Interspecific Hybrids in Bothriochloa
III. Relationships of Some American Species[1]

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Although the genus *Bothriochloa* O. Kuntze is confined mostly to the Old World, a number of species are present in South, Central and North America. These are highly variable morphologically and characterized by $2n=60$, 120 and 180 chromosomes (Gould 1953, 1955, 1957a,b, 1958, 1959). It was observed by us that the synonymy of some of these species is rather confusing and no serious attempt has been made to determine their phylogenetic relationships. Cytological studies at this institution and of Gould *(loc. cit.)* revealed that most of the New World species of this genus, although high polyploids, are very regular in their meiotic behaviour. A cytotaxonomic study of *B. saccharoides* var. *torreyana* (Steud.) Gould and var. *longipaniculata* (Gould) Gould, *B. exaristata* (Nash) Henr., and hybrids of these two species will be presented. The hypothesis of Gould (1956b) that *B. saccharoides* var. *longipaniculata* has arisen from hybridization of *B. exaristata* and *B. saccharoides* var. *torreyana* will also be discussed in this paper.

Seven collections of *B. saccharoides* var. *torreyana* from Oklahoma, Texas, Hawaii, Argentina and Uruguay; two of *B. saccharoides* var. *longipaniculata* from Texas and Argentina; and two of *B. exaristata* from Argentina and Brazil have been studied. Eight interspecific hybrids of *B. saccharoides* var. *torreyana* and *B. exaristata* were obtained as described by Richardson (1958). All the plants were grown in a uniform nursery as outlined by Celarier and Harlan (1956). Cytological studies were made by means of the standard acetocarmine squash technique. Microsporocytes were fixed in Carnoy's fluid (6:3:1) and stored in 70% alcohol at $\pm 5°C$. Herbarium specimens have been deposited with the Department of Botany and Plant Pathology of the Oklahoma State University.

Gould (1957a) in his key to the native and naturalized species of this group classifies the taxa on the basis of the length of the sessile spikelet, awn length, panicle length, shape and color of the glume, pollen size and chromosome number. On the basis of pollen size and chromosome number, as pointed out earlier, he considers that *B. saccharoides* var. *longipaniculata* ($2n=120$), with non-pitted glumes, has arisen from hybridization of *B. exaristata* ($2n=60$) and *B. saccharoides* var. *torreyana* ($2n=60$). The hybrids of *B. saccharoides* var. *torreyana* ($2n=60$) and *B. exaristata* ($2n=60$) obtained by us have $2n=60$ chromosomes. The parents, hybrid and var. *longipaniculata* are plotted on a pictorialized scatter diagram in Fig. 1. The hybrid is intermediate and var. *longipaniculata* has almost double the size of the characters measured in the hybrid. The general appearance of the hybrid and var. *longipaniculata* is somewhat similar The presence of hairs at culm nodes is a variable character in var. *torreyana* and it appears that in var. *longipaniculata* also the presence of hairs at culm nodes depends upon its progenitor. The inflorescence of the var. *longipaniculata* is rather compact when compared to *B. exaristata* which has a loose and spreading type of inflorescence. The spikelet number and branching of *B. exaristata* appears to have combined with the compactness of var. *torreyana* in var. *longipaniculata*.

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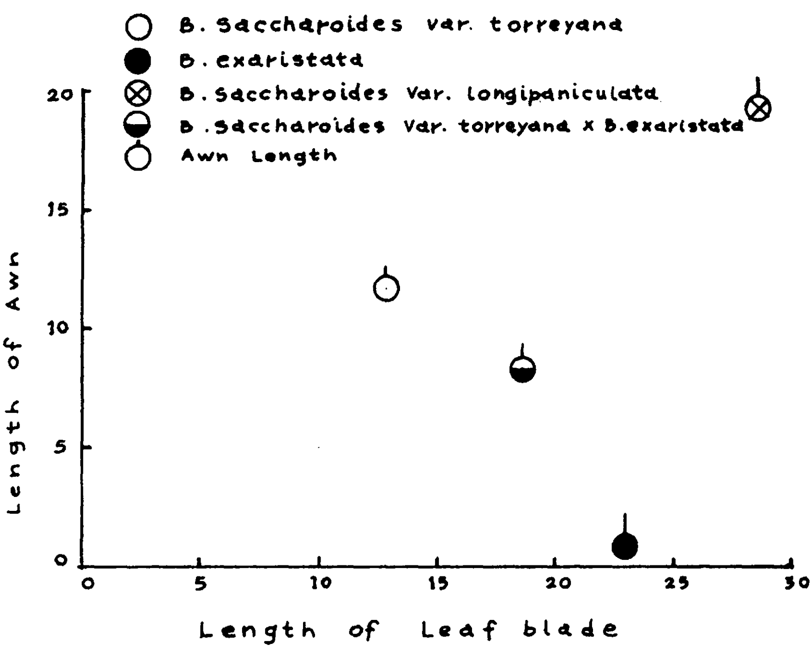

Figure 1. Pictorialized scatter diagram showing some morphological characters in the species and the hybrid.

Chromosome pairing at IM in the collections has been found to be quite regular. Sometimes due to the early separation of chromosomes, two univalents are found. The average frequency of bivalents per cell is 30 in both *B. exaristata* and *B. saccharoides* var. *torreyana*. The hybrids, on the contrary, are highly irregular and show 36 to 58 univalents at IM. The details regarding chromosome behaviour are given in Table 1. It appears that the non-pairing of chromosomes at IM during meiosis in the hybrids is due to non-homology of the chromosomes indicating that the two species *B. exaristata* and *B. saccharoides* var. *torreyana* are distinctly separate taxa. The complete pairing and formation of 30II at IM in the parents indicates that the species are normal allopolyploids. Other American species such as *B. barbinodis* have $2n=180$, *B. altus, B. saccaroides* var. *longipaniculata* have $2n=120$ chromosomes. The chromosomes behave normally in these species during meiosis and form 90 II and 60 II respectively at IM indicating that they are allopolyploids. When hybrids are made between these species the meiotic behaviour of chromosomes is quite irregular and a large number of univalents are found. It may be that the higher-ploid species have arisen from doubling of such hybrids resulting in alloploid or amphiploid species with regular chromosome pairing. Stebbins (1947) has defined such polyploids as true allopolyploids. They rarely have multivalent associations and resemble diploids to a large extent in their cytogenetic behaviour. The collections studied in the present investigations cannot be classified as autopolyploids which are usually characterized by the presence of multivalents at meiosis.

TABLE 1. CHROMOSOME BEHAVIOUR AT I METAPHASE

Accession or Hybrid Number	Location	2n =	Chromosome Range I	Chromosome Range II	Av. per cell I	Av. per cell II
A. 2579. **B. saccharoides** var. *torreyana*	Oklahoma	60				
A. 2580. **B. saccharoides** var. *torreyana*	Oklahoma	60				
A. 3133. **B. saccharoides** var. *longipaniculata*	Argentina	120		60		60.00
A. 3693. **B. saccharoides** var. *longipaniculata*	Texas	120	Gould	(1955)		
A. 4085. **B. saccharoides** var. *torreyana*	Hawaii	80				
A. 4396. **B. saccharoides** var. *torreyana*	Argentina	60	0-2	29-30	0.40	29.80
A. 6096. **B. saccharoides** var. *torreyana*	Texas	60				
A. 6235. **B. saccharoides** var. *torreyana*	Uruguay	60	0-2	29-30	0.09	29.95
A. 7302. **B. saccharoides** var. *torreyana*	Oklahoma	60		30		30.00
A. 6326. *B. exaristata*	Argentina	60		30		30.00
A. 6591. *B. exaristata*	Brazil	60		30		30.00
B. saccharoides var. *torreyana* x *B. exaristata*		60	36-58	2-12	48.36	5.81

In conclusion it may be said that the two species *B. exaristata* and *B. saccharoides* are valid species as they have considerable morphological and cytological differences. It is believed that hybridization of *B. saccharoides* var. *torreyana* with *B. exaristata* followed by chromosome doubling gave rise to *B. saccharoides* var. *longipaniculata*.

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