

1956

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Grant, Verne; Beeks, Richard M.; and Latimer, Howard L. (1956) "Genetic and Taxonomic Studies in *Gilia*: IX. Chromosome Numbers in the Cobwebby *Gilias*," *Aliso: A Journal of Systematic and Floristic Botany*. Vol. 3: Iss. 3, Article 3.

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GENETIC AND TAXONOMIC STUDIES IN *GILIA*IX. CHROMOSOME NUMBERS IN THE COBWEBBY *GILIAS*¹

VERNE GRANT, RICHARD M. BEEKS AND HOWARD L. LATIMER

No chromosome number determinations have as yet been published for the large section *Arachnion* of *Gilia*. The present report includes counts made on natural populations or their garden progeny over a period of seven years. The counts were made from propiono-carminic squashes of pollen mother cells, the best results being obtained by mounting the specimens directly in Hoyer's medium according to the schedule given by Beeks (1955). In making the camera lucida drawings, the position of individual chromosomes was frequently moved in order to eliminate overlapping. Voucher specimens of the plants are deposited in the Herbarium of the Rancho Santa Ana Botanic Garden. The counts are arranged according to the system of classification of Grant and Grant (1956).

1. *GILIA OCHROLEUCA*. (N=9).a) *G. o. exilis*. (Fig. 2).(i) Dripping Springs, Riverside County²; G-9317⁽³⁾

(ii) Fulmore Lake, Riverside County; G-16107.

(iii) Whitewater Canyon near San Geronio Pass, Riverside County;
G-9031.b) *G. o. bizonata*.(iv) Near junction of Stauffer and Mt. Pinos roads, Ventura County;
G-16040.c) *G. o. ochroleuca*. (Fig. 1).

(v) Short Canyon, east slope of Sierra Nevada, Kern County; G-8858.

2. *GILIA CANA*. (N=9).a) *G. c. cana*. (Fig. 6).

(i) Rock Creek, Sierra Nevada, Mono County; G-9249.

b) *G. c. speciosa*. (Fig. 7).

(ii) Short Canyon, east slope of Sierra Nevada, Kern County; G-8860.

c) *G. c. bernardina*.(iii) Cactus Flat, desert slope of San Bernardino Mts., San Bernardino
County; G-8686.d) *G. c. triceps*. (Fig. 3).

(v) China Lake, San Bernardino County; G-9341.

(vi) Homewood Canyon north of Trona, Argus Mts., Inyo County;
G-9344.

(vii) Trona, Inyo County; G-9342, 9343.

(viii) Wildrose Canyon, Panamint Mts., Inyo County; G-8821, 9351.

(ix) Bradbury Wells, Black Mts., Inyo County; G-9072.

¹This study was aided by a research grant from the National Science Foundation.²All localities are in California unless otherwise specified.³Grant collection numbers are abbreviated "G-".

3. *GILIA LEPTANTHA*. (N=9).
 - a) *G. l. leptantha*. (Fig. 15).
 - (i) Santa Ana River near Fish Creek, San Bernardino Mts., San Bernardino County; *G-9155*.
 - b) *G. l. purpusii*. (Figs. 12, 13).
 - (ii) Kern River near Johnsondale, Sierra Nevada, Tulare County; *G-9264*.
 - (iii) Kern River near Old Isabella, Sierra Nevada, Kern County; *G-9220*.
 - (iv) Greenhorn Mts., Sierra Nevada, Kern County; *G-9218*.
 - c) *G. l. transversa*.
 - (v) Cajon Pass, San Bernardino Mts., San Bernardino County; *G-9385*.
 - d) *G. l. vivida*.
 - (vi) Big Pines, San Gabriel Mts., Los Angeles County; *G-16055*.
 - e) *G. l. pinetorum*. (Fig. 14).
 - (vii) Mt. Pinos, South Coast Range, Ventura County; *G-16047, 16052*.
4. *GILIA ALIQUANTA*. (N=9).
 - a) *G. a. aliquanta*. (Fig. 35).
 - (i) Red Rock Canyon, Kern County; *G-9117*.
 - (ii) Pear Blossom, Mojave Desert, Los Angeles County; *G-9324*.
 - (iii) Desert Springs, Mojave Desert, San Bernardino-Los Angeles County; *D. D. Keck 6261*.
5. *GILIA TENUIFLORA*. (N=9).
 - a) *G. t. tenuiflora*. (Fig. 10).
 - (i) Arroyo Seco, Monterey County; *G. L. Stebbins 3945*.
6. *GILIA INCONSPICUA*. (N=9).
 - a) *G. i. interior*. (Fig. 11).
 - (i) Kern Canyon, Sierra Nevada, Kern County; *H. L. Mason 14004* (University of California Herbarium).
 - (ii) Hobo Springs, Kern Canyon, Sierra Nevada, Kern County; *G-9108*.
 - b) *G. i. austrooccidentalis*. (Fig. 9).
 - (iii) Cuyama Valley, Santa Barbara County; *G-9100*.
 - (iv) Ballinger Canyon, Cuyama Valley, Santa Barbara County; *culture 2678* from *G-9364B*, *culture 2680* from *G-9365.2*, *culture 2674* from *G-9364.1*.
 - c) *G. i. inconspicua*.
 - (v) Walker River near Sonora junction, Mono County; *G-9673*.
 - (vi) Wickenburg, Maricopa County, Arizona; *G-9298*.
7. *GILIA MINOR*. (N=9). (Figs. 16, 17, 18).
 - (i) Kramer junction, Mojave Desert, San Bernardino County; *G-8851, 9222*.
 - (ii) Homewood Canyon, Argus Mts., Inyo County; *G-9350*.
 - (iii) Gorman, Los Angeles County; *G-9092*.
 - (iv) Ballinger Canyon, Cuyama Valley, Santa Barbara County; *G-9098*, *culture 2684* from *G-9369.1*, *culture 2677* from *9364.4*.
 - (v) Cuyama Valley, Santa Barbara County; *G-9099*.
8. *GILIA TWEEDYI*. (N=18). (Fig. 23).
 - (i) Encampment, Carbon County, Wyoming; *G-9725*.

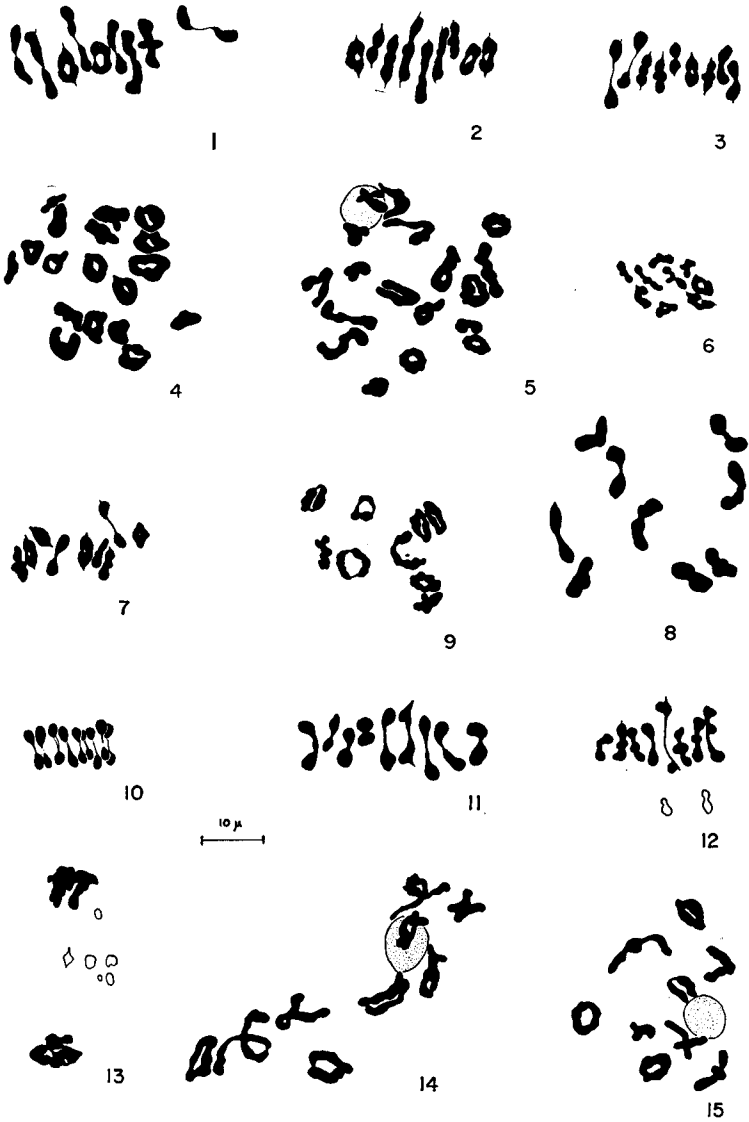
9. *GILIA OPHTHALMOIDES*. (N=18).
- a) *G. o. ophthalmoides*. (Fig. 24).
 - (i) Westgard Pass, White Mts., Inyo County; *G-9431*.
 - b) *G. o. clokeyi*. (Figs. 25, 26).
 - (ii) Kyle Canyon, Charleston Mts., Clark County, Nevada; *E. K. Balls & R. Straw 19276*.
 - (iii) Mountain Pass east of Baker, San Bernardino County; *G-9060*.
 - c) *G. o. flavocincta*. (Figs. 4, 5).
 - (iv) Apache Trail, Maricopa-Gila County, Arizona; *G-9307*.
 - (v) Wickenburg, Maricopa County, Arizona; *G-9297*.
 - d) *G. o. australis*.
 - (vi) Canyon del Oro, west of Tucson, Pima County; *K. F. Parker 7428, Grant culture 2728*.
10. *GILIA TRANSMONTANA*. (N=18). (Figs. 27, 28).
- (i) Short Canyon, east slope of Sierra Nevada, Kern County; *G-9337*.
 - (ii) Johannesburg, San Bernardino-Kern County; *G-8847*.
 - (iii) Virginia City, Ormsby-Storey County, Nevada; *H. L. Mason 13988*;
N=ca. 18.
 - (iv) Cuyama Valley, Santa Barbara County; *G-8696*.
11. *GILIA DIEGENSIS*. (N=9). (Fig. 8).
- (i) Cuyamaca Mts., San Diego County; *G-9225, 9227*.
 - (ii) Anza junction, Riverside County; *G-9234, 9235, 9236*.
 - (iii) Temecula, Riverside County; *G-9316*.
12. *GILIA LATIFLORA*. (N=9).
- a) *G. l. cuyamensis*.
 - (i) Lockwood Valley, South Coast Range, Ventura County; *G-9420*.
 - b) *G. l. latiflora*. (Figs. 19, 20, 21).
 - (ii) Adelanto, Mojave Desert, San Bernardino County; *G-8663*.
 - (iii) Apple Valley, Mojave Desert, San Bernardino County; *Rancho Santa Ana Botanic Garden 20683*.
 - c) *G. l. excellens*. (Fig. 22).
 - (iv) Johannesburg, El Paso Mts., Kern County; *G-9221*.
13. *GILIA SINUATA*. (N=18). (Figs. 29, 30).
- (i) Doyle, Plumas County; *G-9666*.
 - (ii) Halleluja junction, Plumas County; *G-9668*.
 - (iii) Walker River north of Sonora junction, Mono County; *G-9672*.
 - (iv) Benton, Mono County; *G-9620*.
 - (v) Benton Station, Mono County; *G-9613*.
 - (vi) El Paso Mts., Kern County; *G-9557*.
 - (vii) Kern River south of Johnsondale, Sierra Nevada, Tulare County;
G-9265.
 - (viii) Highway 138 near Big Pines junction, Los Angeles-San Bernardino
County; *G-9318, D. D. Keck 6262*.
 - (ix) Phelan, Mojave Desert, San Bernardino County; *G-15995*.
 - (x) Adelanto, Mojave Desert, San Bernardino County; *G-8662*.
 - (xi) Cajon Pass, San Bernardino Mts., San Bernardino County; *G-15993*.
 - (xii) Box S Springs, north base of San Bernardino Mts., San Bernardino
County; *G-8691*.

14. *GILIA CRASSIFOLIA*. (N=18; N=36). (Figs. 31, 32).
 (i) Puente del Inca, Las Heras, Prov. Mendoza, Argentina; *J. Hunziker* 6316; N=18.
 (ii) Estancia Quichaura, Tecka, Terr. Chubut, Argentina; *culture* 2294 from A. Soriano, Rancho Santa Ana Botanic Garden 19651⁽⁴⁾; N=36.
15. *GILIA BRECCIARUM*. (N=9).
 a) *G. b. brecciarum*. (Fig. 34).
 (i) Halleluja junction, Plumas County; *G-9669*.
 (ii) Ballinger Canyon, Cuyama Valley, Santa Barbara County; *culture* 2682 from *G-9365.4*.
 (iii) Mt. Pinos, South Coast Range, Ventura County; *G-16049, 9409*.
 b) *G. b. argusana*. (Fig. 33).
 (iv) Searles Station, El Paso Mts., Kern County; *G-8856*.
 (v) Randsburg, El Paso Mts., Kern County; *G-9358*.
 (vi) Jawbone Canyon near Red Rock Canyon, Kern County; *E. K. Balls* 8569.
 (vii) Homewood Canyon, Argus Mts., Inyo County; *G-9347*.
 c) *G. b. neglecta*.
 (viii) Short Canyon, east slope of Sierra Nevada, Kern County; *G-9335*.
16. *GILIA TETRABRECCIA*. (N=18).
 (i) Mt. Pinos, Ventura County; *G-16042*.

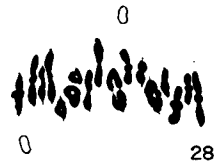
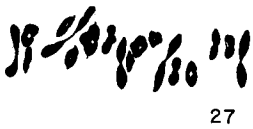
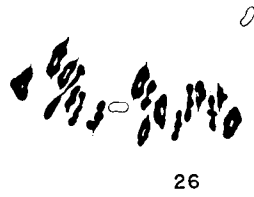
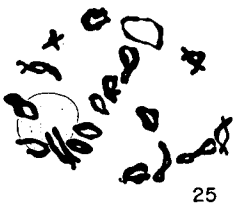
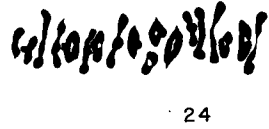
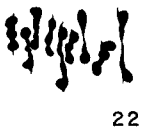
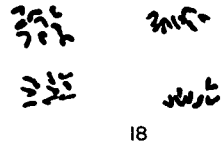
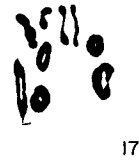
*It is a pleasure to acknowledge the receipt of seed collections of these South American strains of Cobwebby Gilia from Mssrs. Juan Hunziker and Alberto Soriano of Buenos Aires.

LIST OF FIGURES

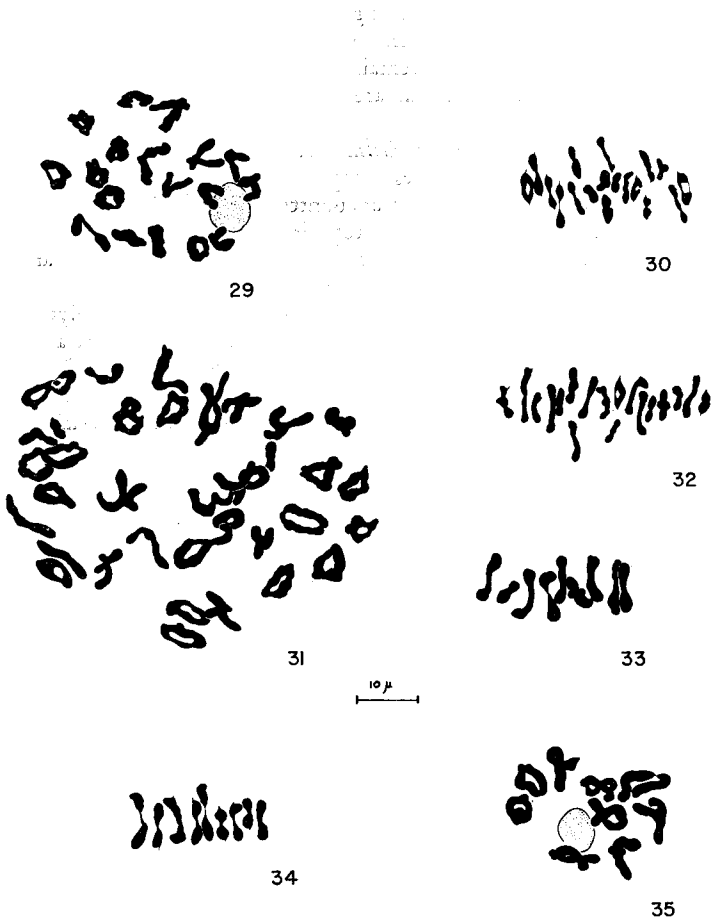
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|--|---|
| 1. <i>G. ochroleuca ochroleuca</i> , Short Canyon. | 20. <i>G. latiflora latiflora</i> , Apple Valley, 8 II+2 I. |
| 2. <i>G. ochroleuca exilis</i> , Dripping Springs. | 21. <i>G. latiflora latiflora</i> , Apple Valley, AI with bridge. |
| 3. <i>G. cana triceps</i> , China Lake. | 22. <i>G. latiflora excellens</i> , Johannesburg. |
| 4. <i>G. ophthalmoides flavocincta</i> , Wickenburg. | 23. <i>G. tweedyi</i> , Encampment. |
| 5. <i>G. ophthalmoides flavocincta</i> , Apache Trail. | 24. <i>G. ophthalmoides ophthalmoides</i> , Westgard Pass. |
| 6. <i>G. cana cana</i> , Rock Creek. | 25. <i>G. ophthalmoides clokeyi</i> , Mountain Pass. |
| 7. <i>G. cana speciosa</i> , Short Canyon | 26. <i>G. ophthalmoides clokeyi</i> , Mountain Pass, 17 II+2 I. |
| 8. <i>G. diegensis</i> , Anza | 27. <i>G. transmontana</i> , Cuyama Valley. |
| 9. <i>G. inconspicua austrooccidentalis</i> , Cuyama Valley. | 28. <i>G. transmontana</i> , Cuyama Valley, 17 II+2 I. |
| 10. <i>G. tenuiflora tenuiflora</i> , Arroyo Seco. | 29. <i>G. sinuata</i> , Cajon Pass. |
| 11. <i>G. inconspicua interior</i> , Hobo Springs. | 30. <i>G. sinuata</i> , Cajon Pass. |
| 12. <i>G. leptantha purpusii</i> , Isabella, 8 II+2 I. | 31. <i>G. crassifolia</i> , Tecka. |
| 13. <i>G. leptantha purpusii</i> , Isabella, TI with laggards. | 32. <i>G. crassifolia</i> , Puente del Inca. |
| 14. <i>G. leptantha pinetorum</i> , Mt. Pinos | 33. <i>G. brecciarum argusana</i> , Randsburg. |
| 15. <i>G. leptantha leptantha</i> , Santa Ana River. | 34. <i>G. brecciarum brecciarum</i> , Halleluja junction. |
| 16. <i>G. minor</i> , Kramer junction. | 35. <i>G. aliquanta aliquanta</i> , Desert Springs. |
| 17. <i>G. minor</i> , Ballinger Canyon. | |
| 18. <i>G. minor</i> , Ballinger Canyon. | |
| 19. <i>G. latiflora latiflora</i> , Apple Valley. | |



Figs. 1-15. Chromosomes of Cobwebby Gilias.



Figs. 16-28. Chromosomes of Cobwebby Gilias.



Figs. 29-35. Chromosomes of Cobwebby Gilias.

CONCLUSIONS

Thirty-four of the 37 species composing the subgenus *Gilia* have been determined for chromosome number. *Gilia nevinii* (sect. *Gilia*), *G. ripleyi* (sect. *Gilmania*), and *G. mexicana* (sect. *Arachnion*) remain uncounted. A number of species, such as *Gilia brecciarum* and *G. tetrabreccia*, are insufficiently explored from a cytotaxonomic point of view.

The basic chromosome number in *Gilia* sect. *Arachnion* is $X=9$, as in the rest of *Gilia* subg. *Gilia*. Of the 18 species comprising this section (*G. crassifolia* being considered here as two species), one is uncounted, ten are diploid with $2N=18$, six are tetraploid with $2N=36$, and one is octoploid with $2N=72$. The octoploid, *Gilia crassifolia* from Argentina, possesses the highest chromosome number and the highest level of ploidy known in the Polemoniaceae.

The proportion of the species of *Gilia* sect. *Arachnion* that are polyploid is 41%. The corresponding figures for the other sections of *Gilia* subg. *Gilia* are as follows: *Gilia* sect. *Gilia*, 22%; sect. *Saltugilia*, 0%; sect. *Gilmania*, 40%. The proportion of polyploid species in the entire subgenus is 31%. Every polyploid species in the subgenus, with the single exception of one subspecies of *Gilia ophthalmoides* (*G. o. flavocincta*), is autogamous.

LITERATURE CITED

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