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Additional Chromosome Numbers of Hawaiian Flowering Plants[1]

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ABSTRACT: Chromosome numbers of 30 collections representing 29 species and 16 families of Hawaiian flowering plants are presented and discussed. The chromosome numbers of 24 of these species have not previously been reported. Chromosome numbers are also documented for the first time in the genera *Colubrina* ($n = 24$), *Isodendrion* ($n = 8$), *Nothocestrum* ($n =$ c. 24), *Remya* ($n = 18$), and *Schiedea* ($n = 30$).

AS OF 1978, CHROMOSOME NUMBERS were known for only about 17.1% of the species of Hawaiian flora (Carr 1978). Moreover, most of these taxa are known from a single determination. Thus, the need for additional cytological work in Hawaii is great. The present paper provides first reports of chromosome numbers for an additional 24 species, 5 of which also represent first reports for the genera *Colubrina*, *Isodendrion*, *Nothocestrum*, *Remya*, and *Schiedea*. This brings the number of cytologically determined Hawaiian species to about 271 (18.8%).

MATERIALS AND METHODS

The chromosome numbers reported herein were determined from meiotic divisions in microsporocytes. Material for study was preserved and stored in modified Carnoy's fixative (6 chloroform : 3 absolute ethanol : 1 glacial acetic acid; v : v). Anthers were squashed in acetocarmine, and slides were made permanent in Hoyer's solution (cf. Beeks 1955). Chromosome indexes consulted for this report include (1) Fedorov (1974), (2) Moore (1973), (3) Moore (1974), (4) Moore (1977), (5) Goldblatt (1981), and (6) Goldblatt (1984). In the remainder of this paper these indexes are cited by number. Voucher specimens are deposited at BISH or HAW. In instances where voucher specimens were not collected concomitant with cytological materials, an existing alternate specimen from the same population is cited.

RESULTS AND DISCUSSION

CARYOPHYLLACEAE: The report of $n = 30$ for *Schiedea verticillata* (Table 1) represents the first for this Hawaiian endemic genus. The related Hawaiian genus *Alsinodendron* has also been reported to have $n = 30$ (Skottsberg 1955). At least half a dozen other genera in the family also have been reported to have the same chromosome number (indexes 1–6). The number $n = 12$ given here for *Silene struthioloides* agrees with most other reports for the genus, including an earlier one for this species by Krukeberg (1960). The only other record for this genus from Hawaii (*S. hawaiiensis* Sherff) also agrees (Carr 1978).

AMARANTHACEAE: *Amaranthus brownei*, first reported here to have $n = 17$, is the only species of the genus that is endemic to the Hawaiian Islands. This record agrees with many other reports for extra-Hawaiian representatives of the genus. The other prominent number in *Amaranthus* is $n = 16$ (indexes 1–6).

POLYGONACEAE: The report here of $n = 30$ for the Hawaiian endemic *Rumex skottsbergii* agrees with an earlier one for this species given

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TABLE 1

CHROMOSOME NUMBERS OF HAWAIIAN PLANTS

TAXON	*n*	COLLECTION DATA
Caryophyllaceae		
***Schiedea verticillata* F. Br. in Christoph. & Caum	30	Nihoa, Devil's Slide, *Conant 115*
Silene struthioloides A. Gray	12	Hawaii, Mauna Kea summit road, *Carr 1092*, cf. *McEldowney 4*
Amaranthaceae		
**Amaranthus brownei* Christoph. & Caum	17	Nihoa, Miller Ridge, *Conant 111*
Polygonaceae		
Rumex skottsbergii Deg. & Deg.	30	Nihoa, Devil's Slide, *Conant 116*
Malvaceae		
**Abutilon menziesii* Seem.	14	Oahu, Ewa Plains, *Char et al. 81.002*
Violaceae		
***Isodendrion longifolium* A. Gray	8	Oahu, Puu Pane, *Obata et al. 77-311*
**I. subsessilifolium* Heller	8	Kauai, Milolii Ridge, *Robichaux*, cf. *Hobdy 1817*
**Viola helena* Forbes & Lydgate var. *lanaiensis* Rock	40	Lanai, Lanai Hale, *Carr 1054*
Cucurbitaceae		
**Sicyos nihoaensis* St. John	12	Nihoa, Miller Ridge, *Conant 112*
Fabaceae		
**Sesbania* sp. nov. Char 1	12	Kauai, Mana, *Char 81.008*
**Sesbania* sp. nov. Char 2	12	Kauai, Polihale, *Char 81.007*
Thymelaeaceae		
**Wikstroemia lanaiensis* Skottsb. var. *acutifolia* Skottsb.	9	Lanai, Lanai Hale, *Carr et al. 1053*
Euphorbiaceae		
**Euphorbia arnottiana* Endl.	c. 19	Oahu, Waialae Nui, *Robichaux*, cf. *Warshauer 2140*
**E. celastroides* Boiss. in A. DC.	c. 19	Oahu, Kaena Point, *Robichaux*, cf. *Degener 20814*
**E. clusiaefolia* Hook. & Arn.	c. 19	Oahu, Manana Trail, *Robichaux*, cf. *Takeuchi 65*
**E. forbesii* Sherff	c. 19	Oahu, Pahole Gulch, *Robichaux*, cf. *Herbst 1428*
**E. hillebrandii* Lévl.	c. 19	Oahu, Pahole Gulch, *Robichaux*, cf. *Herbst 1901*
**E. multiformis* Hook. & Arn.	c. 19	Oahu, Waahila Ridge, *Robichaux*, cf. *Carlquist 1619*
Rhamnaceae		
***Colubrina oppositifolia* Brogn. ex Mann	24	Hawaii, Kaupulehu Forest Reserve, *Carr 1074*
Rutaceae		
**Platydesma rostrata* Hillebrand	18	Kauai, Awaawapuhi Trail, *Carr*, cf. *Stone 1599*
Apiaceae		
**Sanicula sandwicensis* A. Gray	8	Maui, Haleakala, Halemauu Tr. summit, *Carr & Linney 1158*
	8	Hawaii, Mauna Kea, *Herbst*, cf. *St. John 26958*
Solanaceae		
***Nothocestrum longifolium* A. Gray var. *longifolium*	c. 24	Oahu, Pahole Gulch, *Stemmermann 1122*
**Solanum nelsoni* Dunal in A. DC.	12	Nihoa, Miller Valley, *Conant 102*
Boraginaceae		
Heliotropium curassavicum L.	13	Oahu, Kaena Point, *Carr 995*
Goodeniaceae		
**Scaevola kauaiensis* (Deg.) St. John	16	Kauai, Mt. Kahili, *Robichaux*, cf. *Gagné & Montgomery 576*
S. procera Hillebrand	8	Kauai, Wahiawa Bog *Robichaux*, cf. *St. John & Fosberg 13594*
Asteraceae		
**Keysseria helenae* (Forbes & Lydgate) Cabrera	27	Kauai, Waialeale summit, *Medeiros 604*
****Madia sativa* Molina	16	Maui, Haleakala, *Carr 1036*
***Remya mauiensis* Hillebrand	18	West Maui, Manawainui Gulch, *Stemmermann 2330*

NOTE: * denotes species not reported in chromosome indexes; ** denotes genera not reported in chromosome indexes; *** denotes species not native to Hawaii.

by Degraeve (1975) and also with a report for the endemic *R. giganteus* Ait. (Löve 1967). A third Hawaiian endemic species, *R. albescens* Hillebrand, is reported to have $n = 18$ (Skottsberg 1955) and $n = 20$ (Löve 1967). Additional chromosome counts may be helpful in clarifying the taxonomy of the Hawaiian representatives of this genus.

MALVACEAE: The chromosome number of *Abutilon menziesii* is reported here for the first time as $n = 14$. This agrees with at least two other species in the genus (index 1). The only other Hawaiian species of this genus that is chromosomally known is *A. incanum* (Link) Sweet, with $n = 7$ (Carr 1978).

VIOLACEAE: The counts here for *Isodendrion longifolium* and *I. subsessilifolium* of $n = 8$ represent the first for this Hawaiian endemic genus. This number is known in the genera *Hybanthus* (indexes 2, 3, 6) and *Ionidium* (indexes 2, 5, 6). It is also known, but rare, in the genus *Viola*, for example, in *V. kitaibeliana* Schult. and *V. hymettia* Boiss. & Heldr. (index 5). More recently, the author has detected $n = 8$ in *Agatea* from New Caledonia. The count here of $n = 40$ for *V. helena* is the first for this Hawaiian endemic species. It agrees with the count reported for *V. tracheliifolia* Gingins from Hawaii (Carr 1978). In *Viola*, this number is otherwise known only in *V. nannei* Polakowsky (Davidse 1970).

CUCURBITACEAE: The first report here of $n = 12$ for *Sicycos nihoaensis* agrees with that for two other Hawaiian species of the genus (Carr 1978). The only other species of the genus that is chromosomally known also has the same number (indexes 1, 4, 5).

FABACEAE: The chromosome numbers $n = 12$ reported here for *Sesbania* represent counts for two new species in the genus (Char 1983). These counts agree with many others for the genus, although numbers of $n = 6, 7, 8$, and 16 have also been reported (indexes 1, 2, 4–6).

THYMELAEACEAE: The first report here of $n = 9$ for *Wikstroemia lanaiensis* agrees with most others for the genus and brings the number of Hawaiian species chromosomally known to 14 (cf. Gupta and Gillett 1969).

EUPHORBIACEAE: The meiotic counts of $n =$ c. 19 given here for six species of *Euphorbia* (Table 1) apparently represent the first reports for Hawaiian members of the genus. An attempt was made to verify the chromosome number by examining mitotic divisions in root tips of *E. celastroides*. Although two seemingly unambiguous cells were resolved at $2n = 38$, the considerable range in size of chromosomes in the genome and the small sample size make additional confirmation desirable. A very wide range of chromosome numbers are known in *Euphorbia*, including a continuous series from $n = 18$ to $n = 22$ (indexes 1–6).

RHAMNACEAE: The number of $n = 24$ for *Colubrina oppositifolia* is the first report for this Hawaiian endemic genus. Among Rhamnaceae, this number appears to be otherwise restricted to *Zizyphus*, although $n = 12$ is common in at least five other genera (indexes 1, 2, 4–6).

RUTACEAE: The first report here of $n = 18$ for *Platydesma rostrata* agrees with a previous report for *P. cornuta* Hillebrand, the only other species cytologically known in this Hawaiian endemic genus (Carr 1978). The same number is very common in other genera of the family (indexes 1–6).

APIACEAE: The chromosome number of *Sanicula sandwicensis* is reported here for the first time as $n = 8$. Most other species of this genus have the same number (index 1).

SOLANACEAE: The chromosome number of *Solanum nelsoni* first recorded here as $n = 12$ agrees with most other reports for the genus. Numbers of $n = 11, 18, 23, 24, 30$, and 36 also occur in the literature on *Solanum* (indexes 1–6). The report here of $n =$ c. 24 for *Nothocestrum longifolium* represents the first chromosome determination in this Hawaiian endemic genus.

BORAGINACEAE: The indigenous *Heliotropium curassavicum* is reported here to have $n = 13$. This agrees with at least half a dozen other reports for the species (indexes 1, 2, 4, 6). However, $n = 12$, 14, and 26 have also been reported (indexes 1, 2, 5, 6). The Hawaiian endemic *H. anomalum* H. & A. var. *argenteum* Gray is reported to have $n = 14$ (Carr 1978).

GOODENIACEAE: The report here for *Scaevola kauaiensis* of $n = 16$ is the first for this closely related, if not conspecific counterpart of *S. glabra* Hook. & Arn. These two taxa appear to be the only Hawaiian representatives of the genus that are tetraploid (cf. Carr 1978, Gillett 1969). It is interesting to note that, taken as three groups, these tetraploids, the endemic diploid species, and the indigenous diploid *S. taccada* (Gaertn.) Roxb. each exhibit distinctive flavonoid profiles (Patterson 1984). Thus, Gillett's hypothesis (Gillett 1966) of three separate dispersal events to account for these three groups of *Scaevola* in Hawaii is supported by a combination of cytogenetic and phytochemical evidence. The chromosome number of $n = 8$ for *S. procera* has been reported twice before (Carr 1978, Skottsberg 1955). This number agrees with that of all other Hawaiian species of the genus that have been counted except for the tetraploids mentioned above.

ASTERACEAE: The first report for *Keysseria helenae* given here as $n = 27$ agrees with the only other record for this genus from Hawaii (Carr 1978). Elsewhere, this genus is known to have $n = 18$ (Borgmann 1964). Four extra-Hawaiian species of the closely related if not congeneric *Lagenifera* have been reported to have $n = 9$ (indexes 1, 2, 4). St. John (1973) lists one species of *Lagenifera* in the Hawaiian flora. Knowledge of the chromosome number of this species would probably help determine whether these genera should be merged, at least so far as Hawaiian taxa are concerned. The chromosome number of the introduced *Madia sativa* given here as $n = 16$ is the same as that reported by at least five other workers (indexes 1, 6). The report here of $n = 18$ for *Remya mauiensis* represents the first for this endemic Hawaiian genus. Numbers based on $x = 9$ are common in the Astereae tribe to which *Remya* belongs.

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