Chromosome numbers and karyotypes in Asteraceae

Watanabe, Kuniaki ; Yahara, Tetsukazu ; Hashimoto, Goro ; Nagatani, Yoshimi ; Soejima, Akiko ; Kawahara, Takayuki ; Nakazawa, Miyuki

(Citation)
Annals of the Missouri Botanical Garden,94(3):643-654

(Issue Date)
2007-10-04

(Resource Type)
journal article

(Version)
Version of Record

(URL)
https://hdl.handle.net/20.500.14094/90002999

CHROMOSOME NUMBERS AND KARYOTYPES IN ASTERACEAE[1]

Kuniaki Watanabe,[2] Tetsukazu Yahara,[3] Goro Hashimoto,[4] Yoshimi Nagatani,[4] Akiko Soejima,[5] Takayuki Kawahara,[6] and Miyuki Nakazawa[3]

Abstract

Chromosome numbers were determined from microsporocytes (meiotic counts) and root-tip cells (mitotic counts) in 201 collections of 51 genera and 119 specific and infraspecific taxa belonging to nine tribes of Asteraceae and *Acicarpha spathulata* R. Br. of Calyceraceae from Australia, Bolivia, Brazil, Chile, Mexico, and the United States. These include the first reports and new numbers for the basal members of the Barnadesieae and Mutisieae. First reports are provided for 45 taxa, including five genera, *Dasyphyllum* HBK (2*n* = 54), *Dithyrostegia* A. Gray (2*n* = 14), *Epitriche* Turcz. (2*n* = 10), *Revealia* R. M. King & H. Rob. (2*n* = 22), and *Stifftia* J. C. Mikan (2*n* = 54). In addition, new chromosome numbers are established at the generic level in the genera *Barnadesia* Mutis (2*n* = 54), *Eremanthus* Less. (2*n* = 34, 30), *Macvaughiella* R. M. King & H. Rob. (2*n* = 24), and *Trichocline* Cass. (2*n* = 38), and in 12 additional species. Remaining counts augment and agree with previously reported determinations. The base chromosome numbers of Calyceraceae and Asteraceae are discussed in published records and our original counts.

Key words: Asteraceae, Brazil, chromosome number, cytotaxonomy, genome size, karyotype, phylogeny.

Chromosomal information has contributed extensively to our understanding of relationships within the diverse Asteraceae and has resulted in heightened awareness of groups in need of taxonomic reevaluation. Most previous studies on the chromosomes of this family were conducted on plants in temperate regions of the Northern Hemisphere, although there is more species diversity in Central America and South America.

Recent molecular studies have suggested that Barnadesieae is the most primitive tribe in the Asteraceae, followed by Mutisieae, while Calyceraceae is sister to Asteraceae (Jansen & Palmer, 1987, 1988; Kim & Jansen, 1995; Bayer & Starr, 1998; Kim et al., 2002; Panero & Funk, 2002). Most members of Barnadesieae and Mutisieae are concentrated in South America and are relatively poorly known cytologically. In this paper, we report original chromosome counts from 201 accessions representing 120 species and varieties, including first reports for 45 taxa of Asteraceae and one species of Calyceraceae.

Materials and Methods

A total of 201 accessions attributed to 51 genera and 119 specific and infraspecific taxa of nine tribes of Asteraceae and *Acicarpha spathulata* R. Br. of Calyceraceae were collected from Australia, Bolivia, Brazil, Chile, Mexico, and the United States. Chromosome counts were obtained from either floral buds fixed in a 3:1 ethanol-acetic acid fixative in the field or root tips obtained from seedlings grown from cypselae of known provenance in the greenhouse of Kobe University. Excised root tips about 1 cm in length were pre-treated with cold water at 0°C for 24 hours and fixed in 3:1 ethanol-acetic acid for 1–5 hours at 5°C. Haploid karyotypic idiograms are based on the means of 10 measurements for each chromosome.

Although Turner (1987) and Bremer (1994) have treated *Revealia* R. M. King & H. Rob. and *Cronquistia* R. M. King as synonyms of *Carphochaete* A. Gray, in the present study, the two are treated as separate genera with different chromosome numbers

[1] Research was supported by a grant-in-aid for International Scientific Research (Field Research) Nos. 07041140, 08041149, and 14405014 from the Ministry of Education, Culture, Sports, Science, and Technology, Japan. Special thanks are due to P. S. Short (DNA) for collections and identifications of Australian *Dithyrostegia amplexicaulis* and *Epitriche demissus*, and M. Ito (University of Tokyo, Japan) for collections and identifications of Chilean *Mutisia* sp., Bolivian *Stevia bangii*, and *Stevia camachensis*. We would like to especially thank J. L. Strother (UC), D. J. Crawford (KANU), and H. Robinson (US) for kind advice and information that improved an earlier draft of the manuscript.

[2] Department of Biology, Graduate School of Science, Kobe University, Kobe, 657-8501, Japan. Author for correspondence: nabekuni@kobe-u.ac.jp.

[3] Department of Biology, Graduate School of Science, Kyushu University, Hukuoka, 812-8581, Japan.

[4] Centro de Pesquisas de Historia Natural Herbario Goro Hashimoto, Rua Jaime Ribeiro Wright 618 CEP 08260-070 Itaquera, São Paulo, Brazil.

[5] Department of Biology, Graduate School of Science, Osaka Prefectural University, Sakai, 599-8531, Japan.

[6] Hokkaido Research Center Forestry and Forest Products Research Institute, Sapporo, 062-8516, Japan.

Ann. Missouri Bot. Gard. 94: 643–654. Published on 4 October 2007.

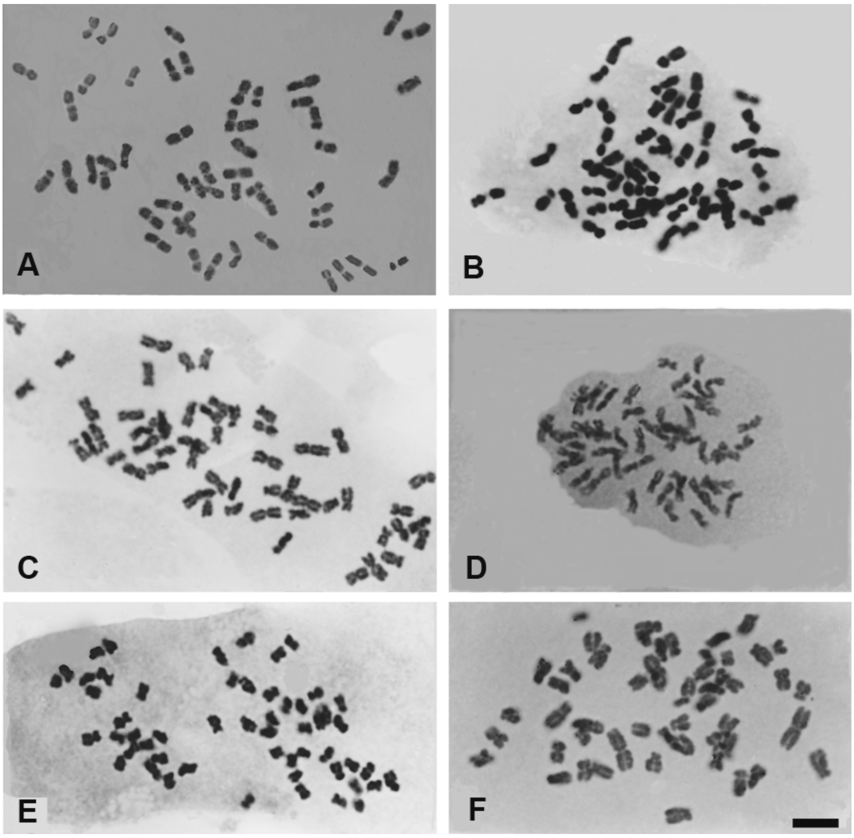

Figure 1. Photomicrographs of somatic metaphase chromosomes. Scale bar = 5 μm. —A. *Dasyphyllum spinescens* (2*n* = 54). —B. *Dasyphyllum brasiliense* (2*n* = 54). —C. *Barnadesia caryophylla* (2*n* = 54). —D. *Stifftia chrysantha* (2*n* = 54). —E. *Trixis praetans* (2*n* = 54). —F. *Mutisia campanulata* (2*n* = 52).

and habits. Voucher specimens have been deposited in the Centro de Pesquisas de Historia Natural Herbario Goro Hashimoto (GHSP, Brazilian specimens), KANA (Bolivian and Chilean specimens), MEL (Australian specimens), MEXU (Mexican specimens), KYO (Brazilian and Mexican specimens), and TI (Australian specimens). Indices consulted for previous chromosome number determinations include: Fedorov (1974), Moore (1973), Goldblatt (1981, 1984, 1985, 1988), Goldblatt and Johnson (1990, 1991, 1994, 1996, 1998, 2000, 2003), and <http://www-asteraceae.cla.kobe-u.ac.jp>. We have cited only these in order to save space and still provide a means of access to the primary literature.

Results and Discussion

Chromosome numbers of 201 collections representing 51 genera and 119 specific and infraspecific taxa belonging to nine tribes of Asteraceae and *Acicarpha spathulata* of Calyceraceae were determined. Among them, the chromosome numbers of 45 species and/or infraspecific taxa and five genera (*Dasyphyllum* Kunth [2*n* = 54], *Dithyrostegia* A. Gray [2*n* = 14], *Epitriche* Turcz. [2*n* = 10], *Revealia* [2*n* = 22], and *Stifftia* J. C. Mikan [2*n* = 54]) have not been previously counted. Chromosome numbers for *Barnadesia* Mutis ex L. f. (2*n* = 54), *Eremanthus* Less. (2*n* = 34, 30), *Macvaughiella* R. M. King & H. Rob. (2*n* = 24), *Trichocline* Cass. (2*n* = 38), and 14 additional species differ from those previously reported; new base chromosome numbers are established for those species. Among taxa reported here, three show infraspecific polyploidy (Appendix 1). Photomicrographs of the mitotic chromosomes of six taxa are displayed in Figure 1, and the idiograms of the mitotic chromosome of 17 taxa are displayed in Figure 2. The characteristics of karyotypes of 17 taxa are presented in Table 1.

The tribal arrangements of Asteraceae listed in Appendix 1 and Table 1 follow those of Panero and Funk (2002).

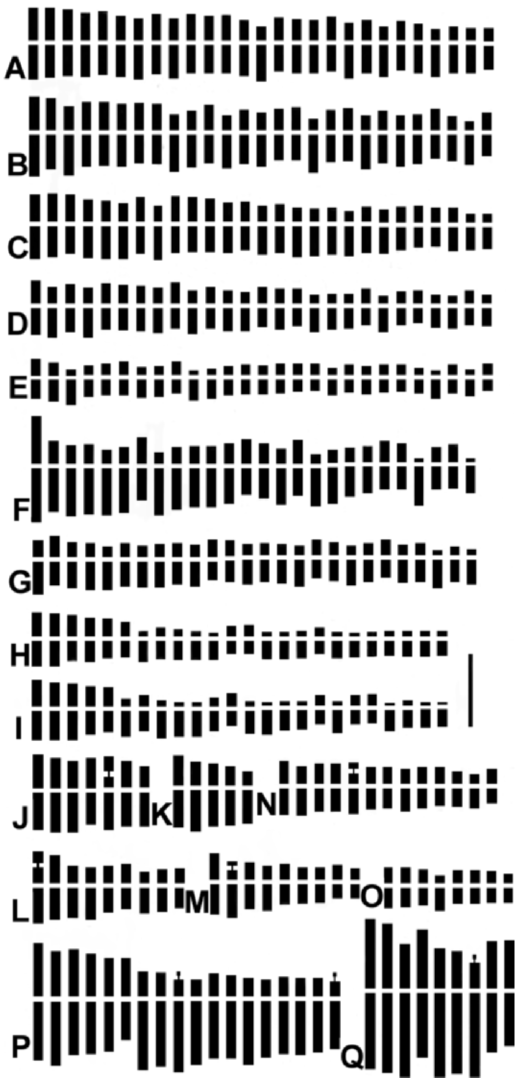

Figure 2. Haploid karyotypic idiograms. Scale bar = 5 μm. —A. *Dasyphyllum spinescens* (n = 27). —B. *Dasyphyllum brasiliense* (n = 27). —C. *Barnadesia caryophylla* (n = 27). —D. *Stifftia chrysantha* (n = 27). —E. *Trixis praetans* (n = 27). —F. *Mutisia campanulata* (n = 26). —G. *Mutisia* sp. (n = 26). —H. *Chaptalia integrifolia* (n = 24). —I. *Chaptalia nutans* (n = 24). —J. *Symphyotrichum graminifolium* (n = 7). —K. *Epitriche demissus* (n = 5). —L. *Aster squamata* (n = 9). —M. *Notiastrum acuminatum* (n = 9). —N. *Dyssodia papposa* (n = 13). —O. *Thymophylla aurea* (n = 8). —P. *Marshalia mohrii* (n = 18, diploid karyotypic idiogram). —Q. *Espejoa mexicana* (n = 9).

CALYCERACEAE

Acicarpha spathulata has a chromosome number of $2n$ = 8II, which is in accord with numbers previously reported.

ASTERACEAE

Barnadesieae. First reports are provided for seven specific and infraspecific taxa of *Dasyphyllum* and *Barnadesia caryophylla* (Vell.) S. F. Blake. In *Barnadesia*, chromosome numbers have been reported for eight species. They vary from n = 12 (Olsen, 1980) to $2n$ = 62 (Cristobal, 1986). In *B. caryophylla*, we found a chromosome number of $2n$ = 54. This is the first report of this number for this genus, and it matches or closely approximates previously reported numbers for other genera such as *Arnaldoa* Cabrera (n = 24–27 in Stuessy & Sagastegui, 1993) and *Chuquiraga* Juss. (n = 27 and/or $2n$ = 54 in Diers, 1961; Wulff, 1990). In addition, $2n$ = 54 is reported here for the first time for seven *Dasyphyllum* taxa. Reports for taxa of *Dasyphyllum* and *Barnadesia* establish a new base chromosome number of x = 27 for both genera here.

Mutisieae. First reports are provided for *Chaptalia graminifolia* (Dusen) Cabrera ($2n$ = 48 + 0–7Bs), *C. runcinata* Kunth ($2n$ = 48), *Jungia sellowii* Less. (n = 20II), *Mutisia campanulata* Less. ($2n$ = 52), two varieties of *Stifftia chrysantha* Mikan ($2n$ = 54), *Trichocline catharinensis* Cabrera ($2n$ = 38), and *Trixis praestans* (Vell.) Cabrera ($2n$ = 54). All of the genera examined have high chromosome numbers. Counts of $2n$ = 54 for the genera *Stifftia*, *Trixis* P. Browne, *Acourtia* D. Don (Vuilleumier, 1969; Pinkava & Keil, 1977; Powell & Powell, 1978; Ward, 1983; Carr et al., 1999; Strother & Panero, 2001), *Plazia* Ruiz & Pav. (Covas & Schnack, 1946), and *Proustia* Lag. (Covas & Schnack, 1946) agree with those of four genera of Barnadesieae. Our counts of $2n$ = 54, as well as many previous reports of n = 27 for *Trixis* species, differ from the report from Carr et al. (1999) for *T. inula* Crantz ($2n$ = 28II). Chilean and Brazilian *Mutisia* L. f. species have chromosome numbers of $2n$ = 52, which agree with those of *M. acuminata* Ruiz & Pav. (Waisman et al., 1984; Carr et al., 1999), *M. clematis* L. f. (Powell & King, 1969), *M. coccinea* A. St.-Hil. (Gibbs & Ingram, 1982), *M. ledifolia* Decne. ex Wedd. (Waisman et al., 1984), and *M. orbignyana* Wedd. (Fernández Casas, 1981) and are different from previous counts for other species (Diers, 1961; Turner et al., 1979). Grau (1987) reported $2n$ = 46 for five Chilean *Mutisia* species. Thus, our count of $2n$ = 52 for Chilean *Mutisia* species is a new report. Previous chromosome counts for *Trichocline* species were reported to be n = 18 (Covas & Schnack, 1947; Zardini, 1975) and n = 20 (Turner et al., 1979). Our count for *Trichocline catharinensis* establishes a new base number, x = 19, at the generic level. Kim et al. (2002) showed that Mutisieae is polyphyletic based on

Table 1. Taxa, chromosome number, total haploid karyotypic length, range of chromosome size, ratio of chromosome size, mean arm ratio, and life form. TKL, total haploid karyotypic length; range, the longest chromosome to the shortest chromosome; ratio, the longest chromosome to the shortest chromosome; SE, standard error; SD, standard deviation; MAR, mean arm ratio (total long arm length to total short arm length); LF, life form; T, tree; S, shrub; L, liana; P, perennial; A, annual.

		TKL (μm)						
Taxon	2*n*	Total	SE	SD	Range (μm)	Ratio	MAR	LF
Dasyphyllum spinescens	54	185.46	10.04	22.45	4.44–2.48	1.79	1.46	T
Dasyphyllum brasiliense	54	185.32	9.29	20.78	5.03–2.44	2.06	1.49	T
Barnadesia caryophylla	54	161.40	5.86	13.11	4.02–1.92	2.10	1.53	S
Stifftia chrysantha	54	126.52	2.96	6.62	3.10–1.72	1.80	1.55	S
Trixis praestans	54	92.58	2.64	5.91	2.20–1.34	1.64	1.71	S
Mutisia campanulata	52	176.66	3.88	8.68	6.78–1.88	3.61	2.17	L
Mutisia sp.	52	116.72	1.96	4.38	3.09–1.69	1.83	2.32	L
Chaptalia integrifolia	48	82.28	6.10	13.63	3.08–1.20	2.57	2.21	P
Chaptalia nutans	48	95.68	4.76	10.65	3.71–1.19	3.12	2.31	P
Dithyrostegia amplexicaulis	14	58.52	0.67	1.50	4.61–3.59	1.28	1.39	A
Epitriche demissus	10	37.84	0.80	1.78	4.34–3.07	1.41	1.77	A
Aster squamatus	18	50.38	2.58	5.77	3.89–2.09	1.86	1.42	P
Noticastrum acuminatum	18	41.86	1.30	2.91	3.58–1.55	2.31	1.43	P
Marshallia mohrii	36	202.64	6.68	14.93	7.50–4.10	1.83	2.13	P
Espejoa mexicana	18	147.16	4.98	9.13	9.66–6.72	1.44	1.61	A
Dyssodia papposa	26	38.98	1.06	2.38	3.17–1.79	1.77	1.32	A
Thymophylla aurea	16	28.70	0.64	1.44	2.08–1.53	1.36	1.11	A

the *ndhF* sequence variation. Panero and Funk (2002) supported the polyphyly of the old Mutisieae and proposed to allocate members of Cardueae and Mutisieae into the following group and subfamilies: "The *Stifftia* group," Mutisioideae, Gochnatioideae, Hecastocleioideae, Carduoideae, Pertyoideae, and Gymnarrhenoideae, based on the comparison of 13380 bp of cpDNA. "The *Stifftia* group" follows the basal Barnadesioideae, a relationship consistent with the same chromosome numbers. The base chromosome number for Mutisieae, including "the *Stifftia* group," may be $x = 27$. The chromosome numbers $2n = 52$, $2n = 48$, and $2n = 38$ may have been derived through dysploidal reduction.

Vernonieae. First reports are provided for *Eremanthus bicolor* (DC.) Baker ($2n = 30$) and three species of *Vernonia* Schreb. There are three unidentified specimens of *Eremanthus*; *Eremanthus* species 1 has a chromosome number of $2n = 30$, but species 2 and species 3 have chromosome numbers of $2n = 34$ and/or $2n = 17II$. Turner et al. (1979) reported $n = 15$ for Brazilian *E. elaeagnus* Sch. Bip. Jones (1982) reported $2n = 36$ for Brazilian *E. reflexo-auriculatus* G. M. Barroso. Thus, three base chromosome numbers ($x = 15$, 17, and 18) have been reported for *Eremanthus*. We report $2n = 17II$ or $2n = 34$ for six species and one unidentified specimen of *Vernonia*. The chromosome base numbers of New World *Vernonia* have been reported to be $x = 17$, 16, 15, 14, and 10 (Ruas et al., 1991; Dematteis, 1997). Dematteis (1998) and Dematteis and Fernandez (2000) reported $2n = 32$ for all species of *Vernonia* they examined.

Gnaphalieae. The additional descending dysploidy of $x = 13$, 12, and 6 in *Angianthus* J. C. Wendl., of $x = 14$, 12, and 11 in *Erymophyllum* Paul G. Wilson, and of $x = 14$ and 13 in *Podotheca* Cass. was found in a previous study (Watanabe et al., 1999a). The Australian members of Gnaphalieae we examined have lower chromosome numbers ($n = 13$, 12, 7, and 5), which are lower than those present on other continents ($n = 14$; Watanabe et al., 1999a).

Astereae. First reports are provided for *Baccharis pentodonta* Malme and *B. triplinervis* Baker. All species of shrubby *Baccharis* L. examined are diploids based on $x = 9$. All of the previous counts for *Symphyotrichum graminifolium* (Spreng.) G. L. Nesom reported as *Aster squamatus* (Spreng.) Hieron. have been $n = 10$ or $2n = 20$ (Schnack & Covas, 1947; Kamel, 1996), except those by Coleman (1968, $n = 9–10$) and Spooner et al. (1995, $n = 5$). The present study found chromosome counts of $2n = 18 + 0–2$Bs. The longest chromosome pair has a large trabant at the end of a short arm (Fig. 2L). Previous studies may have counted this trabant or B chromosome as an independent chromosome.

Plucheeae. *Pluchea sagittalis* (Lam.) Cabrera has $n = 10$II. As noted by Watanabe et al. (1999a), all members reported for this tribe, excluding some erroneous counts, have chromosome counts of $2n = 20$ or polyploid numbers based on $x = 10$.

Helenieae. Two previous counts for *Thymophylla pentachaeta* (DC.) Small var. *hartwegii* (A. Gray) Strother (as *Dyssodia hartwegii* (A. Gray) B. L. Rob.) were $n = 26$ (Johnston & Turner, 1962; De Jong & Longpre, 1963). This is the first chromosome number of $2n = 26$ for this variety, although Strother (1989) has stated that all *Thymophylla* Lag. species have chromosome numbers based on $x = 8$. Strother (1989) reported $2n = 16$II and $2n = 32$ for Texas *T. pentachaeta*. Our two Mexican accessions of this variety had counts of $2n = 24$. The monotypic *Espejoa mexicana* DC. has a chromosome number of $2n = 18$. *Marshallia mohrii* Beadle & F. E. Boynton has a chromosome number of $2n = 36$, which is a tetraploid based on $x = 9$.

Heliantheae. The first report, $2n = 17$II, is provided for *Verbesina clausseni* Sch. Bip. ex Baker and agrees with previous reports for other species of the genus.

Eupatorieae. First reports are provided for species of *Ageratina* Spach (1), *Carphochaete* (1), *Chromolaena* DC. (4), *Decachaeta* DC. (1), *Praxelis* Cass. (1), *Revealia* (1), and *Stevia* Cav. (9). Some species of *Chromolaena* are polyploids and apomicts; *C. kleinii* (Cabrera) R. M. King & H. Rob. is a diploid based on $x = 10$ and is probably sexual. For the first time, hexaploidy ($2n = 60$) is documented for *Chromolaena laevigata* (Lam.) R. M. King & H. Rob. Sundberg et al. (1986) reported $n = 16$ for *D. pyramidalis* (B. L. Rob.) S. D. Sundb., C. P. Cowan & B. L. Turner (= *Erythradenia pyramidalis* (B. L. Rob.) R. M. King & H. Rob). It is confirmed to have a chromosome number of $2n = 32$. A previous chromosome count for *Gyptis crassipes* (Hieron.) R. M. King & H. Rob. was reported as $n = 30$ (as *Eupatorium lanigerum* Hook. & Arn.) by Coleman (1968). Diploidy ($2n = 30$) is documented for the first time in this species. Our count of $2n = 24 + 4–8$Bs for *Macvaughiella mexicana* (Sch. Bip.) R. M. King & H. Rob. is different from a previous count of $n =$ ca. 13 (King et al., 1976). Our accession of *Microspermum nummulariaefolium* Lag. is a triploid with a chromosome number of $2n = 36$; triploidy is documented for the first time in this species. *Praxelis missiona* (Malme) R. M. King & H. Rob., with a chromosome number of $2n = 80$, is an octoploid based on $x = 10$. The diploid chromosome number of $n = 10$ has been reported only for Bolivian *P. clematidea* (Griseb.) R. M. King & H. Rob. by Wulff et al. (1996).

Stevia includes four basic life forms: woody shrubs, plants with woody caudices and herbaceous stems, rhizomatous perennials, and annuals, all of which have been found in Mexico. All Mexican species of shrubs or shrublets are sexual diploids with chromosome numbers of $2n = 24$, while all Mexican species of annual herbs are also sexual diploids, but their chromosome numbers vary from $2n = 24$ to $2n = 8$. North and Central American perennial *Stevia* are diploids or agamospermous polyploids based on $x = 11$ or 12 (Watanabe et al., 2001). The chromosome number of $n = 17$ reported by Grashoff et al. (1972) for the Mexican perennial *S. purpusii* B. L. Rob. is probably a miscount. It is difficult to determine the chromosome number from the irregular meiotic chromosome configurations of odd polyploids. Our accession of Mexican *S. purpusii* has a chromosome number of $2n = 36$ and is a triploid based on $x = 12$. Native South American species of *Stevia* are perennials, and mostly diploids based on $x = 11$. The chromosome number of $n = 12$ for *S. organensis* Gardner reported by Coleman (1970) is possibly erroneous. Our accession collected from the same site as that of Coleman (1970) had a chromosome number of $2n = 22$. Colombian *S. lucida* Lag., with a chromosome number of $n = 12$, is a shrub and is basically a Central American species. Three polyploids reported from South America are also basically Central American (*S. elatior* HBK by Jansen et al., 1984; *S. ovata* Willd. by Turner et al., 1967; *S. serrata* Cav. by Powell & King, 1969). The occurrence of polyploidy in Peruvian *S. andina* B. L. Rob. ($n =$ ca. 22, Turner et al., 1967) and Bolivian *S. bangii* Rusby ($2n = 44 + 0–5$Bs, present study) may represent sporadic origins (a single count, respectively) because their distribution is restricted to small areas instead of the widespread prevalence of agamospermous polyploids in North and Central American.

KARYOTYPES

Figure 2 contains haploid (except for *Marshallia* Schreb.) karyotypic idiograms. In Table 1, we report the mean total haploid karyotypic length with standard errors, standard deviations, ranges of longest and shortest chromosome, arm ratios for each karyotype, mean arm ratio (total long arm length to total short arm length), and life form. The total haploid karyotypic length of *Dasyphyllum* and *Barnadesia* has been shown to be significantly longer than those of members of Astereae and Anthemideae, with $n = 9$ reported in the literature (Table 1; Watanabe et al., 1999b). The karyotypes of members of *Dasyphyllum*, *Barnadesia*, *Stifftia*, *Trixis*, and *Mutisia* do not have the duplicated homologous chromosome sets that would suggest autopolyploid origin. Their karyotypes are well diverged even if they have polyploid origins. The base number for Barnadesieae and Mutisieae may be $x = 27$, but the possibility that they may be hexaploids based on $x = 9$ cannot be discounted, as we mention later.

From our results (Figs. 1–2; Appendix 1; Table 1), it is apparent that there is a great diversity of karyotypes. For example, the karyotypes of *Barnadesia* and *Dasyphyllum* are unimodal and contrast with the bimodal karyotypes of *Mutisia campanulata* and *Trichocline catharinensis*, which have one pair of large chromosomes and 25 or 18 pairs of small chromosomes, respectively. *Mutisia campanulata* has three pairs of nearly telocentric chromosomes, and *Chaptalia* Vent. species *C. integrifolia* (Cass.) Baker and *C. mandonii* (Sch. Bip.) Burkart have 13 to seven pairs of nearly telocentric chromosomes, respectively. Lower chromosome numbers and asymmetric karyotypes of Mutisieae may have been derived through dysploidal reduction from a base of $x = 27$ resulting from structural rearrangements. *Marshallia* is basal in the Helenieae (Baldwin et al., 2002) and has a base chromosome number of $x = 9$. It has an extraordinarily large genome size as shown in Figure 2P and Table 1. (This accession is an allotetraploid karyotypically, and its idiogram and total karyotypic length are given as "diploid.") The smaller chromosome number and genome size (= total haploid karyotypic length) may have been selected in annuals such as *Thymophylla aurea* (A. Gray) Greene, as well as those in many other genera of Asteraceae (Watanabe et al., 1999a, b). The monotypic *Espejoa* DC. is an annual and also has a large genome size (Fig. 2Q and Table 1). It is desirable to estimate the isozyme number or the state of ploidal level for both *Marshallia* and *Espejoa* to determine whether they are "true" diploid states or not.

THE ANCESTRAL BASE CHROMOSOME NUMBER OF ASTERACEAE AND SOME RELATED LIFE FORMS

Among papers that have dealt with the ancestral base chromosome number of Asteraceae, most have suggested $x = 9$, largely because this is the modal number based on more than 30% of all counted species (Solbrig, 1977). Support for $x = 9$ comes from reports for taxa of Astereae and Anthemideae collected from temperate regions of the Northern Hemisphere, where researchers have sampled most intensively in the past. The sister family Calyceraceae has base chromosome numbers of $x = 13$, 15, 18, and 21 in three of four genera examined (Covas & Schnack, 1947; Rahn, 1960; Turner, 1978; Moore, 1981), in addition to $n = 8$, which was reported for two species of *Acicarpha* Juss. (Sugiura, 1936, 1937; Raven et al., 1965; Rodriguez Correira et al., 1977; Benko-Iseppon, 1992; present study). De Vore (1994; cited by Stuessy et al., 1996) treated *Acicarpha* as the most primitive genus within Calyceraceae. But *A. spathulata* ($n = 8$), one of the five species of the genus, is a specialized succulent plant growing on the coastal sands. In Barnadesieae, the chromosome numbers have been reported for six of nine genera. Among them, the perennial monotypic genus *Schlechtendahlia* Benth. & Hook. f. has a chromosome number of $n = 8$ (Cialdella & Lopez de Kresling, 1981; Hunziker et al., 1989), and the five remaining genera have chromosome numbers of $n = 24$, 25 (*Doniophyton* Wedd., annual; Wulff, 1990), and $n = 27$ for *Arnaldoa*, *Barnadesia*, *Chuquiraga*, and *Dasyphyllum*. Based on cladistic analysis of morphological characters, Bremer (1994) and Stuessy et al. (1996) noted that *Schlechtendahlia* and *Dasyphyllum* were primitive and basal in subfamily Barnadesioideae. Stuessy et al. (1996) treated the members of both sections of the subgenus *Dasyphyllum* as having the life form of arching shrubs. Among the accessions we examined, *Dasyphyllum trichophyllum* (Baker) Cabrera (sect. *Macrocephala*), *D. brasiliense* (Spreng.) Cabrera, *D. spinescens* (Less.) Cabrera, and *D. tomentosum* (Spreng.) Cabrera (sect. *Microcephala*), all are trees. Stuessy et al. (1996) mentioned that the arborescent life form in *Dasyphyllum* might be a derived feature. *Schlechtendahlia*, all genera of Calyceraceae, and most of Goodeniaceae are herbaceous perennials. Stuessy et al. (1996) regarded *Schlechtendahlia* and *Acicarpha* as basal and took $x = 8$ as the original base number for both Asteraceae and Calyceraceae. Phylogenetic trees of Barnadesioideae by Bremer (1994) and Stuessy et al. (1996) are based on morphological characters and are influenced significantly by the life form. Molecular systematic data on the chloroplast *ndhF* sequences (Kim & Jansen, 1995) indicate that two clades including *Dasyphyllum* and *Schlechtendahlia* diverged at the base of subfamily Barnadesioideae. Gustaffson et al. (2001) and Funk et al. (2005) reported the more detailed molecular phylogenetic trees of the Barnasioides. Their trees show that the genera of *Barnadesia* and *Dasyphyllum* are at the basal position in the separate clades, and *Schlechtendahlia* is a derivative in the *Dasyphyllum* clade. Both genera of *Barnadesia* and *Dasyphyllum* have a chromosome number of $2n = 54$, and *Schlechtendahlia* has a chromosome number of $2n = 16$. It is difficult to infer the dysploid reduction from $2n = 54$ to $2n = 18$ by the simple steps of chromosomal changes. Thus, we consider that the chromosome number of $n = 8$ for *Schlechtendahlia* has been derived from the ancestral $n = 9$ by the dysploid reduction, and the chromosome number of $2n = 54$ for *Barnadesia* and *Dasyphyllum* is a hexaploid state based on the original base chromosome number, $x = 9$. Because their genome sizes (= total haploid chromosome length) are so large (Table 1), some tribes have higher base chromosome numbers than previously suspected (i.e., $x = 17$ for Cardueae and Vernonieae, $x = 14$ for Gnaphalieae; Watanabe et al., 1999a). The base chromosome number in the clade comprising Heliantheae s.l.–Eupatorieae is $x = 18$. Estimated base chromosome numbers for helenioid tribes include $x = 19$ for Madieae, $x = 18$ for Helenieae s. str. and Perityleae, and $x = 17$ for Bahieae (Baldwin et al., 2002). Dysploid reduction in chromosome number from the putatively high base number in Heliantheae s.l.–Eupatorieae (Watanabe et al., 1995; Ito et al., 2000) and other tribes, except for Astereae ($x = 9$), Anthemideae ($x = 9$), Inuleae ($x = 11–7$), Lactuceae ($x = 9$), and Plucheeae ($x = 10$), to the typical diploid levels appears to have occurred repeatedly in different sublineages, especially in groups rich in annuals (Stebbins, 1950; Robinson et al., 1981; Kadereit & Jeffrey, 1996; Watanabe et al., 1996, 1999; Baldwin et al., 2002).

Literature Cited

Baldwin, B. G., B. L. Wessa & J. L. Panero. 2002. Nuclear rDNA evidence for major lineages of Helenioid Heliantheae (Compositae). Syst. Bot. 27: 161–198.

Bayer, R. J. & J. R. Starr. 1998. Tribal phylogeny of the Asteraceae based on two non-coding chloroplast sequences, the *trnL* intron and *trnL/trnF* intergenic spacer. Ann. Missouri Bot. Gard. 85: 242–256.

Benko-Iseppon, A. M. 1992. Karyologische Untersuchung der Caprifoliaceae s.l. und moglicher verwandter Familien. Ph.D. Dissertation, Formal- und Naturwissenschaften Fakaltate Universitat Wien, Vienna.

Bremer, K. 1994. Asteraceae: Cladistics and Classification. Timber Press, Portland.

Carr, G. D., R. M. King, A. M. Powell & H. Robinson. 1999. Chromosome numbers in Compositae. XVIII. Amer. J. Bot. 86: 1003–1013.

Cialdella, A. M. & A. G. López de Kresling. 1981. Cariologia de *Schlechtendahlia luzulaefolia* (Compositae). Darwiniana 23: 357–360.

Coleman, J. R. 1968. Chromosome numbers in some Brazilian Compositae. Rhodora 70: 228–240.

———. 1970. Additional chromosome numbers in some Brazilian Compositae. Rhodora 72: 94–99.

Covas, G. & B. Schnack. 1946. Numero de cromosomas en Antofitas de la Cuya (Republica Argentina). Revista Argent. Agron. 13: 153–166.

——— & ———. 1947. Estudios cariologicos en Antofitas. II Parte. Revista Argent. Agron. 14: 224–231.

Cristobal, C. L. 1986. El numero cromosomico de dos Compositae-Mutisieae. Bol. Soc. Argent. Bot. 24: 363–380.

De Jong, D. C. D. & E. K. Longpre. 1963. Chromosome studies in Mexican Compositae. Rhodora 65: 225–240.

Dematteis, M. 1997. Numeros cromosomicos y cariotipos de algunas especies de *Vernonia* (Asteraceae). Bol. Soc. Argent. Bot 33: 85–90.

———. 1998. Karyotype analysis in some *Vernonia* species (Asteraceae) from South America. Caryologia 51: 279–288.

——— & A. Fernandez. 2000. Chromosome studies on nine South America species of *Vernonia* (Vernonieae, Asteraceae). Caryologia 53: 55–61.

De Vore, M. L. 1994. Systematic studies of Calyceraceae. Ph.D. Dissertation, Ohio State University, Columbus.

Diers, L. 1961. Der Anteil an Polyploiden in den Vegetations gurteln der Westkordillere Perus. Z. Bot. 49: 437–488.

Fedorov, A. A. (editor). 1974. Chromosome Numbers of Flowering Plants. Otto Koeltz Scientific Publications, Koenigstein.

Fernández Casas, J. 1981. Recuentos cromosomaticos de algunas angiospermas de Bolivia y Peru. Saussurea 12: 157–164.

Funk, V. A., R. J. Bayer, S. Keeley, R. Chan, R. Watson, B. Gemeinholzer, E. Schilling, J. L. Panero, B. G. Baldwin, N. Garcia-Jacas, A. Susanna & R. K. Jansen. 2005. Everywhere but Antarctica: Using a supertree to understand the diversity and distribution of the Compositae. Biol. Skr. 55: 343–374.

Gibbs, P. E. & R. Ingram. 1982. Chromosome numbers of some Brazilian flowering plants. Notes Bot. Gard. Edinburgh 40: 399–407.

Goldblatt, P. (editor). 1981. Index to Plant Chromosome Numbers, 1975–1978. Monogr. Syst. Bot. Missouri Bot. Gard. 5.

———. 1984. Index to Plant Chromosome Numbers, 1979–1981. Monogr. Syst. Bot. Missouri Bot. Gard. 8.

———. 1985. Index to Plant Chromosome Numbers, 1982–1983. Monogr. Syst. Bot. Missouri Bot. Gard. 13.

———. 1988. Index to Plant Chromosome Numbers, 1984–1985. Monogr. Syst. Bot. Missouri Bot. Gard. 23.

——— & D. E. Johnson (editors). 1990. Index to Plant Chromosome Numbers, 1986–1987. Monogr. Syst. Bot. Missouri Bot. Gard. 30.

——— & ———. 1991. Index to Plant Chromosome Numbers, 1988–1989. Monogr. Syst. Bot. Missouri Bot. Gard. 40.

——— & ———. 1994. Index to Plant Chromosome Numbers, 1990–1991. Monogr. Syst. Bot. Missouri Bot. Gard. 51.

——— & ———. 1996. Index to Plant Chromosome Numbers, 1992–1993. Monogr. Syst. Bot. Missouri Bot. Gard. 58.

——— & ———. 1998. Index to Plant Chromosome Numbers, 1994–1995. Monogr. Syst. Bot. Missouri Bot. Gard. 69.

——— & ———. 2000. Index to Plant Chromosome Numbers, 1996–1997. Monogr. Syst. Bot. Missouri Bot. Gard. 81.

——— & ———. 2003. Index to Plant Chromosome Numbers, 1998–2000. Monogr. Syst. Bot. Missouri Bot. Gard. 94.

Grashoff, J. L., M. W. Bierner & D. K. Northington. 1972. Chromosome numbers in North and Central American Compositae. Brittonia 24: 379–394.

Grau, J. 1987. Chromosomenzahlen chilenischer Mutisieen (Compositae). Bot. Jahrb. Syst. 108: 229–237.

Gustafsson, M. H. G., A. S.-R. Pepper, V. A. Albert & M. Kallersjo. 2001. Molecular phylogeny of the Barnadesioideae (Asteraceae). Nord. J. Bot. 21: 149–160.

Hunziker, J. H., A. Wulff, C. C. Xifreda & A. Escobar. 1989. Estudios cariologicos en Compositae. V. Darwiniana 29: 25–39.

Ito, M., T. Yahara, R. M. King, K. Watanabe, S. Oshita, J. Yokoyama & D. J. Crawford. 2000. Molecular phylogeny of Eupatorieae (Asteraceae) estimated from cpDNA and its implication for the polyploid origin hypothesis of the tribe. J. Pl. Res. 113: 91–96.

Jansen, R. K. & J. D. Palmer. 1987. Chloroplast DNA from lettuce and *Barnadesia* (Asteraceae): Structure, gene localization, and characterization of a large inversion. Curr. Genet. 11: 553–564.

——— & ———. 1988. Phylogenetic implication of chloroplast DNA restriction site variation in the Mutisieae (Asteraceae). Amer. J. Bot. 75: 751–764.

———, T. F. Stuessy, S. Dias-Piedrahita & V. A. Funk. 1984. Recuentos cromosomicos en Compositae de Colombia. Caldasia 14: 7–20.

Johnston, M. C. & B. L. Turner. 1962. Chromosome numbers of *Dyssodia* (Compositae–Tagetinae) and phyletic interpretations. Rhodora 64: 1–15.

Jones, S. B. 1982. In IOPB chromosome number reports LXXIV. Taxon 31: 126–127.

Kadereit, J. W. & C. Jeffrey. 1996. A preliminary analysis of cpDNA variation in the tribe Senecioneae (Compositae). Pp. 349–360 *in* D. J. N. Hind & H. S. Beentje (editors), Compositae: Systematics. Proceedings of the International Compositae Conference, Kew, 1994. Vol. 1. Royal Botanic Gardens, Kew.

Kamel, E. A. 1996. Studies on Some Relationships between Some Taxa in the Asteraceae. Ph.D. Thesis, Ain Shams University, Cairo.

Kim, H. G. & R. K. Jansen. 1995. *ndh*F Sequence evolution and the major clades in the sunflower family. Proc. Natl. Acad. Sci. U.S.A. 92: 10379–10383.

———, D. J. Lookerman & R. K. Jansen. 2002. Systematic implications of *ndh*F sequence variation in the Mutisieae (Asteraceae). Syst. Bot. 27: 598–609.

King, R. M., D. W. Kyhos, A. M. Powell, P. H. Raven & H. Robinson. 1976. Chromosome numbers in Compositae. XIII. Eupatorieae. Ann. Missouri Bot. Gard. 63: 862–888.

Moore, D. M. 1981. Chromosome numbers of Fuegian angiosperms. Bol. Soc. Brot. 53: 995–1012.

Moore, R. J. (editor). 1973. Index to Plant Chromosome Numbers 1967–1971. Regnum Veg. Vol. 90.

Olsen, J. 1980. In IOPB chromosome number reports LXVII. Taxon 29: 346–367.

Panero, J. L. & V. A. Funk. 2002. Toward a phylogenetic subfamilial classification for the Compositae (Asteraceae). Proc. Biol. Soc. Washington 115: 909–922.

Pinkava, D. J. & D. J. Keil. 1977. Chromosome counts of Compositae from the United States and Mexico. Amer. J. Bot. 64: 680–686.

Powell, A. M. & R. M. King. 1969. Chromosome numbers in Compositae: Colombian species. Amer. J. Bot. 56: 116–121.

——— & S. A. Powell. 1978. Chromosome numbers in Asteraceae. Madroño 25: 160–169.

Rahn, K. 1960. Chromosome numbers in some South American angiosperms. Bot. Tidsskr. 56: 117–127.

Raven, P. H., D. W. Kyhos & A. J. Hill. 1965. Chromosome numbers of spermatophytes, mostly California. Aliso 6: 105–113.

Robinson, H., A. M. Powell, R. M. King & J. F. Weedin. 1981. Chromosome numbers in Compositae XII: Heliantheae. Smithsonian Contr. Bot. 52: 1–28.

Rodriquez Correira, M. C., W. T. Ormond & M. C. Bezerra Pinheiro. 1977. Contribucao a citologia de *Acicarpha spathulata* R. Brow., Calyceraceae. Bol. Mus. Nac. 45: 1–6.

Ruas, P. M., C. F. Ruas, A. O. S. Vieira, N. I. Matzenbacher & N. S. Martins. 1991. Cytogenetics of genus *Vernonia* Schreber (Compositae). Cytologia 56: 239–247.

Schnack, B. & G. Covas. 1947. Estudios cariologicos en antofitas. Haumania 1: 32–41.

Solbrig, O. T. 1977. Chromosomal cytology and evolution in the family Compositae. Pp. 267–281 *in* V. H. Heywood, J. B. Harborn & B. L. Turner (editors), The Biology and Chemistry of the Compositae, Vol. 1. Academic Press, London.

Spooner, D. M., D. C. De Jong, B. Y. Sun, T. F. Stuessy, K. M. Gengler, G. L. Nesom & P. E. Berry. 1995. Chromosome counts of Compositae from Ecuador and Venezuela. Ann. Missouri Bot. Gard. 82: 596–602.

Stebbins, G. L. 1950. Variation and Evolution in Plants. Columbia Univ. Press, New York.

Strother, J. L. 1989. Chromosome numbers in *Thymophylla* (Compositae:Tageteae). Sida 13: 351–358.

——— & J. L. Panero. 2001. Chromosome studies: Mexican Compositae. Amer. J. Bot. 88: 499–502.

Stuessy, T. F. & A. A. Sagastegui. 1993. Revision de *Arnaldoa* (Compositae, Barnadesioideae) genero endemico del norte del Peru. Arnaldoa 1: 9–21.

———, T. Sang & M. L. De Vore. 1996. Phylogeny and biogeography of the subfamily Barnadesioideae with implications for early evolution of the Compositae. Pp. 463–490 *in* D. J. N. Hind & H. S. Beentje (editors), Compositae: Systematics. Proceedings of the International Compositae Conference, Kew, 1994. Vol. 1. Royal Botanic Gardens, Kew.

Sugiura, T. 1936. A list of chromosome numbers in angiosperms plants. II. Proc. Imp. Acad. Japan 12: 144–146.

———. 1937. Studies on the chromosome numbers in higher plants, with special references to cytokinesis. II. Cytologia 2: 845–849.

Sundberg, S., C. P. Cowan & B. L. Turner. 1986. Chromosome counts of Latin American Compositae. Amer. J. Bot. 73: 33–38.

Turner, B. L. 1978. In IOPB chromosome number reports LXII. Taxon 27: 519–535.

———. 1987. Taxonomy of *Carphochaete* (Asteraceae–Eupatorieae). Phytologia 64: 145–162.

———, A. M. Powell & J. Cuatrecasas. 1967. Chromosome numbers in the Compositae (XI) Peruvian species. Ann. Missouri Bot. Gard. 54: 172–177.

———, J. Bacon, L. Urbatsch & B. Simpson. 1979. Chromosome numbers in South American Compositae. Amer. J. Bot. 66: 173–178.

Vuilleumier, B. S. 1969. The systematics and evolution of *Perezia* sect. Perezia (Compositae). Contr. Gray Herb. 199: 3–163.

Waisman, C. E., E. Rozenblum & J. H. Hunziker. 1984. Estudios cariologicos en Compositae I. Darwiniana 25: 217–226.
Ward, D. E. 1983. Chromosome counts from New Mexico and southern Colorado. Phytologia 54: 302–309.
Watanabe, K., R. M. King, T. Yahara, M. Ito, J. Yokoyama, T. Suzuki & D. J. Crawford. 1995. Chromosome cytology and evolution in Eupatorieae (Asteraceae). Ann. Missouri Bot. Gard. 82: 581–592.
———, P. S. Short, T. Denda, Y. Suzuki, M. Ito, T. Yahara & K. Kosuge. 1996. Chromosome numbers determinations in the Australian Astereae (Asteraceae). Muelleria 9: 197–228.
———, ———, ———, N. Konishi, M. Ito & K. Kosuge. 1999a. Chromosome numbers and karyotypes in the Australian Gnaphalieae and Plucheeae (Asteraceae). Austral. Syst. Bot. 12: 781–802.
———, T. Yahara, T. Denda & K. Kosuge. 1999b. Chromosomal evolution in the genus *Brachyscome* (Asteraceae, Astereae): Statistical tests regarding correlation between changes in karyotype and habit using phylogenetic information. J. Pl. Res. 112: 145–161.
———, ———, A. Soejima & M. Ito. 2001. Mexican species of the genus *Stevia* (Eupatorieae, Asteraceae): Chromosome numbers and geographical distribution. Pl. Spec. Biol. 16: 49–68.
Wulff, A. F. 1990. Estudios cromosomicos en Barnadesiinae (Mutisieae, Asteraceae). *I. Chuquiraga* y *Doniophyton*. Darwiniana 30: 185–193.
———, J. H. Hunziker & A. Escobar. 1996. Estudios cariologios en Compositae. VII. Darwiniana 34: 213–231.
Zardini, E. M. H. 1975. Revision del genero *Trichocline* (Compositae). Darwiniana 19: 618–733.

APPENDIX 1. New chromosome number counts and voucher data for species of Asteraceae and Calyceraceae. *First report for species, **first report for genus.

CALYCERACEAE

Acicarpha spathulata R. Br. 2*n* = 8II. Brazil. Sao Paulo: Itanhaem, Nova Itanhaem, *Watanabe & Nagatani 205* (GHSP, KYO).

ASTERACEAE

Barnadesieae

**Barnadesia caryophylla* (Vell.) S. F. Blake. 2*n* = 54. Brazil. Goias: 11 km SW from Colinas do Sul to Niquelandia, *Watanabe & Nagatani 232* (GHSP, KYO); 2*n* = 54. Brazil. Goiás: 13 km SW from Colinas do Sul to Niquelandia, *Watanabe & Nagatani 234* (GHSP, KYO).
***Dasyphyllum brasiliense* (Spreng.) Cabrera var. *brasiliense*. 2*n* = 54. Brazil. Minas Gerais: 13 km SE from Carandai, *Watanabe & Nagatani 43 & 46* (GHSP, KYO); 2*n* = 54. Brazil. São Paulo: cultivated in Jardim Botanico do Estado de São Paulo, *Watanabe & Nagatani 258* (GHSP, KYO).
***Dasyphyllum brasiliense* (Spreng.) Cabrera var. *multiflorum* (Baker) Cabrera. 2*n* = 54. Brazil. Paraná: 54 km NE from Curitiba, *Watanabe & Nagatani 133* (GHSP, KYO).
***Dasyphyllum flagellare* (Casar.) Cabrera. 2*n* = 54. Brazil. Minas Gerais: ca. 13 km from Corrego do Bom Jesus to Pedra de São Domingo, *Watanabe & Nagatani 109* (GHSP, KYO).
***Dasyphyllum spinescens* (Less.) Cabrera. 2*n* = 54. Brazil. Minas Gerais: ca. 13 km from Corrego do Bom Jesus to Pedra de São Domingo, *Watanabe & Nagatani 108* (GHSP, KYO).
***Dasyphyllum tomentosum* (Spreng.) Cabrera var. *tomentosum*. 2*n* = 54. Brazil. Santa Catarina: E Catanduvas along BR282, *Watanabe & Nagatani 144* (GHSP, KYO).
***Dasyphyllum tomentosum* (Spreng.) Cabrera var. *multiflorum* (Baker) Cabrera. 2*n* = 54. Brazil. Santa Catarina: 14 km N from Santa Cecilia, *Watanabe & Nagatani 139* (GHSP, KYO).
***Dasyphyllum trichophyllum* (Baker) Cabrera. 2*n* = 54. Brazil. Minas Gerais: São Tome das Letras, *Watanabe & Nagatani 96* (GHSP, KYO).

Mutisieae

**Chaptalia graminifolia* (Dusen) Cabrera. 2*n* = 48 + 0–7Bs. Brazil. Paraná: waterfall of Mariquinha, 34 km from Ponta Grossa, *Watanabe & Nagatani 174* (GHSP, KYO).
Chaptalia integrifolia (Cass.) Baker. 2*n* = 48. Brazil. São Paulo: 26 km SE from Cunha, *Watanabe & Nagatani 24* (GHSP, KYO). 2*n* = 48. Brazil. Minas Gerais: 27 km SW from Barbacena to Ibertioga, *Watanabe & Nagatani 61* (GHSP, KYO); 2*n* = 48. Brazil. Paraná: waterfall of Mariquinha, 34 km from Ponta Grossa, *Watanabe & Nagatani 177* (GHSP, KYO); 2*n* = 48. Brazil. Santa Catarina: 13 km NE of São Joaquim, *Yahara et al. B317* (GHSP, KYO).
Chaptalia mandonii (Sch. Bip.) Burkart. 2*n* = 48. Brazil. São Paulo: 26 km SE from Cunha, *Watanabe & Nagatani 25* (GHSP, KYO).
Chaptalia nutans (L.) Polak. 2*n* = 48. Brazil. São Paulo: 17 km SE from Cunha to Parati, *Watanabe & Nagatani 8 & 9* (GHSP, KYO); 2*n* = 48. Brazil. São Paulo: 26 km SE from Cunha, *Watanabe & Nagatani 23* (GHSP, KYO); 2*n* = 48. Brazil. Santa Catarina: the W entrance of Campos Novos BR470, *Watanabe & Nagatani 142* (GHSP, KYO).
**Chaptalia runcinata* Kunth. 2*n* = 48. Brazil. Paraná: waterfall of Mariquinha, 34 km from Ponta Grossa, *Watanabe & Nagatani 185* (GHSP, KYO).
**Jungia sellowii* Less. 2*n* = 20II. Brazil. Santa Catarina: 13 km N of Urubici, *Yahara et al. B291* (GHSP, KYO).
**Mutisia campanulata* Less. 2*n* = 52. Brazil. São Paulo: 3 km from Campode Jordao to Petra do Bau, *Watanabe & Nagatani 113* (GHSP, KYO); 2*n* = 52. Brazil. São Paulo: ca. 10 km from Campos do Jordao to Santo Antonio do Pinhal through Lageado, *Watanabe & Nagatan 114* (GHSP, KYO).
Mutisia sp. 2*n* = 52. Chile. *Ito 021501-2* (KANA).
***Stifftia chrysantha* Mikan var. *chrysantha*. 2*n* = 54. Brazil. Rio de Janeiro: cultivated in Jardim Botanico do Estado de Rio de Janeiro, *Watanabe & Nagatani s.n.* (GHSP, KYO).
***Stifftia chrysantha* Mikan var. *fravicans* Toredo ex Dedecca. 2*n* = 54. Brazil. São Paulo: cultivated in Jardim Botanico do Estado de São Paulo, *Watanabe & Nagatani 257* (GHSP, KYO).
**Trichocline catharinensis* Cabrera var. *catharinensis*. 2*n* = 38. Brazil. Santa Catarina: 2.5 km SW of Lages, *Watanabe & Nagatani 146* (GHSP, KYO).
Trixis antimenorrhoea (Schrank) Mart. ex Baker. 2*n* = 54. Brazil. Minas Gerais: 67 km SW from Barbacena, *Watanabe & Nagatani 72* (GHSP, KYO).
**Trixis praestans* (Vell.) Cabrera. 2*n* = 54. Brazil. São Paulo: 18 km SE from Cunha to Parati, *Watanabe & Nagatani 11* (GHSP, KYO); 2*n* = 54. Brazil. São Paulo: 26 km SE from Cunha, *Watanabe & Nagatani 28* (GHSP, KYO); 2*n* = 54. Brazil. Minas Gerais: ca. 10 km from corrego do

Bom Jesus to Pedra de São Domingo, *Watanabe & Nagatani 104* (GHSP, KYO).

Vernonieae

**Eremanthus bicolor* (DC.) Baker. 2*n* = 30. Brazil. Goiás: 44 km NE from Niquelandia, *Watanabe & Nagatani 236* (GHSP, KYO).

Eremanthus sp. 1. 2*n* = 30. Brazil. Goiás: 15 km N of GO118 from Brasilia to Planaltina, *Watanabe & Nagatani 210* (GHSP, KYO).

Eremanthus sp. 2. 2*n* = 34. Brazil. São Paulo: 2.5 km SE from Cunha to Parati, *Watanabe & Nagatani 15* (GHSP, KYO).

Eremanthus sp. 3. 2*n* = 17II. Brazil. Rio de Janeiro: 4 km S of Petropolis, *Watanabe & Nagatani 35* (GHSP, KYO).

**Vernonia florida* Gardner. 2*n* = 34. Brazil. Paraná: 3 km W of São Luis do Puruna, *Yahara et al. B208* (GHSP, KYO).

**Vernonia hypochaeris* DC. 2*n* = 17II. Brazil. Santa Catarina: Morro do Quiriri, *Yahara et al. B134* (HGS, KYO, P); 2*n* = 34. Brazil. Paraná: 3 km W of São Luis do Puruna, *Yahara et al. B235* (GHSP, KYO).

Vernonia nitidula Less. 2*n* = 17II. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B261* (GHSP, KYO).

Vernonia polyanthes Less. 2*n* = 34. Brazil. São Paulo: 26 km SE from Guaratingueta to Cunha, *Watanabe & Nagatani 1* (GHSP, KYO); 2*n* = 34+0–2Bs. Brazil. São Paulo: 26 km SE from Guaratingueta to Cunha, *Watanabe & Nagatani 3* (GHSP, KYO).

Vernonia scorpioides (Lam.) Pers. 2*n* = 34. Brazil. Rio de Janeiro: Petropolis, 5 km S of Petropolis, *Watanabe & Nagatani 32* (GHSP, KYO); 2*n* = 17II. Brazil. São Paulo: Nova Itanhaem, sandy beach, *Watanabe & Nagatani 206* (GHSP, KYO).

Vernonia sp. 1. 2*n* = 34. Brazil. Goiás: 32 km W from Niquelandia to Uruacu, *Watanabe & Nagatani 237* (GHSP, KYO).

**Vernonia* sp. 2. 2*n* = 17II. Brazil. Paraná: E limit of Guarapuava, *Yahara et al. B166* (GHSP, KYO).

Gnaphalieae

Achyrocline alata DC. 2*n* = 14II. Brazil. Santa Catarina: 15 km N of Urubici. *Yahara et al. B302* (GHSP, KYO).

Achyrocline satureioides DC. 2*n* = 14II. Brazil. Santa Catarina: 15 km N of Urubici, *Yahara et al. B303* (GHSP, KYO).

**Angianthus micropodioides* (Benth.) Benth. 2*n* = 12II. Australia. W Australia: 2 km W of Hines Hill township, *Short 4449* (MEL, TI).

***Dithyrostegia amplexicaulis* A. Gray. 2*n* = 14. Australia. W Australia: 12 km W of Pindar, *Short 4489* (MEL, TI).

***Epitriche demissus* (A. Gray) P. S. Short. 2*n* = 10. Australia. W Australia: 5 km from Morawa on rd. to Perenjori, *Short 4508* (MEL, TI).

**Erymophyllum ramosum* subsp. *ramosum* (A. Gray) Paul G. Wilson. 2*n* = 12II. Australia. W Australia: 138.9 km W from Balladonia, *Watanabe et al. 344* (MEL, TI).

Leptorhynchos squamatus (Labill.) Less. 2*n* = 12II. Australia. Victoria: 36 km W of Mitre, *Watanabe et al. 303* (MEL, TI).

**Podotheca uniseta* P. S. Short. 2*n* = 26. Australia. W Australia: 7 km S of Bunjil along rd. to Latham, *Short 4512* (MEL, TI).

Waitzia acuminata Steetz. 2*n* = 12II. Australia. W Australia: 18 km S of Binnu, *Short 4492 & 4493* (MEL, TI).

Astereae

Baccharis anomala DC. 2*n* = 18. Brazil. São Paulo: Cunha, 17 km SE from Cunha to Parati, *Watanabe & Nagatani 9* (GHSP, KYO); 2*n* = 9II + BII. Brazil. Paraná: E of Guarapuava, *Yahara et al. B180* (GHSP, KYO); 2*n* = 9II. Brazil. Santa Catarina: 13 km NE of São Joaquim, *Yahara et al. B310* (GHSP, KYO).

**Baccharis pentodonta* Malme. 2*n* = 9II. Brazil. Paraná: 3 km W of São Luis do Puruna, *Yahara et al. B211* (GHSP, KYO).

**Baccharis triplinervis* Baker. 2*n* = 18. Brazil. Santa Catarina: W entrance of Campos Novos BR470, *Watanabe & Nagatani 143* (GHSP, KYO).

Noticastrum acuminatum (DC.) Cuatrec. 2*n* = 18. Brazil. Santa Catarina: 5 km S of Campo Alegre, *Yahara et al. B228* (GHSP, KYO); 2*n* = 9II. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B254* (GHSP, KYO).

Symphyotrichum graminifolium (Spreng.) G. L. Nesom. 2*n* = 18 + 0–2Bs. Brazil. Santa Catarina: Serra da Anta Gorda, 13 km N of Urubici, *Yahara et al. B289* (GHSP, KYO).

Plucheeae

Pluchea sagittalis (Lam.) Cabrera. 2*n* = 10II. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B257* (GHSP, KYO).

Helenieae

Chrysactinia truncata S. Watson. 2*n* = 30. Mexico. Nuevo León: 3 km W from San Juan Bautista, *Yahara et al. 1458* (KYO, MEXU).

Dyssodia papposa (Vent.) Hitchc. 2*n* = 26. Mexico. Coahuila: 15 km WNW of Coahuila–Nuevo Leon State border on Mex 57, *Yahara et al. 1467* (KYO, MEXU).

Dyssodia tagetiflora Lag. 2*n* = 26. Mexico. Nuevo León: 29.4 km NW from Galeana, *Yahara et al. 1438* (KYO, MEXU).

Espejoa mexicana DC. 2*n* = 18. Mexico. Guerrero: 1.5 km E of aeropuerto on Mex 200, *Yahara et al. 2001* (KYO, MEXU).

Florestina tripteris DC. 2*n* = 20. Mexico. Nuevo León: 7.6 km E of Salida to General Bravo on hwy. 40D, *Yahaar et al. 1460* (KYO, MEXU).

Marshallia mohrii Beadle & F. E. Boynton. 2*n* = 36. U.S.A. Missouri: *Yahara & Mishima s.n.* (KYO).

Palafoxia texana DC. 2*n* = 22. Mexico. Veracruz: Playa palma Sola, *Yahara et al. 1365* (KYO, MEXU).

Porophyllum macrocephalum DC. 2*n* = 22. Mexico. Oaxaca: Village of Sta. Maria Petapa, *Yahara et al. 1372* (KYO, MEXU).

Strotheria gypsophila B. L. Turner. 2*n* = 16. Mexico. Nuevo León: 3 km W from Hwy. 57, salida to El Refugio, *Yahara et al. 142* (KYO, MEXU).

Thymophylla aurea (A. Gray) Greene. 2*n* = 16. Mexico. Coahuila: 8.5 km N of Bermejillo, *Yahara et al. 1497* (KYO, MEXU).

Thymophylla gentryi (M. C. Johnst.) Strother. 2*n* = 16 + 0–1B. Mexico. Coahuila: 15 km W of Mex 30 and Mex 45 jct., *Yahara et al. 1505* (KYO, MEXU).

Thymophylla pentachaeta (DC.) Small var. *pentachaeta*. 2*n* = 24. Mexico. Nuevo León: 2.1 km SE of Zaragoza, *Yahara et al. 1414* (KYO, MEXU); 2*n* = 24. Mexico. Coahuila: 15 km WNW of Coahuila–Nuevo León State border on Mex 57, *Yahara et al. 1466* (KYO, MEXU).

Thymophylla pentachaeta (DC.) Small var. *hartwegii* (A. Gray) Strother. 2*n* = 26. Mexico. Nuevo León: 79 km from Monterrey to Sabinas Hidalgo on 85 Libre, *Yahara et al. 463* (KYO, MEXU).

Urbinella palmeri Greenm. 2*n* = 16. Mexico. Durango: 49 km W of Durango City on Mex 40, *Yahara et al. 1507* (KYO, MEXU).

Heliantheae

Galinsoga parviflora Cav. 2*n* = 16II. Brazil. Santa Catarina: 13 km N of Urubici, *Yahara et al. B299* (GHSP, KYO).

Jaegeria hirta (Lag.) Less. 2*n* = 18II. Brazil. Santa Catarina: 13 km N of Urubici, *Yahara et al. B292* (GHSP, KYO).

Tithonia speciosa (Hook.) Hook. ex Griseb. 2n = 17II. Brazil. Minas Gerais: 4 km SW from Marbacena to Ibertiega, *Watanabe & Nagatani 52* (GHSP, KYO).

**Verbesina clausseni* Sch. Bip. ex Baker. 2n = 17II. Brazil. Santa Catarina: Morro do Quiriri, *Yahara et al. B233* (GHSP, KYO).

Eupatorieae

Ageratina cardiophylla (B. L. Rob.) R. M. King & H. Rob. 2*n* = 68. Mexico. Michoacan: 9 km W from jct. to Zinapecuaro, *Yahara et al. 72* (KYO, MEXU).

**Ageratina hintonii* R. M. King & H. Rob. 2*n* = 34 + 0–2Bs. Mexico. Guerrero: 64 km SW from Filo de Caballo, *Yahara et al. 54* (KYO, MEXU).

Ageratina sp. 2*n* = 34. Mexico. Michoacan: 38 km E of Morelia, *Yahara et al. 73* (KYO, MEXU).

**Carphochaete wislizeni* A. Gray. 2*n* = 22. Mexico. Chihuahua: 31.7 km W from Parral on Mex 24, *Yahara et al. 733* (KYO, MEXU).

**Chromolaena horminoides* DC. 2*n* = 30. Brazil. Goiás: Serra dos Pirineus. 13 km W from Pirenopolis, *Watanabe & Nagatani 243* (GHSP, KYO).

**Chromolaena kleinii* (Cabrera) R. M. King & H. Rob. 2*n* = 10II. Brazil. Santa Catarina: 13 km N of Urubici, *Yahara et al. B298* (GHSP, KYO).

Chromolaena laevigata (Lam.) R. M. King & H. Rob. 2*n* = 60. Brazil. São Paulo: 21 km SE from Cunha to Pedra de Macela, *Watanabe & Nagatani 19* (GHSP, KYO).

**Chromolaena oinopolepis* (Malme) R. M. King & H. Rob. 2*n* = 10II + 10I, 6III + 4II + 4I. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B281* (GHSP, KYO).

**Chromolaena pedunculosa* (Hook. & Arn.) R. M. King & H. Rob. 2*n* = 10II + 10I, 8III + 2II + 2I. Brazil. Paraná: Serra da Esperanca, *Yahara et al. B159* (GHSP, KYO); 2*n* = 20II + 10I, 2*n* = 30. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B262 & B276* (GHSP, KYO).

Cronquistia pringlei (S. Watson) R. M. King. 2*n* = 24. Mexico. Chihuahua: 95.7 km SW from Parral on Mex 24, *Yahara et al. 735* (KYO, MEXU).

**Decachaeta haenkeana* DC. 2*n* = 32. Mexico. Guerrero: 24 km S of Chilpansingo, *Yahara et al. 60* (KYO, MEXU).

Erythradenia pyramidalis (B. L. Rob.) R. M. King & H. Rob. 2*n* = 32. Mexico. Guerrero: 24 km S of Chilpansingo, *Yahara et al. 59* (KYO, MEXU).

Gyptis crassipes (Hieron.) R. M. King & H. Rob. 2*n* = 30. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B284* (GHSP, KYO).

Macvaughiella mexicana (Sch. Bip.) R. M. King & H. Rob. 2*n* = 24 + 4–8Bs. Mexico. Oaxaca: 7 km SW of El Cameron, *Yahara & Soejima 372* (KYO, MEXU).

Microspermum debile Benth. 2*n* = 24. Mexico. Guerrero: 64 km SW from Filo de Caballo, *Yahara et al. 53* (KYO, MEXU).

Microspermum nummulariaefolium Lag. 2*n* = 36. Mexico. Guerrero: 14.8 km N of jct. to Ixtateopan, *Yahara & Soejima 239* (KYO, MEXU).

Mikania sp. 2*n* = 34. Brazil. Minas Gerais: Conceicão do Ibitipoca, Serra de Ibitipoca, *Watanabe & Nagatani 84* (GHSP, KYO).

Oxylobus adscendens B. L. Rob. & Greenm. 2*n* = 32. Mexico. Hidalgo: 8 km N from jct. to Mineral del Chico, *Yahara et al. 9* (KYO, MEXU).

**Praxelis missiona* (Malme) R. M. King & H. Rob. 2*n* = 80. Brazil. São Paulo: 2 km N from Campos do Jordão, *Yahara et al. B128* (GHSP, KYO).

Piqueria pilosa Kunth. 2*n* = 24. Mexico. Mexico: 29 km W of Jalatlaca, *Yahara et al. 90* (KYO, MEXU).

***Revealia macrocephala* (Paray) R. M. King & H. Rob. 2*n* = 22. Mexico. Guerrero: 76 km SW from Filo de Caballo, *Yahara et al. 56* (KYO, MEXU).

**Stevia alternifolia* Hieron. 2*n* = 11II + 0–1B, 2*n* = 22. Brazil. Paraná: 3 km W of Palmeira, *Yahara et al. B190* (GHSP, KYO); 2*n* = 11II. Brazil. Paraná: Rio dos Papagoios, *Yahara et al. B216* (GHSP, KYO).

**Stevia bangii* Rusby. 2*n* = 44 + 0–5Bs. Bolivia. Laja: *Ito 010209-2* (KANA).

Stevia camachensis Hieron. 2*n* = 22. Bolivia. Comarapa to Matara: *Ito ASA199-1* (KANA).

**Stevia cinerascens* Sch. Bip. ex Baker. 2*n* = 22. Brazil. Santa Catarina: 2.5 km SW of Lages, *Yahara et al. B58* (GHSP, KYO); 2*n* = 22. Brazil. Santa Catarina: 27 km S from Lages, *Yahara et al. B66 & B67* (GHSP, KYO); 2*n* = 11II, 2*n* = 22. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B251 & B252* (GHSP, KYO).

**Stevia clausseni* Sch. Bip. ex Baker. 2*n* = 22. Brazil. Santa Catarina: 14 km E of Bom Joaquim da Serra, *Yahara et al. B89* (GHSP, KYO); 2*n* = 22. Brazil. Santa Catarina: 18 km E of Bom Joaquim da Serra, *Yahara et al. B99* (GHSP, KYO).

Stevia clinopodioides Greenm. 2*n* = 36 + 0–4Bs. Mexico. Nuevo León: Cerro Potosi, *Yahara et al. 1440* (MEXU, KYO).

Stevia coahuilensis Soejima & Yahara. 2*n* = 33. Mexico. Coahuila: 0.4 km E of Montereal, *Yahara et al 1668* (KYO, MEXU); 2*n* = 33. Mexico. Coahuila: 9.4 km E of Montereal, *Yahara et al. 1696* (KYO, MEXU); 2*n* = 44. Mexico. Nuevo León: 3.3 km W of Dieciocho de Marzo, *Yahara et al. 1794* (KYO, MEXU).

Stevia commixta B. L. Rob. 2*n* = 22, 22,+,2–3Bs. Brazil. São Paulo: 2 km N of jct. from Campos do Jordao to Pedra do Bau, *Yahara et al. B1, B3 & B5* (GHSP, KYO); 2*n* = 22. Brazil. São Paulo: 15 km N from Campos do Jordão to Pedra do Bau, *Yahara et al. B11 & B12* (GHSP, KYO).

Stevia decussata Baker. 2*n* = 22. Brazil. Minas Gerais: Pico de São Domingo, *Yahara et al. B18* (GHSP, KYO).

Stevia hintoniorum B. L. Turner. 2*n* = 22. Mexico. Coahuila: 5.2 km E of Montereal, *Yahara et al. 1695* (Type 1) (KYO, MEXU); 2*n* = 33. Mexico. Coahuila: 0.4 km E of Montereal, *Yahara et al. 1665* (KYO, MEXU); 2*n* = 33 + 1B. Mexico. Coahuila: 4.7 km E of Montereal, *Yahara et al. 1678* (KYO, MEXU); 2*n* = 44. Mexico. Nuevo León: 17 km W of Dieciocho de Marzo, *Yahara et al. 1795 & 1796* (KYO, MEXU); 2*n* = 44 + 1B. Mexico. Coahuila: 15.2 km E of Montereal, *Yahara et al. 1692* (Type 1) (KYO, MEXU).

Stevia incognita Grashoff. 2*n* = 33 + 1–3Bs. Mexico. Coahuila: 11.3 km E of Montereal, *Yahara et al. 1704* (KYO, MEXU); 2*n* = 44 + 0–2Bs. Mexico. Nuevo León: 17 km NE of San Antonio Pena Nevada, *Yahara et al. 1569* (KYO, MEXU).

Stevia jorullensis Kunth. 2*n* = 36. Mexico. Nuevo León: 4.8 km W of San Ishidro, *Yahara et al. 1645* (KYO, MEXU); 2*n* = 36. Mexico. Nuevo León: 5.8 km W of San

Ishidro, *Yahara et al. 1650* (KYO, MEXU); $2n = 36$. Mexico. Nuevo León: 15 km E of San Antonio de las Alazanas, *Yahara et al. 1662* (KYO, MEXU); $2n = 36$. Mexico. Coahuila: 10.1 km E of Jame, *Yahara et al. 1717* (KYO, MEXU); $2n = 36$. Mexico. Nuevo León: 11.6 km SE of Zaragoza, *Yahara et al. 1814* (KYO, MEXU); $2n = 36 + 0–1B$. Mexico. Nuevo León: 6.9 km SE of Zaragoza, *Yahara et al. 1808* (KYO, MEXU).

Stevia leptophylla Sch. Bip. ex Baker. $2n = 22 + 0–1B$. Brazil. Paraná: 6 km E of São Luis do Puruna, *Yahara et al. B151* (GHSP, KYO); $2n = 11II$. Brazil. Paraná: E limit of Lapa, *Yahara et al. B223* (GHSP, KYO).

**Stevia lundiana* DC. $2n = 22, 22 + 1B$. Brazil. São Paulo: 2 km N of Campos do Jordão to Pedra do Bau, *Yahara et al. B2 & B4* (GHSP, KYO); $2n = 22$. Brazil. Santa Catarina: 2.5 km S from Lages, *Yahara et al. B49* (GHSP, KYO); $2n = 22$. Brazil. Santa Catarina: 27 km S from Lages, *Yahara et al. B75* (GHSP, KYO); $2n = 11II$, $2n = 22$. Brazil. Santa Catarina: 15 km N of Urubici, *Yahara et al. B300* (GHSP, KYO); $2n = 22$. Brazil. Santa Catarina: 13 km NE of São Joaquim, *Yahara et al. B311* (GHSP, KYO).

**Stevia mitopoda* B. L. Rob. $2n = 24$. Mexico. Puebla: 21 km SE of Izcar de Matamoros on Mex 160, *Yahara et al. 1022* (KYO, MEXU).

**Stevia myriadenia* Sch. Bip. ex Baker. $2n = 11II$, $2n = 22$. Brazil. Santa Catarina: 15 km N of Urubici, *Yahara et al. B308 & B309* (GHSP, KYO).

Stevia nepetifolia Kunth. $2n = 33 + 3Bs$. Mexico. Coahuila: 0.4 km E of Montereal, *Yahara et al. 1667* (KYO, MEXU); $2n = 33$. Mexico. Coahuila: 4.7 km E of Montereal, *Yahara et al. 1669* (Type 2) (KYO, MEXU); $2n = 33 + 1B$. Mexico. Coahuila: 5.2 km E of Montereal, *Yahara et al. 1694* (Type 2) (KYO, MEXU); $2n = 44 + 1–4Bs$. Mexico. Nuevo León: 20 km NE from San Antonio Pena Nevada, *Yahara et al. 1596* (KYO, MEXU).

Stevia ophryophylla B. L. Rob. $2n = 11II$, $2n = 22$. Brazil. Paraná: E limit of Lapa, *Yahara et al. B220* (GHSP, KYO).

Stevia organensis Gardner. $2n = 22$. Brazil. São Paulo: Pedra do Bau, *Yahara et al. B8 & B148* (GHSP, KYO).

Stevia ovata Willd. $2n = 22 + 0–2Bs$. Mexico. Nuevo León: 6 km W of Cola de Caballo, *Yahara et al. 1619* (KYO, MEXU); $2n = 33 + 0–2Bs$. Mexico. Coahuila: 10.1 km E of Jame, *Yahara et al. 1715* (KYO, MEXU); $2n = 33 + 3Bs$. Mexico. Nuevo León: 69 km SE of Zaragoza, *Yahara et al. 1806* (KYO, MEXU); $2n = 33 + 2–3Bs$. Mexico. Coahuila: 5.2 km E of Montereal, *Yahara et al. 1693* (KYO, MEXU); $2n = 33 + 3–8Bs$. Mexico. Nuevo León: 8.2 km W of San Ishidro, *Yahara et al. 1654* (KYO, MEXU); $2n = 44 + 2Bs$. Mexico. Nuevo León: 20 km NE from San Antonio Pena Nevada, *Yahara et al. 1600* (KYO, MEXU).

**Stevia parvifolia* Hassl. $2n = 11II$, $2n = 22$. Brazil. Santa Catarina: Morro do Quiriri, *Yahara et al. B232* (GHSP, KYO).

Stevia pilosa Lag. $2n = 33$. Mexico. Nuevo León: 3.3 km W of Dieciocho de Marzo, *Yahara et al. 1786* (KYO, MEXU); $2n = 33$. Mexico. Coahuila: 15 km E from San Antonio de las Alazanas, *Yahara et al. 1663* (KYO, MEXU); $2n = 33 + 0–1B$. Mexico. Nuevo León: 20 km NE from San Antonio Pena Nevada, *Yahara et al. 1576* (KYO, MEXU); $2n = 44$. Mexico. Coahuila: 4.7 km E of Montereal, *Yahara et al. 1679* (KYO, MEXU); $2n = 44$. Mexico. Coahuila: 15.2 km E of Montereal, *Yahara et al. 1691* (KYO, MEXU).

Stevia porphyrea McVaugh. $2n = 44$. Mexico. Nuevo León: 1 km W of San Ishidro, *Yahara et al. 1640* (KYO, MEXU).

Stevia potosina Soejima Yahara & K. Watan. $2n = 33$. Mexico. Nuevo León: 15 km E of San Antonio de las Alazanas, *Yahara et al. 1661* (KYO, MEXU); $2n = 33$. Mexico. Coahuila: 10 km E of Montereal, *Yahara et al. 1680* (KYO, MEXU); $2n = 33$. Mexico. Nuevo León: 3.3 km W of Dieciocho de Marzo, *Yahara et al. 1776* (KYO, MEXU); $2n = 33$. Mexico. Nuevo León: 12 km W of Dieciocho de Marzo, *Yahara et al. 1800* (KYO, MEXU); $2n = 33 + 0–1B$. Mexico. Coahuila: 10.1 km E of Jame, *Yahara et al. 1716* (KYO, MEXU).

Stevia purpusii B. L. Rob. $2n = 36$. Mexico. Morelos: Steep mtn. above Tepoztlan, *Yahara et al. 2029* (KYO, MEXU).

Stevia selloi Sch. Bip. ex Baker. $2n = 22$. Brazil. Santa Catarina: 2.5 km SW of Lagas, *Yahara et al. B51* (GHSP, KYO); $2n = 22$. Brazil. Santa Catarina: 27 km S from Lagas, *Yahara et al. B65* (GHSP, KYO); $2n = 11II$. Brazil. Paraná: 3 km W of Palmeira, *Yahara et al. B191* (GHSP, KYO).

Stevia serrata Cav. var. *serrata*. $2n = 44$. Mexico. Coahuila: 4.7 km E of Montereal, *Yahara et al. 1671* (KYO, MEXU); $2n = 44 + 1B$. Mexico. Coahuila: 4.7 km E of Montereal, *Yahara et al. 1670* (KYO, MEXU); $2n = 44 + 1–2Bs$. Mexico. Nuevo León: 20 km NE from San Antonio Pena Nevada, *Yahara et al. 1585* (KYO, MEXU).

Stevia setifera Rusby ex B. L. Rob. $2n = 22$. Bolivia. Unduavi: *Ito 15-2st* (KANA).

Stevia sp. 2. $2n = 22$. Bolivia. Sta Cruz New Rd., near Siberia, *Ito 0102095-2* (KANA).

**Stevia tenuis* Hook. & Arn. $2n = 22$. Brazil. Santa Catarina: 14 km E of Bom Joaquim da Serra, *Yahara et al. B97* (GHSP, KYO).

Stevia tephra B. L. Rob. $2n = 33 + 1–2Bs$. Mexico. Nuevo León: 1 km W of San Ishidro, *Yahara et al. 1640* (KYO, MEXU); $2n = 33 + 3Bs$. Mexico. Nuevo León: 8.2 km W of San Ishidro, *Yahara et al. 1656* (KYO, MEXU); $2n = 33 + 0–1B$. Mexico. Nuevo León: 45.4 km SW of Mex 58 & 85 jct. in Linares, *Yahara et al. 1771* (KYO, MEXU); $2n = 33 + 3–4Bs$. Mexico. Nuevo León: 45.4 km SW of Mex 58 & 85 jct. in Linares, *Yahara et al. 1772* (KYO, MEXU).

Stevia tomentosa Kunth. $2n = 33 + 2Bs$. Mexico. Nuevo León: 45.4 km SW of Mex 58 & 85 jct. in Linares, *Yahara et al. 1770* (KYO, MEXU); $2n = 33 + 3Bs$. Mexico. Nuevo León: 8.2 km W of San Ishidro, *Yahara et al. 1651* (KYO, MEXU); $2n = 44 + 2–4Bs$. Mexico. Nuevo León: 8.7 km SE of Zaragoza, *Yahara et al. 1811* (KYO, MEXU).

Stevia veronicae DC. $2n = 11II$. Brazil. Paraná: E limit of Guarapuava, *Yahara et al. B170* (GHSP, KYO); $2n = 11II$, $2n = 22$. Brazil. Paraná: 3 km W of São Luis do Puruna, *Yahara et al. B204 & B205* (GHSP, KYO); $2n = 11II$. Brazil. Santa Catarina: 10 km SW of Lages, *Yahara et al. B250* (GHSP, KYO).

Erratum

Watanabe, K., T. Yahara, G. Hashimoto, Y. Nagatani, A. Soejima, T. Kawahara & M. Nakazawa. 2007. Chromosome numbers and karyotypes in Asteraceae. Ann. Missouri Bot. Gard. 94: 643–654.

In Appendix 1 on p. 653, under Eupatorieae, the second accession for *Chromolaena pedunculosa* (Hook. & Arn.) R. M. King & H. Rob. was erroneously listed as $2n = 20II + 10I$. The correct accession is $2n = 10II + 10I$. The authors regret the error.

doi: 10.3417/2008009