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Chromosome Number and Pollen Size in the Genus Aristida

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Chromosome Number and Pollen Size in the genus *Aristida*[1]

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Abstract. Chromosome numbers and pollen measurements are given for sixty-four collections representing eight species in the grass genus *Aristida* from central and southwestern United States. Meiotic chromosome counts of N=22, 33, and 44, in *A. purpurea* are reported for the first time. Counts of N=11 and 22 in *A. fendleriana, A. glauca,* and *A. wrightii,* are new for these species, as are counts of N=11 for *A. longiseta* and *A. roemeriana.* The relationship of pollen size and ploidy level is examined in five taxa, and the occurrence of intraspecific polyploidy in the genus is noted.

The cosmopolitan grass genus *Aristida* consists of approximately 300 species, about 40 of which are found in North America. They are characterized by having one-flowered spikelets with indurate, sharp-pointed lemmas prolonged into three awns. Taxonomy of the North American species is difficult due to the wide distribution and variation of most species.

This paper deals with the results of cytological studies during the past two years on eight common species of the Central and Southwestern United States. With one exception, (*A. adscensionis*), all are tufted perennials of widespread distribution in poor soils and disturbed areas.

These taxa have generally been distinguished on the basis of spikelet and awn lengths and the appearance of the inflorescence. There is such wide variation in these characters, however, that the existing taxonomic treatments are confusing. Very few chromosome counts have been obtained for these grasses, and little is known about their reproductive biology and ecology.

To obtain significant additional cytological and morphological data for a taxonomic revision of the genus in North America, field studies and collections are being made throughout the ranges of these species. A total of sixty-four chromosome numbers, involving eight species, were examined to determine if there is significant correlation of different ploidy levels and the size of pollen grains. Correlations of this type have been useful in taxonomic studies of a number of other grass genera.

Methods

Young inflorescences were collected in the field and fixed in Carnoy's, (4 parts chloroform: 3 parts absolute ethanol: 1 part

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glacial acetic acid). Material was left in the fixative for periods of up to three weeks before being refrigerated. Prolonged storage in the fixing solution had no apparent adverse effects on subsequent cytological studies.

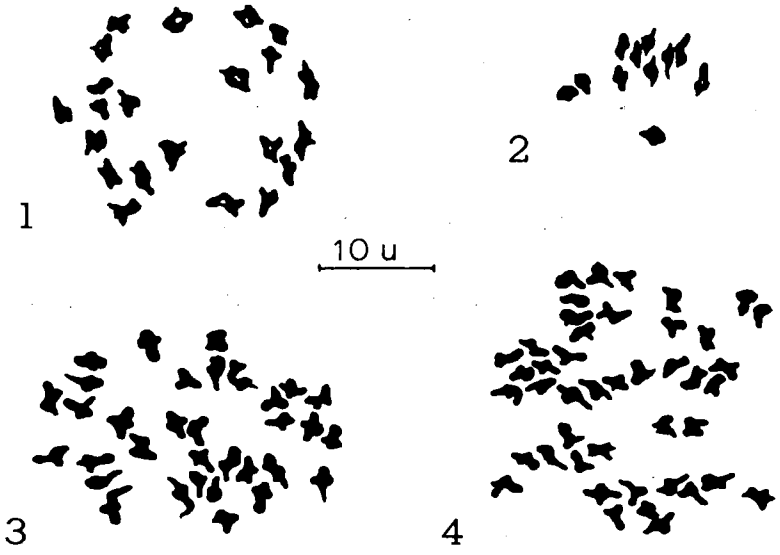
Dissected anthers were macerated on a slide in aceto-carmine; then squashed under a cover glass. Prepared slides of the chromosomes were made semi-permanent by application of a drop of Hoyer's medium to the macerated anthers prior to addition of the cover glass. Camera-lucida drawings were made of all meiotic figures to facilitate counting the chromosomes. Voucher specimens are deposited in the Simpson College Herbarium together with the slides from which counts were obtained.

Pollen grains were obtained from anthers of dried collections. Spikelets containing mature anthers were soaked in a wetting agent (Pohl, 1954). The anthers were removed and transferred to a slide containing a drop of lacto-phenol and cotton-blue stain. After maceration to force out the pollen, a cover glass was added. Slides so prepared were allowed to stand for twenty-four hours before examination of pollen. Measurements were made on one-hundred pollen grains per slide using a calibrated ocular micrometer and a 43X objective. Diameters were recorded to the nearest tenth micron.

Cytology

Polyploidy in genetically related types, in which chromosome numbers are multiples of each other, is a widespread feature of higher plants, and the literature abounds with reports of its occurrence in many genera of the Gramineae. Intraspecific polyploidy is also well documented, but, as far as is known, has not been reported in *Aristida*. My cytological studies of the genus reveal the existence of intraspecific polyploid series in six widely distributed species of *Aristida* from central and southwestern United States. The taxa concerned include, *A. fendleriana, A. glauca, A. longiseta, A. roemeriana, A. purpurea,* and *A. wrightii.* Chromosome counts and collection locations are given in Table 1. The four ploidy levels observed are shown in Figures 1-4.

Gametic chromosome numbers of N=11, 22, 33, and 44 were observed in collections of *A. purpurea.* The only previous records for this species are N=11 (Gould, 1958) and 2N=22 (Gould, 1968). My counts of N=22, 33, and 44 are new for this taxon. Counts of N=33 by Gould (1958) and 2N=66 (Gould, 1968) are verified by my own counts for *A. wrightii,* to which N=11 and 22 are now added. The numbers N=11, and 22, were also observed in *A. longiseta.* Gould (1958) reports N=11 for this species. Meiotic counts made on five different collections of *A. roemeriana* were all



Figures 1-4. Camera-lucida drawings of meiotic chromosomes in *Aristida*. Figure 1. *A. wrightii* (N=22). Figure 2. *A. roemeriana* (N=11). Figure 3. *A. wrightii* (N=33). Figure 4. *A. purpurea* (N=44).

consistently N=11. The only previous record for this taxon is the number 2=44 (Gould, 1968). The number N=22 in three collections of *A. hamulosa* is in accord with reports by Gould (1968) and Stebbins and Love, (1941). Gould (1960) indicates the num-

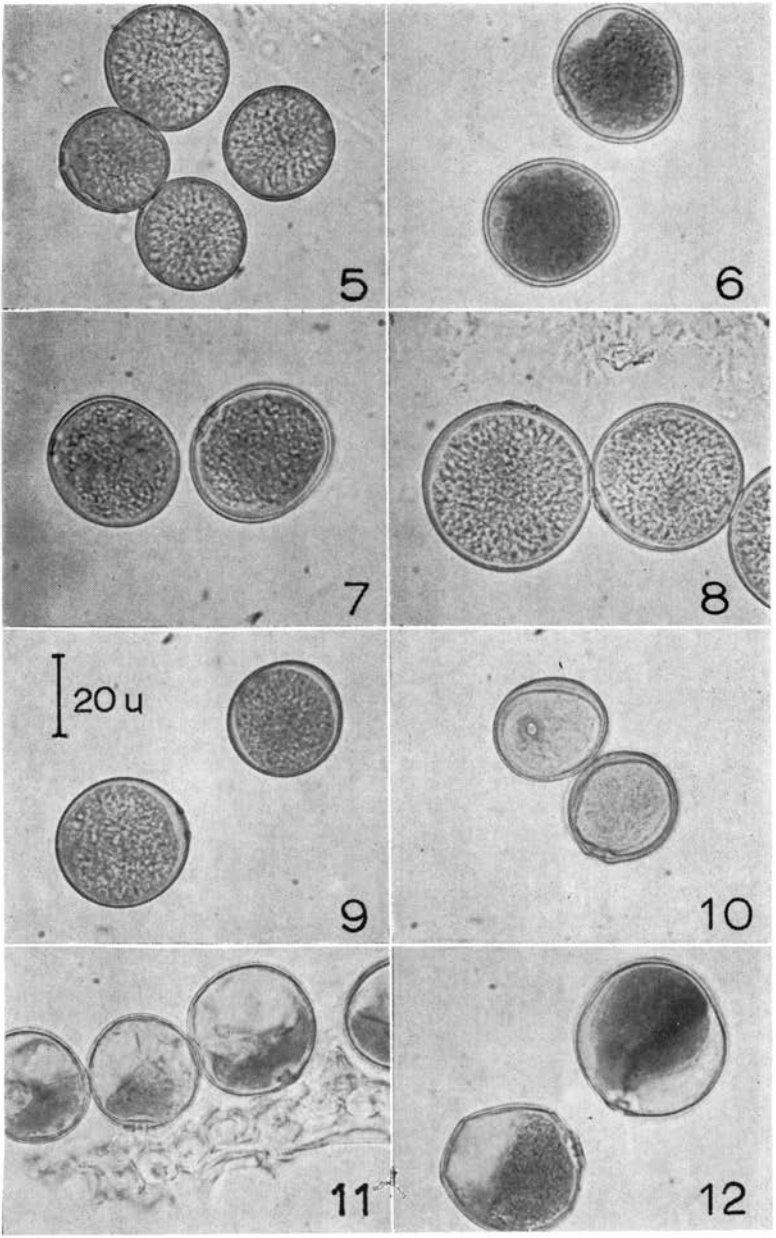
Table 1. Gametic chromosome numbers and pollen diameter, in microns, of eight species of *Aristida*.

Species	Gametic Number	Pollen Diameter Mean	Range	Location & Voucher Number[a]
A. adscensionis L.	11	33.4	28.6-35.6	San Saba Co., Texas, Shinners 30148
A. fendleriana Steud.	11	30.9	25.3-36.8	Lea Co., New Mexico, 1567
	11	27.5	23.0-32.2	Culberson Co., Texas, 1765
	22	32.2	28.7-34.5	Lincoln Co., New Mexico, 1761
	22	35.6	32.2-40.2	Hudspeth Co., Texas, 1764
A. glauca (Nees) Walp.	11	33.3	31.1-36.8	Kinney Co., Texas, 1568
	11	32.2	27.6-34.6	Travis Co., Texas, 1239
	11	28.8	25.3-32.1	Burnet Co., Texas, 1300
	22	30.8	27.6-36.8	Brewster Co., Texas, 1781
	22	34.1	25.3-41.4	Culberson Co., Texas, 1767
	22	43.3	36.8-50.6	Lea Co., New Mexico, 1577
	22	41.6	34.5-50.6	Brewster Co., Texas, 1590
	22	31.2	25.3-37.9	Val Verde Co., Texas, 1597
	22	36.3	29.9-49.4	Terrell Co., Texas, 1595
	22	32.6	27.6-39.1	Scurry Co., Texas, 1792

Table 1. Continued.

Species	Gametic Number	Pollen Mean	Diameter Range	Location & Voucher Number[a]
A. hamulosa Henr.	22	27.4	23.0-33.4	Brewster Co., Texas, 1786
	22	30.7	25.3-36.8	Brewster Co., Texas, 1785
	22	23.4	18.4-29.9	Brewster Co., Texas, 1780
A. longiseta Steud.	11	30.5	25.3-36.8	Motley Co., Texas, 1796
	11	25.8	20.7-31.0	Bee Co., Texas, 1614
	11	29.8	23.3-34.5	Zapata Co., Texas, 1604
	11	32.4	26.4-42.5	Lea Co., New Mexico, 1567
	11	30.9	26.5-36.8	Jeff Davis Co., Texas, 1775
	22	31.2	26.4-34.5	Texas Co., Oklahoma, 1746
	22	30.0	25.3-35.6	Texas Co., Oklahoma, 1745
	22	28.1	25.3-33.4	Texas Co., Oklahoma, 1749
	22	27.9	23.0-34.5	Texas Co., Oklahoma, 1747
	22	33.1	27.6-41.4	Quay Co., New Mexico, 1756
	22	32.5	26.4-36.8	Quay Co., New Mexico, 1757
	22	32.3	23.3-36.9	Potter Co., Texas, 1753
	22	27.9	23.0-34.5	Moore Co., Texas, 1750
	22			Fremont Co., Colorado, 1722
A. purpurea Nutt.	11	33.7	25.3-36.8	Brewster Co., Texas, 1789
	22	41.7	34.5-50.6	Comal Co., Texas, 1616
	22	32.6	25.3-39.1	Motley Co., Texas, 1797
	22	31.3	27.6-36.8	Kent Co., Texas, 1795
	22	33.2	29.9-39.1	Jeff Davis Co., Texas, 1771
	22	29.2	25.3-32.2	Willacy Co., Texas, 933
	22	34.1	27.6-40.3	Karnes Co., Texas, 911
	22	26.7	23.0-32.2	Kenedy Co., Texas, 1608
	22	31.7	25.3-36.8	Baylor Co., Texas, 1561
	22	34.1	27.6-42.5	Comal Co., Texas, 1615
	22			Brooks Co., Texas, 948
	33	35.6	32.1-39.1	Potter Co., Texas, 1751
	44	40.3	33.4-43.7	Potter Co., Texas, 1752
	44			Texas Co., Oklahoma, 1701
A. roemeriana Scheele	11	25.3	20.7-34.5	Cameron Co., Texas, 1607
	11	36.8	29.9-43.7	Kenedy Co., Texas, 1610
	11	32.1	27.6-39.1	Zapata Co., Texas, 1605
	11	28.6	24.2-36.8	Kenedy Co., Texas, 1609
	11	32.7	25.3-41.4	Kenedy Co., Texas, 1611
A. wrightii Nash	11	33.3	28.6-39.0	Kenedy Co., Texas, 1271
	22	32.4	25.3-37.9	Brewster Co., Texas, 1784
	22	32.3	29.9-36.8	Brewster Co., Texas, 1783
	22	33.3	28.7-36.8	Bee Co., Texas, 1613
	22	35.6	31.0-39.1	Kenedy Co., Texas, 1275
	22			Pecos Co., Texas, 1594
	22	36.8	29.9-44.8	Brewster Co., Texas, 1588
	22	29.9	27.6-32.2	Brewster Co., Texas, 1589
	22	34.5	28.7-40.2	Burnet Co., Texas, 1617
	22	28.8	26.4-33.3	Travis Co., Texas, 1234
	33	43.4	36.6-48.3	Lea Co., New Mexico, 1566
	33	33.3	29.9-39.1	Otero Co., New Mexico, 1763
	33	29.5	25.3-33.4	Guadalupe Co., New Mexico, 1759
	33			Travis Co., Texas, 894

[a]All collection numbers are the authors unless otherwise noted.



Figures 5-12. *Aristida* pollen. Figure 5. *A. roemeriana* (N=11). Figure 6. *A. fendleriana* (N=22). Figure 7. *A. wrightii* (N=22). Figure 8. *A. wrightii* (N=33). Figure 9. *A. purpurea* (N=11). Figure 10. *A. purpurea* (N=22). Figure 11. *A. purpurea* (N=33). Figure 12. *A. purpurea* (N=44).

ber N=11 for *A. adscensionis* which I also observed in this species. The numbers N=11, and 22 observed in *A. fendleriana* and *A. glauca* are new for these two taxa.

Pollen Size and Morphology

Several workers (Celarier and Mehra, 1958; Kapadia and Gould, 1964) have recently examined correlations between pollen size and chromosome numbers in grasses. In some cases these correlations have provided useful data for delimiting taxa and for determining ploidy levels without the necessity of making chromosome counts. Pollen studies in *Aristida* were done to determine if similar correlations exist in this genus and to see if they might be of use in subsequent taxonomic treatments.

Pollen measurements were made on most of the collections for which chromosome numbers had been determined. The mean and ranges of pollen diameters are listed in Table 1. The pollen of all taxa examined was quite uniform morphologically, but showed considerable variation in size. Morphology and size variations are shown in Figures 5-12. In general, larger pollen diameter was noted in plants with high chromosome numbers, i.e. N=33, Figures 8 and 11, and N=44, Figure 12. At lower ploidy levels (N=11 and

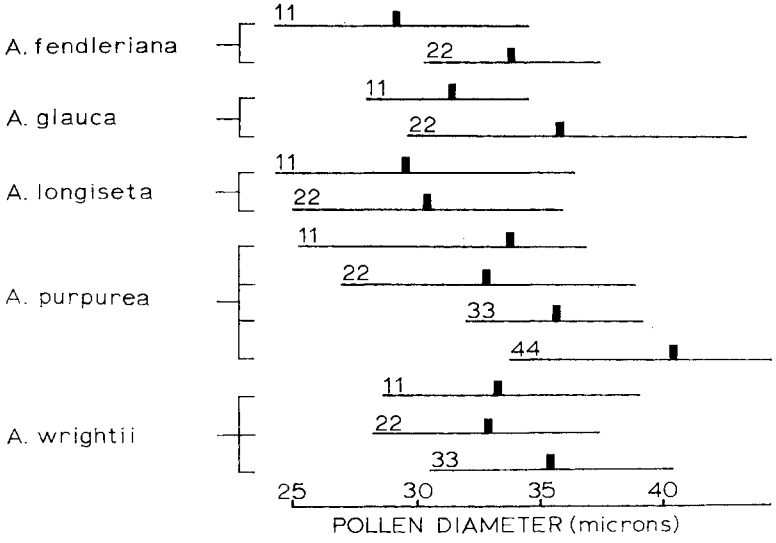


Figure 13. Average mean and range of pollen diameter in five species of *Aristida*. Vertical bars indicate the means; horizontal lines designate the ranges. Meiotic chromsome numbers are shown at the left of each line.

22), there is fairly good correlation in ploidy and pollen diameter in *A. fendleriana* and *A. glauca*. However, in *A. purpurea* and *A. wrightii* pollen diameter is greater in the diploids than in the tetraploids, as indicated in Figure 13. The mean pollen diameters (Figure 13, and Table 1.) are all quite close and there is considerable overlap in the ranges of variation. It should also be noted that in four determinations (Table 1.) only one collection was available for each.

Discussion

The presence of intraspecific polyploidy is indicated in six closely related taxa of the genus *Aristida,* and to my knowledge, this is the first record of its occurrence in the genus. The basic chromosome number is X=11, with multiples of the number observed up to the octoploid level in one species, and at the hexaploid level in two species. It is of interest that those collections with the highest chromosome number (N=44) are from the panhandle region of Texas and Oklahoma.

My observations have shown little or no relationship of morphology of vegetative and floral characters to ploidy level within a species. This fact would suggest the existence of cryptic polyploidy (Davis and Heywood, 1963) a situation wherein several cytological races or cytodemes occur which cannot be distinguished morphologically from one another. All taxa observed having more than one chromosome number are xeromorphic perennials. Stebbins (1966) suggests that polyploidy may confer some selective advantage on perennials growing in xeric regions. An understanding of the full significance of polyploidy in these species of *Aristida,* must await further study to determine how extensive it is, and if, indeed, there are correlative morphological traits at different ploidy levels.

There is reasonably good correlation of pollen diameter with chromosome number in several species of *Aristida.* However, there are only relatively small differences in mean pollen diameters among the fixe taxa studied, and all exhibit wide ranges of variation which overlap considerably. Until more data are available, the utility of this trait in estimating ploidy in the genus is open to question.

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