Breeding Crested Wheatgrass for Seed Size and Yield

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INCENTIVES for the improvement of seed characters in perennial forage grasses are (1) the low cost of seeding as a means of propagation, (2) age-old problems of stand establishment, and (3) difficulties in seed processing, handling, and planting. Traits most often considered in grass-breeding programs for seed improvement are yield and size. These characteristics are particularly important in crested wheatgrass and other range grasses planted on large acreages and usually under adverse conditions.

Positive relations between seed size and seedling vigor of forage grasses have been demonstrated by Kneebone (5) and Kneebone and Cremer (6) in sand bluestem, indiangrass, switchgrass, buffalograss, and sideoats grama, by Tossell (11) in smooth brome, and by Lawrence (7) in intermediate wheatgrass. In crested wheatgrass, Rogler (9) found a close relation between seed size and ability to emerge from increasing depths of planting. Seed quality as well as inherited traits other than size undoubtedly affect seedling vigor and stand establishment (3). Selection for seed size, however, is a criterion easy to use in breeding for seedling vigor (9). Increased size also improves processing, handling, and planting qualities of grass seed.

Detailed knowledge of relations among seed size, yield, and other heritable seed and forage traits is essential for intelligent execution of programs directed at improving these characters. A significant step in that direction was provided by Dewey and Lu (2) with their comprehensive correlation and path-coefficient analysis of components of seed production in a spaced population of crested wheatgrass. The most important components of seed yield were seed set and plant size (mature-plant weight). A significant negative correlation between seed set and plant size, however, intimated the necessity for compromise in selection for the two characters to attain maximum seed yields. On the basis of data from crested wheatgrass strain tests covering an 11-year period, Schaaf et al. (10) reported a very highly significant average correlation, \( r = +0.403 \), between forage yields and seed sizes obtained in solid plantings and spaced rows, respectively.

This report provides information on associations between seed yield and size for selected crested wheatgrass clones and their polycross progenies. In addition, data are presented on performances of 2-clone synthetics in the Syn\(_1\), Syn\(_2\), and Syn\(_3\) generations.

MATERIAL AND METHODS

Data are presented from a clonal nursery established in 1955 and from 6 seeded tests established from 1950 to 1957. All have been described elsewhere (10).

The 1955 clonal nursery included 15 clones of Agropyron desertorum (Fisch.) Schult. maternal parentage. All were vigorous plants and together represented relatively wide ranges in both seed yield and size. Vegetative propagules of these clones were set out on 3-foot centers in a block of 8 replications. Seed was harvested from the nursery in 1956, 1957, and 1958. Seed yields, reported as pounds per acre calculated on the basis of plots 3 feet square, are 3-year averages. Seed weights, expressed as grams per 200 seeds, were determined for seed produced in 1957 and 1958 and are presented as 2-year averages. As used here, seed weight is considered synonymous with seed size. Seeded progenies of each clone were established in 1957 (test described below) with composite seed from the 1956 harvest. Nordan, an improved crested wheatgrass variety (8), was included in the test.

Seed of 2-clone synthetics was produced by interplanting several cuttings of the 2 parental clones in isolation. Equal parts of seed from each parent were bulked for the Syn\(_1\) generation of all synthetics except two. Both exceptions resulted through loss of seed from one of the parents involved. The term "synthetic" is used here in accordance with Kehr, et al. (4). A 2-clone synthetic is the product of intercrossing 2 clones grown together in isolation under open-pollination conditions. The first generation of a synthetic is designated Syn\(_1\), and more advanced generations as Syn\(_2\), Syn\(_3\), and so forth.

The synthetics, along with other crested wheatgrass strains, were grown in seeded tests established in 1950, 1952, 1953, 1955, 1956, and 1957 (10). Plots were single rows spaced 3 feet apart and 20 feet long, with permanent 1-foot alleys between the ends of abutting plots. Randomized complete-block designs were used. The 1950 and 1952 tests consisted of 3 replications, the 1953 test 5 replications, and all remaining tests 4 replications. Seed harvests were made at the stiff-dough stage in each test for 3 successive years after the year of establishment. Both seed yields and weights, presented as pounds per acre and as grams per 200 seeds, respectively, are 3-year averages. Since all 6 tests included entries other than those reported here (10), the LSD's and CV's given are those obtained in variance analyses which included all entries in each year and respective tests. Forty pounds of N per acre were applied each fall.

EXPERIMENTAL RESULTS

Clonal Performance in Relation to Polycross Progeny Performance

Differences in seed yield and weight among the 15 clones and their polycross progenies were significant at the 1% level or higher for both characters for all determinations. Average seed yields and weights for the clones and for...