin & Powell 1978, all as *O. violacea* var. *santa-rita*), (Pinkava et al. 1992, 1998).

O. schickendantzii F.A.C. Weber 2*n* = 22 (Yuasa et al. 1973).

O. soederstromiana Britton & Rose 2*n* = 88 (Baker 2002).

O. soehrensii Britton & Rose — see *Tunilla soehrensii*.

O. × *spinosibacca* Anthony (*O. aureispina* × *O. phaeacantha*) 2*n* = 44 (Weedin & Powell 1978, as *O. phaeacantha* var. *spinosibacca*), (Powell & Weedin 2001).

O. spinulifera Salm-Dyck 2*n* = 44 (Segura et al. 2007), 2*n* = 66 (Yuasa et al. 1973).

O. spinosissima P. Miller — *Consolea spinosissima*.

O. stenopetala Engelm. 2*n* = 22 (Pinkava et al. 1977).

O. streptacantha Lemaire 2*n* = 22 (Yuasa et al. 1973), 2*n* = 66 (Flores et al. 1988), 2*n* = 88 (Yuasa et al. 1973; Pinkava & Parfitt 1982; Heras et al. 1988; Palomino et al. 2001; Muñoz-Urias et al. 2006, 2008), (Segura et al. 2007, as subspp. *streptacantha* and *aguirrana*).

O. stricta (Haw.) Haw. without vars. 2*n* = 66 (Mazzola et al. 1988; Pinkava et al. 1992). As *O. dillenii* (Ker-Gawl) Haw. 2*n* = 12 (Sampathkumar & Navaneetham 1980a, b, also 2*n* = 22, 26, 36), 2*n* = 22 (Spencer 1955), 2*n* = 40 (Chen et al. 2003), 2*n* = 44 (Yuasa et al. 1973; Brandyopadhyay & Sharma 2000; Baker et al. 2009a); 2*n* = 66 (Carpio 1952; Yuasa et al. 1973; Mazzola et al. 1988; Sajeva et al. 1988; Pinkava et al. 1992, Negrón-Ortiz 2007; Majure et al. 2012a), as *O. stricta* 2*n* = 66 (Mazzola et al. 1988; Majure et al. 2012a).

O. strigil Engelm. 2*n* = 22 (Weedin & Powell 1978, 1989; Pinkava et al. 1992; Powell & Weedin 2001, 2005), 2*n* = 44 (Weedin et al. 1989).

O. sulphurea Gillies ex Salm-Dyck var. *hildamanni* (Fric) Backeb. 2*n* = 66 (Yuasa et al. 1973).

O. tapona Engelm. ex J.M. Coult. 2*n* = 22 (Pinkava et al. 1998).

O. tayapayensis Cárdenas — see *O. pubescens*.

O. tenuispina Engelm. 2*n* = 66 (Katagiri 1952; 1953).

O. tomentosa Salm-Dyck. 2*n* = 44 (Katagiri 1952, 1953), 2*n* = 88 (Yuasa et al. 1973; Baker et al. 2009b).

O. tortispina Engelm. ex J.M. Bigelow 2*n* = 44 (Majure et al. 2012a), 2*n* = 66 (Powell & Weedin 2001; Majure et al. 2012a), 2*n* ~ 66 (Powell & Weedin 2005). Note: most previous counts of *O. tortispina* are likely referable to *O. cymochila* (D.J. Pinkava, unpubl. data).

O. triacantha (Willd.) Sweet 2*n* = 22 (Spencer 1955).

O. tuna (L.) P. Miller 2*n* = 44 (Yuasa et al. 1973, as *monstrosa*).

O. × *vaseyi* (Coulter) Britton & Rose (*O. littoralis* × *O. phaeacantha*) 2*n* = 66 (Pinkava et al. 1973, 1992).

O. violacea Engelm. var. *castetteri* L.D. Benson — see *O macrocentra*.

O. violacea var. *macrocentra* L.D. Benson — see *O. macrocentra*.

O. violacea var. *santa-rita* (Griffiths & Hare) L.D. Benson — see *O. santa-rita*.

O. violacea var. *violacea* — see *O. macrocentra*.

O. vulgaris P. Miller — see *O. monacantha*.

O. xanthoglochia Griffiths — see *O. macrorhiza*.

O. zamudioi Scheinvar 2*n* = 88 (Segura et al. 2007).

Salmiopuntia Frič ex Guiggi

S. salmiana (Parm. ex Pfeiff.) Guiggi 2*n* = 44 (Bowden 1945; Katagiri 1952, 1953); 2*n* ~ 44 (Baker et al. 2009a), 2*n* = 55 (Yuasa et al. 1973).

Tacinga Britton & Rose

T. funalis Britton & Rose 2*n* = 22 (Yuasa et al. 1973).

T. inamoena (K. Schumann) Stuppy & Taylor 2*n* = 44 (de Castro 2008), 2*n* = 66 (Yuasa et al. 1973, as *O. inamoena*).

T. palmadora (Britton & Rose) N.P. Taylor & Stuppy 2*n* = 22 (de Castro 2008).

Tunilla D.R. Hunt & Illif

T. corrugata (Salm-Dyck) Dr. Hunt & Illif 2*n* = 44 (Yuasa et al. 1973, as *O. microdisca*), 2n = 66 (Yuasa et al. 1973, as *O. longispina*).

T. erectoclada (Backeb.) D.R. Hunt & Illif 2*n* = 44 (Yuasa et al. 1973).

T. soehrensii (Britton & Rose) D.R. Hunt & Illif 2*n* = 44 (Yuasa et al. 1973, as *O. soehrensii*).