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GENETIC STUDIES ON SOYBEAN
[*Glycine max* (L.) Merrill]

By

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INTRODUCTION

The success of a breeding program depends mainly upon the existance of sufficient genetic variability in the breeding material that permit effective selection ; and the extent to which the desirable characters are heritable. A critical survey of genetic variability is therefore a pre-requisite for planning and evaluating breeding programs.

Soybean is considered to be an important crop in Egypt since its seeds contain high protein and oil contents. It is expected to be a main field crop, especially with the rapid increase of its cultivated area to meet the demands of human needs and poultry.

The main objective of this investigation was to study the genetic parameters for important agronomic traits in soybean that could be helpful in the improvement of this crop in Egypt through four crosses made among four soybean varicties (Harosoy, Clark, Williams, and Ransom) differs in certain agronomic characters.

REVIEW OF LITERATURE

The following is a review for some previous studies delt with heterosis, dominance relations, number of gene pairs, gene action, heritability and expected genetic advance for studied agronomic traits in soybean.

1. Earliness :

Weiss et al., (1947), found that date of maturity in F_1 was intermediate between that of parents in soybean crosses.

Mahmoud and Kramer (1951), found slight evidence for dominance deviation and epistasis for yield but nonefor maturity. Heritability values ranged from 92 to 100% for maturity when such estimates were based on generationsgrown in the same season in soybean crosses.

Weber and Moorthy (1952), studied four soybean varieties, their F_1 hybrids, and 300 F_2 plants from each of three crosses, Adams x Hawkeye, Adams x Habaro and Haboro x Mandell. For folowering time in Adams x Hawkeye and Adams x Habor, the F_2 mean values, and the F_2 range covered almost the entire range of both the parents. In Habaro x Mandell the means of both parents were the same and their F_2 range indicated a probable transgressive segregation towards late flowering. Parental types were recovered in the F_2 generation of all crosses. The F_2 range indicated transgressive segregation towards early maturity in the Adams x Hawkeye and Adams x Habaro crosses, and in both directions in Habaro x Mandell. It was concluded that parents differed in relatively few genes, with sufficient plus and minus gene effects present to account for transgressive segregation. Flowering time and maturity date showed comperetively high heritabilities : 75.6% and 75.3% respectively. Hence it is a composite character determined by genes conditioning both flowering time and maturity.

The method of Jinks and Hayman (1953), after deletion of data interpreted by them as attributable to epistatic effects of genes, indicated partial dominance of flowering, and maturity in soybean populations.

Johnson *et al*., (1955), estimated heritability and expected genetic gain for days to flowering in two soybean populations. Haritability was 84.4 and 89.3% and expected genetic gain was 9.2 and 6.7%.

Hanway (1956), studied the inheritance of date of flowering in soybean. He found that the F_1 population was intermediate between the parental values and that heritability value from F_2 data was high.

Horner and Weber (1956), found that about 96% among sample variance components for maturity was due to additive effects in self fertilized populations ; and in two crosses, additive genetic variance was principle source of genetic variance for flowering time.

Leffel and Weiss (1958), made an analysis of diallel crosses among ten soybean varieties. They suggested partial dominance for early flowering and early maturity. Most of the non-additive effects could be traced to a specific crosses or line in flowering.

Gates *et al*., (1960), indicated that linkage was of importance for flowering time, but not for maturity. Linkage related to additive genetic variance were found in flowering and maturity in soybean crosses.

Brim and Cockerham (1961), found that additive genetic variance was principle source of genetic variance for flowering time and maturity date in two soybean crosses. They found that both date of flowering and date of maturity of soybean hybrids were generally between the midparent value and the later parent value.

Hanson and Weber (1962), found that heritability estimates were high for maturity and flowering in soybean. The expected genetic progress ranged from 5.4 to 7.3 days and from 5.5. to 7.4 days for flowering time and maturity, respectively. Estimates of genotype by environment component contained additive genetic variance for maturity and flowering time.

Anand and Tarrie (1963), found that heritability for flowering and maturity ranged from 65 to 91 % , and from 81 to 86 %, respectively in three soybean crosses. The expected genetic advance from selection of the top 5% of the population mean in general ranged from 2 to 7.3 days, and from 3.4 to 11.1 days for flowering and maturity, respectively.

Ibrahim (1963), found that the parental difference was governed by one pair of genes as indicated by F_2 and F_3 data and very few number of genes as indicated by F_2 data in two crosses of Vicia faba L.

Kwon and Torrie (1964), found that heritability estimates were 75% and 76%, for flowering and 79% and 82% for maturity in two soybean populations. The expected genetic advance ranged from 3.5 to 6, and from 6.9 to 11.8 days for flowering and maturity date, respectively.

Caldwell and Weber (1965), found that the genotype x enuironment interaction component was not significant for maturity in soybean crosses.

Hanson et al., (1967), found that epistatic variability was suggested for maturity in soybean genotypes. They found also that heritability estimate for maturity was 0.82.

Mahmoud (1968), found that the early flowering was partially dominant over late flowering in broad bean.

Byth et al., (1969), found that the heritability for maturity ranged from 76 to 96% in soybean crosses. They also found that predicted genetic advance for maturity ranged from 0.4 to 7.5%, and actual genetic advance ranged from -0.2 to -3.7 % at maternal lines and -1.0 to 3.6 % at daughter lines.

Byth and Caldwell (1970), found that the effects of genotypic heterogeneity within relatively homozygous lines of soybean in three environments were essentially additive for maturity when averaged over populations of lines within a cross.

Selim et al., (1970), found that early flowering was partially dominant over late flowering in eight crosses of broad bean. The number of major genes estimated ranged from one to four pairs of genes, and heritability values ranged from 45.06 to 92.57 %, showing the effectiveness of selection for early flowering.

Weber et al., (1970), found that soybean hybrids approximated the midparent average in maturity. Generally, the F_1's were earlier in maturity than their respective high parent. Variable results were obtained in midparent heterosis for maturity.

Croissant and Torrie (1971), found that the additive genetic variance was the principle source of genetic variance for flowering time and maturity in two soybean crosses.

Shahin et al., (1973), found that earliness was partially dominant over lateness in broad bean crosses. Using the Mendelian principles in F_2, difference between the parental varieties was influenced by more than three pairs of major genes in one cross and by three pairs of genes in another for date of flowering. Using Castle-Wright, and Wright's formulae, the number of genes pairs controlling the parental defference in this trait ranged from 12-13. The Mendelian deductions are lower than the results obtained by using above fermulae, and might be due to the presence of minor genes in addition to the principle major genes for early flowering. Heritability values ranged from 46.16 to 76.08% showing that individual plant selection for earliness could be practiced successfully.

Paschal and Wilcox (1975), studied heterosis in exotic soybean germplasm and found that the parents were significantly later maturing than F_1's, and F_1's tended to be intermediate to their parents for maturity. Four hybrids were significantly earlier and two were significantly later in maturity than their respective midparents.

Kaw and Menon (1979), studied heterosis in a ten parent diallel cross in soybean and found that F_1's flowered and matured earlier than their respective parents.

El-Bayoumi (1980), found that heritability and expected genetic gain estimates for earliness were high and thus selection would be effective in improving this character.

Thseng (1980), found that in breeding depression was indicated in F_2 soybean crosses between different types for number of days to flowering.

Garland and Fehr (1981), found that heritability estimates for maturity were 80% for row plots and ranged from 28 to 36 % for hill plats of soybeans.

El-Hosary (1982), studied the inheritance of some quantitative characters in two field bean crosses. He found that highly significant negative heterotic effects was detected for flowering in both crosses. Over dominance towards the lower parent was detected for flowering time in one cross and partial dominance towards the lower parent in another cross. As inbreeding depression, significant positive values were obtained for flowering date in one cross, and negative high significant in the other for flowering and maturity. Flowering date exhibited highly significant positive estimate of additive gene effects in both crosses. The estimated value for dominance type was of negative nature and not reach the level of significance in one cross. However, significant positive estimate of dominance gene effect was obtained in the other. The additive and dominance genetic effects were significant for