IMPORTANCE OF SEED COAT CHARACTERISTIC INHERITANCE IN COWPEA IMPROVEMENT

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The cowpea, Vigna unguiculata (L.) Walp., varies considerably in expressing testa characteristics. Only certain combinations of seed coat color, eye pattern, and testa texture are preferred by consumers, but these combinations differ from one region of the world to another. In Nigeria cowpea seeds with a rough brown testa or a rough white testa with a colored eye are preferred (Ojomo, 1968). Mottled and tan seeds with a smooth testa will be consumed if preferred types are not available. In other areas of the world, black, red, white-eyeless, or black-eyed seeds may be the desirable type.

Commonly, the improvement of a self-pollinated crop such as the cowpea involves crossing of two desirable parents and selecting superior recombinants. Selection for desirable seed coat characteristics in such crosses limits the intensity of selection for other desirable characters. For example, assume that root-knot nematode resistance is to be transferred from a cultivar with smooth black seed to a Nigerian cultivar with a rough white testa and a small brown eye. Rough testa texture is a quantitative character controlled by at least two recessives. Small eye, a small colored region around the hilum, is produced by the watson gene w in combination with the hilum ring gene r^o (Harland, 1920; Ojomo, 1968). The black seed coat color B is monogenic dominant to the expression of brown testa b. If a segregate having a rough testa and a small brown eye is desired from this cross, a considerable portion of the population must be discarded because of testa characteristics (Table 1). If the cowpea breeder can handle F_2 and F_3 progenies of 1000 plants, there is good probability of finding five to ten plants with desirable testa characteristics. If the plant breeder can afford to carry the population from a single cross for many generations, the frequency of desirable segregates increases considerably. Since root-knot nematode resistance is inherited as a monogenic dominant, over half the selected plants will be expected to carry resistance to the root-knot nematode. Obviously, this small portion of plants with nematode resistance and preferred testa characteristics is unacceptable to the cowpea breeder since he must improve yield potential, disease resistance, insect resistance, agronomic characters, seed size, and protein quality and content of the crop. Improvement of these characters may involve selection of the desirable allele at a hundred or even a thousand loci. The cowpea breeder's challenge, however, is to make rapid improvement in the cowpea within a few years.

A knowledge of the inheritance of the cowpea testa characteristics can aid the plant breeder in solving this problem. Inheritance studies of various testa characteristics show that other genes and gene combinations can produce acceptable small eye and rough testa seeds. In fact, certain combinations may improve consumer acceptability of improved cultivars. The loose testa lt gene is a monogenic recessive which produces rough testa in seeds with eye patterns. The small eye can be produced by another allele r^e at the R locus. Utilization of these genes for eye pattern and rough testa will increase by

16-fold the frequency of F_2 plants which have desirable seed coat characteristics. Addition of the holstein h gene can produce an extremely small eye. The r allele of the R locus produces a white eyeless seed coat which may be preferred to small eye.

In cowpea genetic factors exist which reduce the appeal of cultivars with a white seed coat. The cowpea introductions cream pea and blackeye pea from the United States contain factors which produce a cream colored testa. A few Nigerian cultivars contain genes which produce brown splashes or gray coloration on the white portion of the seed coat. Inadvertent incorporation of these genes into breeding materials will increase the difficulty of the plant breeder's task.

Although manipulations with the various seed coat characteristics will improve the frequency of desirable seed types, this does little to help alleviate the enormous task facing the cowpea breeder. Considerable literature has accumulated on breeding techniques that simplify the plant improvement process. The backcross method and crossing of early generation selections can increase the frequency of desirable segregates. The bulk population method and composite crosses make use of natural selection to improve the productivity of the population and the probability of obtaining high yielding lines. Since highly desirable cultivars do not exist in the cowpea, a good recurrent parent for the backcrossing system is not available. The bulk population method and crosses among early generation selections limit the number of lines that can contribute to the improved cultivar. The use of composite crosses in a self-pollinated crop introduces genes from many parents in the population (Jenson 1970), but unless a mechanism for outcrossing is incorporated into the population, recombination among genes is limited.

Development of cowpea breeding populations having male sterility will facilitate utilization of population improvement techniques developed for cross pollinated crop species. Recurrent selection with intercrossing of desirable selections will allow frequent recombination of genes and improvement of desirable gene frequency (Doggett, 1972; Eberhart, 1972) so that there should be a high percentage of outstanding genotypes.

Table 1. Effect of gene numbers on population size required to find plants with desirable seed-coat characteristics

Testa Characteristic	Number of Allelic Pairs	Expected Proportion of Desirable Segregates F_2	F_3	F_8
Brown color	1	0.25	0.33	0.50
Small eye	2	.063	.071	.25
Rough testa	2	.063	.071	.25
All three above	5	.00098	.0083	.031

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