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CHROMOSOME NUMBERS OF SOME ANNUAL SPECIES OF *CHORIZANTHE* AND RELATED GENERA (POLYGONACEAE: ERIOGONOIDEAE)

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ABSTRACT

Chromosome numbers for 29 species or varieties of *Chorizanthe* and some related genera are listed. Few of the chorizanthes lack aneuploidy and an indication of the frequency of various numbers is included along with notes on any observed anomalies.

KEY WORDS: Polygonaceae, chromosome numbers, *Aristocapsa, Centrostegia, Chorizanthe, Hollisteria, Lastarriaea, Mucronea, Systenotheca*, California.

INTRODUCTION

Some annual species of *Chorizanthe* (Polygonaceae Juss. subf. Eriogonoideae Meisner) have some aneuploidy, while others have little if any. For a few species it is difficult to determine the base number. There is no consistent pattern so it is impossible to prognosticate which species will have aneuploidy and which will not. Some of the species with aneuploidy are probably of hybrid origin, though not all populations of *Chorizanthe* that I suspect consist of hybrids or appear to have been introgressed by another, show aneuploidy. In other cases the species consist of numerous, isolated populations that are morphologically variable one from another. Conversely several species apparently have no aneuploidy at all. The wide-ranging morphologically uniform species, *C. membranacea*, has both diploids, tetraploids and aneuploids in the one population from which suitable cytological material was obtained. In *C. polygonoides* var. *longispina* pollen mother cells were observed to vary from 2-8 per anther so pollen is scarce and and counts hard to obtain. I have never yet obtained a chromosome count from the northern subspecies though there are a few pollen grains. One suspects that apomixis must be evolving in this species. (Reveal counted the var. *polygonoides* and found the one population counted consistently to be $n = 20$; Reveal & Hardham 1989a). No studies were made on pollen size or viability.

In *Chorizanthe* the tetraploid base numbers are probably $n = 19$ and 20, not merely $n = 20$ as suggested by Reveal & Moran (1977) when the first count for the genus was published. The base number for the genus, however, is still likely $x = 10$ as proposed by Stokes & Stebbins (1955) for *Eriogonum* and supported by Reveal (1978) and Shields and Reveal (1988). Occasionally an anaphase slide will suggest two genomes, one of large and one of small chromosomes, as in *C. clevelandii* where this is clearly observable. The octoploids ($n = 40$) also will occasionally indicate the presence of two distinct genomes, one of small and one of large chromosomes. A review of the literature on aneuploidy which I did some fifteen years ago shows that in Europe and Africa, at least, aneuploidy within a population or a species with a number of about n = 20 is not uncommon in some genera of both annuals and perennials. At the species level, this is certainly the case in *Eriogonum* where known numbers are n = 9, 11, 12, 16, 17, 18, 20, 22, 38, and 40 (Shields & Reveal 1988). However, in *Eriogonum*, aneuploidy is found in different species (especially the subg. *Oregonium*), not in the same populations of a species as is apparently the case in *Chorizanthe*.

In a few cases in this review of chromosome numbers there are no vouchers to support my observations. To some degree, it is often necessary to collect cytological material well before any of the specimens are in flower, so that cytological material was often taken the year following the location and identification of the species. In addition, there is a real limit to the number of collections one can make of a species like *Chorizanthe membranacea* which I collected numerous times over the years before obtaining any suitable cytological material. The entire population of *C. angustifolia* with three stamens, thought at the time to be var. *angustifolia* (Goodman 1934) and virtually extinct, barely made a sample large enough for cytological purposes with a few individuals left for seed. All of the collection numbers cited herein are my own, and all collections but those made of *C. brevicornu* var. *spathulata* from Oregon and *C. procumbens* and *C. fimbriata* var. *fimbriata* from Baja California Norte, México, were obtained in California. Some additional chromosome counts of *Chorizanthe*, mainly Mexican species, are reported in Reveal and Hardham (1989a).

In the following section, N refers to the sample size or the number of good cells counted. If a chromosome number (n) is present several times, the number of times it was present is given in parenthesis, e.g. (4x). All vouchers are in the author's personal herbarium and/or duplicates may be found at CAS, MARY, RSA or USSB among other institutions.

Chromosome Numbers

Aristocapsa insignis (Curran) Rev. & Hardham. *5681*, hills between San Juan River and Carrisa Plains, San Luis Obispo Co.

N= numerous. n = 14. (See also Reveal & Hardham 1989b)

Centrostegia thurberi A. Gray ex Benth. in A. DC. *5683*, hills between San Juan River and Carrisa Plains, San Luis Obispo Co.

N= numerous. n = 19.

Chorizanthe angustifolia Nutt. *7045*, Baywood Park, San Luis Obispo Co.

N= 20. n = 19(6x), 19II 1I, 20(5x), 20II 1I, 21, 22(3x), 23(3x).

Unvouchered. Nipomo Mesa near Aden Way, San Luis Obispo Co. Flowers with three stamens.

N= 1. n = 20, some cells 19 to 20, others 20 to 21.

Chorizanthe biloba Goodman var. *biloba*. *6952*, El Pomar area E of Paso Robles, San Luis Obispo Co.

N= 9. n = 20.

7127, 7128, Black Mountain, La Panza Range, San Luis Obispo Co. Recounted (without vouchers) from the same populations in 1962.

N= numerous. n = 20. This variable population, not refound due to habitat modification associated with a long absence of fire in the area, may have been introgressed by *C. rectispina* which occured nearby. The variation in many traits suggests this.

Chorizanthe biloba Goodman var. *immemora* Rev. & Hardham. *30590a*, Clear Creek, near Hernandez, San Benito Co.

N= 19. *n* = 17, 18(5x), 19(2x), 20(2x), 20 or more, 21, 22(3x), 22 or 23, 23. Lots of nucleoli present, often three large ones as well as some smaller. Some chromosomes are small. Some triads (rather than the typical tetrads) observed so this taxon may have a relatively low fertility.

Chorizanthe blakleyi Hardham. *30553*, New Cuyama Oil Field, Santa Barbara Co.
N= 1. *n* = ca 19.

Chorizanthe brevicornu Torr. in Emory var. *brevicornu*. *8910*, Salton Sea, Riverside Co.
N= numerous. *n* = 19(20), 21(23).

Unvouchered, Joshua Tree National Monument, Riverside Co.
N= 12. *n* = 19, 20(3x), 21(5x), 23(3x).

Chorizanthe brevicornu Torr. in Emory var. *spathulata* (Small ex Rydb.) C.L. Hitchc. *7982*, Alkali Lake, Lake Co., Oregon.
N= 1. *n* = 19.

Chorizanthe breweri S. Wats. *6942*, Sargent Cypress Grove N of San Luis Obispo, San Luis Obispo Co.
N= numerous. *n* = 19.

Chorizanthe clevelandii C. Parry. *10393*, Vineyard Canyon, Monterey Co.
N= numerous. *n* = 21.

7136, Franklin Creek, W of Adelaida, San Luis Obispo Co.
N= numerous. *n* = 20(or 21), 21. The latter had chromosomes of two sizes, 11 large and 10 small.

Chorizanthe corrugata (Torr. in Blake) Torr. & A. Gray. Unvouchered, Salton Sea, Riverside Co.
N= numerous. *n* = 19. Hypoploids (*n* = 17) were also seen.

Chorizanthe cuspidata S. Wats. var. *villosa* (Eastw.) Munz. *10452*, Bodega, Sonoma Co.
N= 23. *n* = 18 or 19, 19(5x), 20?, 20(9x), 20II 1I(3x), 20 or 21(2x), 21

10451, Point Reyes, Marin Co.
N= 14. *n* = 19, 20(8x), 20-21, 21(3x), 23(2x).

Chorizanthe diffusa Benth. in A. DC. *7165*, Ocean Grove, Monterey Co. The phase with indistinct involucral margins (or the "var. *diffusa*" in the strict sense).
N= 14. *n* = 18?, 19(3x), 19-20(2x), 20(4x), 21(3x), 22. One tetrad with *n* = 14, 15, 17 and 17.

10254, Huasna District, San Luis Obispo Co.
N= 3. *n* = 19II, 1I, 20 or possibly 21. Material not perfect. The phase with broad involucral margins (or the "var. *nivea*").

Chorizanthe douglasii Benth. *6995*, Corral del Tierra, Santa Lucia Mountains, Monterey Co.
N= 8. *n* = 18II 2I, 19II 1I, 20(6x)

Unvouchered, San Antonio Mission, Monterey Co.
N= 3. *n* = 20(3x).

Chorizanthe fimbriata Nutt. var. *fimbriata*. *1962*, Temecala Canyon, Riverside Co.
N= numerous. *n* = 19II 1I, lagging, 20, 20II 1I.

8931, Ensenada, Baja California Norte, México.
N= 7. *n* = 20(2x), 21II 1I, 22, 22 or more, 22II 2I, 22II 3I.

Chorizanthe howellii Goodman. *10464*, Fort Bragg, Mendocino Co.
N= 28. *n* = 36 or perhaps 37, 37(2x), 38, 39(5x), 39II 1I, 40(3x), 41(7x), 42(2x), 43(6x), 44, 45. There were additional hypo- (ca 36-37) and hyperoctoploids (ca 44-45). One cell had 19 small chromosomes and 20 large chromosomes.

Chorizanthe membranacea Benth. Unvouchered, La Panza area, San Luis Obispo Co.
N= 9. *n*= 19(3x), 19II 1I, 19(or 20), 20 (21?), 21, ca 40, 42 or more.

Chorizanthe obovata Goodman. *10460*, Hurricane Deck, San Rafael Mountains, Santa Barbara Co.
N= 5. *n*= 19, 19(or 20), 20, 20II, 2I.

7044, See Canyon near Avila, San Luis Obispo Co.
N= 12. *n*= 19, 19II 2I(2x), 20(8x), 21.

Chorizanthe orcuttiana C. Parry. *8941*, Del Mar, San Diego Co.
N= numerous. *n*= 38, 39 (both several times), 40, 42.

8945, Point Loma, San Diego Co.
N= numerous. *n*= 39, 39-40, 40, 40II.

Chorizanthe palmeri S. Wats. *3781*, Sargent Cypress Grove near Alder Creek, Monterey Co., at the NW edge of the range of this species. The cytological material was collected at a later date.
N= 14. *n*= 19(3x), 19(or 20), 20(6x), 20-21(2x), 24(2x).

10903, Waterdog Creek W of Bryson, Monterey and San Luis Obispo Co. line.
N= 15. *n*= 20(3x), 21(4x), 21 or 22, 22(4x), 22 or more, 23(4x), 23 or more, 24(5x), 25(2x), 27 or more.

Unvouchered, Huasna District, San Luis Obispo Co., obtained in 1962. A later collection from the same population is *Reveal et al. 6487*, upper slope of Tar Spring Ridge N of Huasna Road, 5 air mi E of Arroyo Grande; it may serve as a representative.
N= 12. *n*= 20(2x), 21(4x), 21 or 22, 24(4x), 26.

Chorizanthe polygonoides Torr. & A. Gray var. *longispina* (Goodman) Munz. 8936, Camp Elliott, Kearney Mesa, San Diego Co.
N= 5. *n*= 20.

Chorizanthe procumbens Nutt. *8949*, near Temecala Canyon, Riverside Co. The white-flowered expression.
N= numerous. *n*= 20, 21.

8944, Dana Point, Orange Co. The typical phase of the species.
N= 3. *n*= 20(2x), 21.

8932, 6 mi S of Tecate, Baja California Norte, México. The *C. jonesiana* Goodman phase.
N= 19. *n*= 19(2x), 20(7x), 20II 2I(3x), 21 or more, 22(3x), 23, 23 or more.

Chorizanthe pungens Benth. var. *pungens*. *7166*, 29 May 1961, Ocean Grove, Monterey Co.
N= 1. *n*= 20. The var. *hartwegiana* is also a tetraploid at *n*= 20; it was counted by Reveal (Reveal & Hardham 1989a).

Chorizanthe rectispina Goodman. *2279*, Black Mountain, La Panza Range, San Luis Obispo Co. The cytological material was collected at a later date.
N= 4. *n*= 20(2x), three cells apparently hypoploids with *n*= 18.

4804, Atascadero, on the Santa Barbara Road, San Luis Obispo Co. The cytological material was collected at a later date.
N= 12. *n*= 18, 20(7x), 21, 21II 1I, 22.

10397, Cross Road SE of Jolon, Monterey Co..
N= numerous. *n*= 18II, 2I, 19II, 20II, 20II 1I.

Trivalents, one or even two per cell, are common. This population has more brilliantly bicolored flowers than the other two.

I suspect *Chorizanthe rectispina* of having been involved in episodes of hybridization with *C. clevelandii* to give *C. uniaristata*, with *C. palmeri* to give *C. ventricosa*, and with *C. biloba* to give local hybrid populations. Experimental work would be needed to confirm these observations.

Chorizanthe rigida (Torr. in Whipple) Torr. & A. Gray. *8924*, S end of the Salton Sea, Riverside Co. A one-flowered population.
N= numerous. *n* = 19, 20, also 19 and 21 in sister anaphase cells.

Chorizanthe spinosa S. Wats. *1435*, Cantil, Kern Co.
N= numerous. *n* = 22, probably also 20 and, rarely, 23. Repeated collections gave the same results.

Chorizanthe staticoides Benth. Unvouchered. Upper Sespe River drainage, near Rose Lake, Ventura Co.
N= 22. *n* = 19(10x), 20(9x), 21(3x).

Chorizanthe stellulata Benth. in A. DC. *30580*, near Raymond, Mariposa Co.
N=3. *n* = 19, 20, 22. Needs more study. Some chromosomes large and some small. Some cells seem to have no more than 17 or 18 chromosomes while others as many as 26.

Chorizanthe uniaristata Torr. & A. Gray. *5682*, hills between San Juan River and the Carrisa Plains. The cytological material was collected at a later date.
N= 5. *n* = 39-40, 40(2x), 41(2x).

Chorizanthe ventricosa Goodman. *6793*, Cottonwood Pass, E of Cholame, San Luis Obispo Co.
N= 9. *n* = 20(4x), 21(3x), 21 or 22, 22.
10817, Parkfield Mountain, Monterey Co.
N= 11. *n* = 18, 20(2x), 20?, 21(3x), 21?, 22, 22 or 23, 23?.

Chorizanthe xantii S. Wats. var. *xantii*. Unvouchered, hills E of the San Juan River, San Luis Obispo Co.
N= 2. *n* = 21.
Unvouchered, Sespe River drainage, Ventura Co.
N= 4. *n* = 19(2x), 21(2x).
Unvouchered, Sespe River drainage, Ventura Co.
N=2. *n* = 19.

Hollisteria lanata S. Wats. *5452*, Cammatti Road and Calf Canyon Road, San Luis Obispo Co.
N= numerous. *n* = 21, occasionally 22. See Reveal (1989) for a vouchered count of *n* = 21.

Lastarriaea coriacea (Goodman) Hoover. Unvouchered, Atascadero, San Luis Obispo Co.
N= 1. *n* = 21(22).
Unvouchered, Shell Creek, San Luis Obispo Co.
N= 2. *n* = 28-30.
Unvouchered, Del Mar–La Jolla area, San Diego Co.
N= 1. *n* = more than 30.

Mucronea californica Benth. *1962*, Shell Creek, San Luis Obispo Co.
N= numerous. *n* = 19II. Numerous counts of the various ecotypes gave identical results.

Mucronea perfoliata (A. Gray) A. Heller. *5756*, Tierra Redondo, San Luis Obispo Co.
N= numerous. *n* = 19.
5848, Black Mountain, La Panza Range, San Luis Obispo Co.
N= 4. *n* = 19II.
12633, Sandstone Camp along California Highway 33, San Luis Obispo Co. The cytological material was collected at an earlier date.
N= 4. *n* = 20II.

Systenotheca vortreidii (Brandegee) Rev. & Hardham. Unvouchered, Ocean View Mine, San Luis Obispo Co.
N = 4. *n* = 19, occasionally 20.

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