Agronomic Significance of Supernumary Chromosomes in Crested Wheatgrass

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Previous studies of supernumerary, accessory, or B-type chromosomes have emphasized morphology, cytological behavior, and frequency in various populations. The agronomic significance of these chromosomes has received scant attention.

In rye, Müntzing (7) observed significant negative correlations between the number of accessory chromosomes and kernel weight per plant, number of kernels per ear, percent seed set, and pollen fertility. Plants with six or more accessories were significantly lower in weight than plants without these chromosomes. The author concluded that plant fertility was more severely depressed by accessory chromosomes than was vegetative development.

Randolph (11) observed undesirable effects of B-chromosomes in corn. Large numbers of B-chromosomes caused reductions in fertility and plant vigor; the formation of defective seeds which were frequently germless; and an increase in the percentage of aborted pollen. Genetic tests involving genes located on 17 arms of the basic complement indicated that these chromosome regions were not represented in the B-chromosomes.

Several workers have studied the effects of accessory chromosomes in perennial forage grasses. Bosemark (2) obtained inconclusive results from populations of Festuca pratensis with small numbers of accessories and attributed this to the narrow genetic base of his plant material. However, fertility was depressed consistently in populations with large numbers of additional chromosomes. In Anthoxanthum one to four accessories were associated with irregular pollen mitosis and a reduction in fertility (10). Östergren (9) concluded that accessory chromosomes have no useful function and often lead an exclusively parasitic existence. Hill and Myers (3) and Nielsen (8) noted variation in somatic and meiotic chromosome numbers of Bromus inermis. They considered chromosomes in addition to the basic complement analogous to B-chromosomes. Reduced fertility was observed in plants with chromosome numbers higher and lower than the basic number of the species.

Diploid and tetraploid varieties of crested wheatgrass are grown as forage and seed crops in the drier parts of Western Canada. An extensive breeding program with this crop is being conducted at the Canada Agriculture Research Station, Saskatoon. Since supernumerary chromosomes occur with a high frequency in the commercial variety Summit (1, 5), and because this variety is characterized by low fertility, a study was initiated to determine the significance of supernumeraries in breeding improved strains. Investigations of the effect of supernumerary chromosomes on fertility were particularly emphasized. Combining ability of selected plants, as shown by forage and seed yields of their open-pollination progenies, was also studied in relation to supernumerary chromosomes.

Materials and Methods

The plant material used in this study included selected plants of strains S-841, S-1333, and Summit, and open-pollination progenies of these selections, all of which were described in detail in an earlier report (1). The main objectives in selection were high...