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A MODIFIED PEDIGREE METHOD OF SELECTION IN SOYBEANS[1]

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THERE are no reliable methods available to the plant breeder for predicting the hybrid combinations from which the highest proportion of superior segregates will be derived. Consequently, the breeder is forced to evaluate the progeny of as many crosses as possible with the facilities available. Thus breeding procedures which utilize the facilities as efficiently as possible must be chosen.

It has been pointed out that when genetic variance for a character is all additive the means of the generations do not change with inbreeding. Further, with inbreeding, variance among progeny means will increase while variance within progenies will decrease. The evidence available (1,2,5) indicates that a large proportion of the genetic variance is additive for economic traits in soybeans. Brim and Cockerham (1) showed in soybeans that expected progress from selecting the upper 5% of the progenies increased with selfing but at a decreasing rate. Our results indicated that additional gain from inbreeding must be weighed against the time and effort involved, but that there would almost always be an advantage to inbreed the parents to the F_3, and often to the F_4, before evaluating the progenies.

A method devised at this station for advancing generations to the desired level of inbreeding in soybeans has been in use for several years. This procedure is an adaptation of a scheme proposed by Goulden (3). Essentially, the method consists of advancing each F_2 plant in the population by single seed descent. In the F_2 and succeeding generations only one seed is used from each plant in the population selected as a parent for the next generation. For practical reasons, a single pod (2-3 seeds) is taken from each plant, but only one plant from the pod serves as parental material. When the desired level of inbreeding is attained, each progeny which traces to a different F_2 parent, is maintained in bulk.

The method has the following advantages compared to the pedigree system of breeding:

1. Less space is required per generation since hill plantings are used compared with progeny rows. Relatively close spacings may be used in early stages although wide spacings are necessary in the last generation in order to produce sufficient seed for testing.
2. Time and effort in harvesting is considerably less.
3. Bookkeeping and note taking is reduced considerably since no records are kept except the pedigree of the cross and the degree of inbreeding. The pod is the identifying unit. Extensive note taking or labeling is eliminated by destroying undesirable plants during the growing season. In the case of disease resistance a plastic tie around the main stem identifies resistant plants.
4. Selection for characters of high heritability, e.g. height, maturity, disease and shatter resistance, and seed quality can be effectively practiced on a single plant. Selection is equally as effective against obvious off types.
5. Several generations can be grown per year. Soybeans grown under short days generally flower 26 to 30 days after emergence. Germinable seed can usually be obtained in 10 to 12 weeks in the greenhouse at Raleigh, N. C. Hence, from F_2 plants in the field, F_5 seed can be obtained in the greenhouse for hill or drilled plantings the following growing season.
6. Less effort is expended in obtaining homozygous types for simply inherited characters which are discontinuous in expression. For example, in the F_5 generation only 1/16 of the plants are heterozygous for characters such as flower and pubescence color. In the case of resistance to diseases involving single factor recessives, the proportion of resistant plants increases with every generation of selfing, if susceptibles are not discarded. This could be a factor in increasing final population size as compared to selection for disease resistance in the F_2.

The main disadvantages are as follows:

1. Selection for characters with low heritability is ineffective on a single plant basis. Since visual selection for yield, for example, is largely ineffective in soybeans on a single plant or on replicated progeny rows (4) this is not too critical.
2. Selection for lodging resistance is not as effective in space plantings compared with drill plantings.
3. The identity of superior F_2 plants is lost and cannot be recovered.

The application of this method to other self-fertilized species is contingent on the type of genetic variance predominating for economic characters, and on whether self-fertilization is obligatory for commercial use. It should be noted that where additive types of epistasis are of significance in the inheritance of economic traits the method is as efficient as when genotypic variance is mostly additive. If gene interactions of the additive type are important, testing at higher levels of inbreeding than the F_3 or F_4 is likely to be more efficient. The facilities available, and the ease with which the species can be manipulated in terms of generation time, are also factors to be considered.

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