CHROMOSOMES OF *GUARDIOLA* (COMPOSITAE, HELIANTHEAE)

Paul Van Faasen
Hope College
Holland, Michigan 49423

Guardiola is a genus of twelve closely related species which are confined primarily to the mountains of western Mexico and extreme southern Arizona. It occurs in the oak-pine forests between 1500 and 2000 meters elevation. It is traditionally placed in the Melampodinae but is without close relatives in that subtribe. Gray (1888) and B. L. Turner (personal communication) point out that the general aspect of the plant suggests a relationship with the Coreopsidinae. Stuessey (1973) retained the genus in the Melampodinae in his review of the subtribe Melampodinae.

Examination of the chromosomes was part of a systematic study of the genus. Meiotic chromosome counts are published elsewhere (Van Faasen 1973, 1976; Van Faasen and Nadeau 1976) and are not included here.

METHODS. Buds and root tips were collected in Carnoy's 6:3:1 (absolute alcohol:glacial acetic acid:chloroform). Pretreatment of root tips in either p-dichlorobenzene or 8-oxyquinoline shortened the chromosomes so much that it was impossible to interpret chromosome morphology. For this reason untreated cells were used in this study. Acetocarmine squashes were prepared for study.

OBSERVATIONS. The meiotic chromosome number of all *Guardiola* species counted was $n = 12$. Selected meiotic configurations are illustrated in Figure 1.

The meiotic chromosomes are relatively small and nearly uniform in size, although they are slightly larger in the broad-leaved species (*G. rosei*, *G. rotundifolia*, *G. platyphylla*) than in the narrow-leaved species (*G. mexicana*, *G. arguta*, *G. tulocarpus*, *G. thompsonii*, *G. angustifolia*).

All of the cells in which I was able to determine the number of somatic chromosomes present contained 24 chromosomes. Idiograms of the somatic chromosomes of the *Guardiola* species examined are found in Figure 2 and measurements of the same are in Table 1.

The somatic chromosomes of the *Guardiola* species studied are very small and vary in length from approximately 1.7 microns to approximately 4.3 microns. No satellites were observed on any of the chromosomes.

Among the somatic karyotypes in *Guardiola* there are readily detected differences in chromosome size and total chromosome length between the broad-leaved and narrow-leaved species. Chromosome length varies from 2.3 to 4.3 microns in the broad-leaved species

Figure 1. Meiotic chromosomes of *Guardiola*. A. *G. rosei*; B. *G. rotundifolia*; C. *G. platyphylla*; D. *G. mexicana*; E. *G. arguta*; F. *G. tulocarpus*; H. *G. angustifolia*.

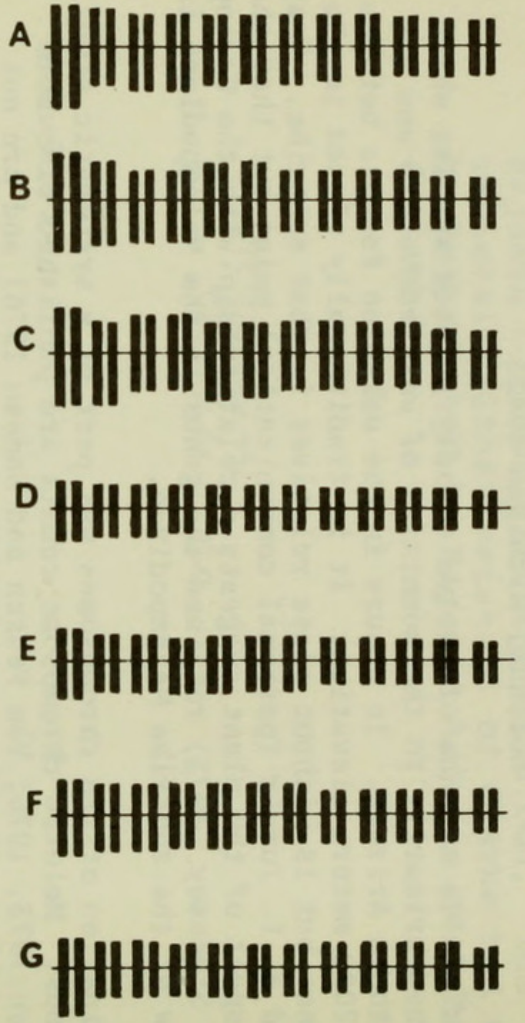

Figure 2. Idiograms of somatic chromosomes of *Guardiola*. A. *G. rosei;* B. *G. rotundifolia;* C. *G. platyphylla;* D. *G. mexicana;* E. *G. tulocarpus;* F. *G. thompsonii;* G. *G. angustifolia*.

Table 1. Mean measurements of somatic chromosomes of seven *Guardiola* species. Most possess median centromeres. Those with submedian centromeres are marked with an *.

Species	Chromosomes	Length in μ	Short arm %
Guardiola rosei	1,2	4.3	38*
	3,4	3.3	50
	5-8	3.3	40
Total chromosome length: 83.2μ	9-16	3.0	44
	17-20	2.7	50
	21-24	2.5	47
Guardiola rotundifolia	1,2	4.3	46
	3,4	3.6	45
	5-8	3.3	40
	9-12	3.3	50
Total chromosome length: 73.4μ	13-16	2.8	47
	17-20	2.7	50
	21-24	2.3	42
Guardiola platyphylla	1,2	4.3	46
	3,4	3.7	36*
	5-8	3.3	50
	9-12	3.3	40
Total chromosome length: 77.2μ	13-16	3.2	47
	17-20	2.8	47
	21-24	2.7	38*
Guardiola mexicana	1,2	2.7	44
	3-6	2.3	43
	7-10	2.2	46
Total chromosome length: 55.4μ	11-14	2.0	50
	15-22	1.8	45
	23,24	1.7	40
Guardiola tulocarpus	1,2	3.0	44
	3-6	2.7	44
	7-10	2.5	40
Total chromosome length: 55.6μ	11-14	2.3	43
	15-22	2.0	50
	23,24	1.8	45
Guardiola thompsonii	1,2	3.3	45
	3-6	3.0	44
	7-10	2.8	47
Total chromosome length: 62.6μ	11-14	2.7	50
	15,22	2.3	43
	23,24	1.8	40
Guardiola angustifolia	1,2	3.3	40
	3-6	2.5	47
	7-14	2.3	43
Total chromosome length: 55.4μ	15-18	2.2	46
	19-22	2.0	50
	23,24	1.8	45

(Table 1). The total chromosome length of the broad-leaved species varies from 73.2 to 77.8 microns while that of the narrow-leaved species varies from 49.2 to 62.6 microns. Mean lengths for the two groups are 74.8 and 55.7 microns respectively. In both the broad-leaved and narrow-leaved groups, however, species considered advanced have greater total chromosome length than more primitive ones.

The karyotypes of all *Guardiola* species examined are rather symmetrical (Figure 2); nearly all chromosomes have median centromeres. (Centromere position nomenclature follows Levan *et al*, 1965.)

Primitive karyotype characters (Stebbins, 1966) found in *Guardiola*, i.e. symmetrical karyotypes, median centromeres, and lack of secondary constrictions, suggest a generally primitive karyotype for the genus. However, the small chromosome size, a derived condition (Stebbins, 1966), indicates some karyotype evolution within the genus.

Since the chromosomes were examined in untreated cells, their morphology may have been determined at times prior to maximum shortening and arrest on the metaphase plane, the point at which karyotypes are normally studied. Thus the measurements must be considered approximations. However, consistent chromosome size differences between the broad-leaved and narrow-leaved species appear real and contribute toward that basic subdivision of the genus.

LITERATURE CITED

Gray, A. 1888. Synoptical flora of North America. Smithsonian Misc. Coll. v. 31.

Levan, A., K. Fredger and A. S. Sandberg. 1965. Nomenclature for centromeric position on chromosomes. Hereiditas 52: 201-220.

Stebbins, G. L. 1966. Chromosomal variation and evolution. Science 1952: 1463-1469.

Steussy, T. F. 1973. A systematic review of the subtribe Melampodinae (Compositae, Heliantheae). Contr. Gray Herb. 203: 65-80.

Van Faasen, P. 1973. *In* IOPB Chromosome number reports XL. Taxon 22: 291.

Van Faasen, P. 1976. A new species of *Guardiola* Humb. & Bonpl. (Compositae-Heliantheae). The Southwestern Naturalist 21: 27-30.

Van Faasen, P. and P. Nadeau. 1976. *In* IOPB Chromosome number reports LI. Taxon 25: 156-158.