Early Generation Testing of Diallel Crosses of Soybeans

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Early-generation testing of progenies from crosses between selected parents has been a subject of considerable study in self-pollinated crops, including soybeans. Recent literature reviews on the topic in self-pollinated species, and specifically soybeans, have been presented by Elliott (1) and Johnson (6), respectively. The most general problem has been concerned with the effectiveness of selection for high yield of seed among and within crosses during the early generations after hybridization. Judicious selection of parents has been an accepted part of the breeding procedure, but little information has been obtained on the relative merits of soybean varieties as parents. Possible explanations for the failure to recognize high yielding progenies in early generations include: (1) genotype-environment interactions, (2) inadequate testing in time and space, (3) heterosis attributable to epistatic or dominance effects of genes which is not obtained or maintained in pure lines, (4) heterozygosity and heterogeneity of genotypes within progenies, and (5) interplant and interplot competition. The studies reported herein were conducted to determine the value of parental and early generation progeny performance in identifying crosses that would yield segregates most desirable for various agronomic or chemical characters.

Materials and Methods

The 10 parents and all the possible 45 $F_2$ single crosses among them that constituted the basic plant materials were described previously by Leffel and Weiss (7). Space-planted nurseries of the 45 $F_2$ populations were evaluated at Beltsville in 1953 and 1954 and a sample of 160 $F_2$ plants per cross for subsequent $F_3$ line tests. Each $F_3$ line is defined herein as the progeny of an $F_2$ plant. $F_3$ bulk populations of all 45 crosses and the 10 parent varieties were evaluated at 3 locations, Beltsville, Cambridge, and Upper Marlboro, Md., in 1953 and 1954. Similarly, the 45 $F_2$ and 10 parents were evaluated at Beltsville and Cambridge in 1955 and 1956. Seed for each $F_3$ bulk population was a composite of equal numbers of seeds from each of the three previous $F_2$ bulk populations tests of 1953. $F_3$ line tests were conducted in four environments: Beltsville and Cambridge, 1955 and 1956. Each $F_3$ line test evaluated a different random sample of 20 $F_3$ lines from each of the 45 crosses, thus allowing 80 $F_3$ lines per cross to be evaluated. A summary of all experiments is provided in Table 1.

Forty-five $F_3$ lines (one per cross) were grouped as sub experiments within a replication of a randomized complete block design for all four $F_3$ line tests, the $F_1$ generation was evaluated in a split-plot 7 X 7 simple lattice (7), the 1953 $F_2$ space-planted nursery was designed as a 7 X 8 simple rectangular lattice and all $F_2$ space-planted nurseries utilized a 7 X 8 triple rectangular lattice design. $F_2$ and $F_3$ bulk and $F_3$ line tests were evaluated for seed yield, size, and quality; for plant maturity, height, and lodging; and for oil and protein contents and purple stain (Cercospora kikuchii (T. Matsu. and Tomoyasu) Gardner) score of seed. The 1953 $F_2$ space-planted nursery was evaluated for these same characters except plant lodging. $F_2$ space-planted nurseries were evaluated for oil and protein contents and height. Evaluation of characters in all environments was described in detail previously (7). Spaced $F_2$ and $F_3$ line tests were evaluated similarly, with the following exceptions or additions: