Interrelations Among Vigor, Height, and Seed-Set Following Self- and Open-Pollination of Timothy (Phleum pratense L.)

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THE establishment of interrelationships among plant characters, both within and between generations, is of interest in a timothy improvement program. Characteristics considered in this paper include vigor, plant height, and seed-set following self- and open-pollination in S₀, S₁, and S₂ populations. Although this species has been subjected to many investigations, data dealing with correlated studies between inbred and open-pollinated populations are relatively scarce.

The literature relating to timothy has been reviewed recently (3); hence only that regarded as particularly pertinent is referred to in this paper. Nilsson (4) found an average of 27.3 seeds per panicle following self-pollination of 131 plants of several strains. The average is based on 0 to 521 seeds obtained per panicle selfed. Variations in self-fertility were attributed to the genetic nature of different individuals. Cross-pollination produced from 67 to 552, with a mean of 261, seeds per inflorescence. A positive correlation of 0.72 was obtained between seed-set in selfed and open-pollinated inflorescences of previously non-inbred plants. Associations between self- and cross-fertility among different families tended to be statistically nonsignificant. However, this relationship was highly significant (r = 0.41; P > 0.001) when the computation was based upon the entire population. Nilsson regarded variations in self- and cross-fertility as independent. Significant positive inter-annual correlations were recorded in height of families (1). Intra-annually, height and general fertility, and height and self-fertility, were closely correlated.

Hayes and Barker (2) found that seed-set following self-pollination varied from 1 to 331 seeds per panicle of greenhouse-grown plants. Seed-set in an isolated field varied from 0 to 495 seeds per inflorescence. The variations were considered genotypic.

Nielsen and Smith (3) found no correlation between vigor of S₀ and S₁ seedlings whereas the vigor of the S₀ and S₁ adult plants was highly correlated. The mean heights of S₀ and S₁ progenies in their first heading year were closely associated.

MATERIALS AND METHODS

The plants included in the investigations were derived from polycross progenies of 81 plants. The sources included: 28 Lorain, 12 Hopkins, 4 Drummond, 3 Marietta, 2 each of Climax, Milton, Bottinia, and Omnia, and 26 plants from sources such as foreign plant introductions and local collections.

Polycross progenies were established during May 1954. Data relating to plant height, vigor, and seed-set following self-pollination and open-pollination were obtained during 1955, 1957, and 1959 for the successive generations.

The height of plants was measured in inches and vigor was based upon arbitrary classification with 1 representing superior and 3 representing inferior performance or desirability. Approximately 450 plants were self-pollinated. The plants selfed were selected on the basis of superior height, vigor, and freedom from foliage diseases. Thus, the population examined did not necessarily represent a random population of the species.

Self-pollination was effected by enclosing five panicles in parchment selfing sleeves. Usually three sleeves were applied to each plant. Self- and open-pollinated panicles were harvested at maturity, threshed, and cleaned, and the amounts of S₀ and S₁ seed-set from self- and open-pollination of S₀ and S₁ plants were determined. The number of seedlings obtained following self-pollination was determined from lots being propagated for establishment in field plantings. Since a single Caryopsis of timothy weighs approximately 0.4 mg., the amount of viable seed resulting from selfing could be determined. Seed-set was expressed in milligrams per centimeter of spike. The S₀ seed-set and that resulting from open-pollination of all plants considered were, in all cases, calculated from the weight of cleaned seed obtained from measured spikes. This was also expressed in milligrams per centimeter of spike.

Correlation coefficients were computed to estimate the relationships among pollen stainability and seed-fertility, height, and vigor to determine their transmissibility in successive generations. Open-pollination seed-set of inbred lines is designated as S₀, with n = 0, 1, 2, or 3 indicating generations of inbreeding. All observations made in the S₀ generation represent single-plant values and S₀ and S₁ values for characters (including seed-set) and S₀ seed-set were based upon family means.

RESULTS

The association examined and their r² values are tabulated in Table 1. Vigor and height were positively associated within generations, whereas no association was found among different generations. Similarly, no relationships were found between height or vigor when the family means of these characters were studied in different generations.

The association of vigor with OP seed-set followed essentially the same pattern. For example, S₀ vigor: S₀ seed-set, S₁ vigor: S₀ (OP) seed-set, and S₃ vigor: S₀ (OP) seed-set were positively related. However, the relationships of vigor to selfed seed-set were not significant excepting in the comparison of S₀ vigor and S₁ seed-set. This discrepancy has not been resolved.

1 Results of co-operative investigations of the Crops Research Division, ARS, USDA, and the Wisconsin Agricultural Experiment Station, Madison. A portion of a thesis submitted by the senior author in partial fulfillment of the requirements for the Ph.D. degree, University of Wisconsin, Received Jan. 30, 1961.
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