

Selection and Evaluation of the Relative Influence of the Morphological Characters and Yield Components on Yield in Soybean (*Glycine max.* (L.) Merr.)

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Sixty promising soybean varieties were evaluated in a randomised block design with two replications during *kharif* seasons of 1972 and 1973 at the I. A. R. I. Regional Station, Coimbatore. Morphological characters viz., plant height number of branches and days to flowering showed significant positive correlation with yield due to higher positive direct and indirect effects via other characters. Due to the inter-related positive and negative, direct and indirect effects via other characters, yield components showed very low correlation values with yield. The varieties PLSO-18, UPSS-69, EC-25683 and EC 18737 were promising for their higher yields and other desirable characters.

Correlation and path coefficient analysis provide useful information on the nature of influence of different characters on yield. Brim and Cokerham (1961) showed that the additive effect was the principal component of genetic variance for all characters in soybean. Lal and Haque (1971) in their path analysis studies in soybean concluded that leaf area, plant height and number of pods were the reliable selection indices. Pandey and Torrie (1973) reported that in soybean, plant stand (seeding rate) was inversely related to pods per plant and most of the yield components were negatively associated with each other. Johnson *et al.* (1955) found that for soybean lines, estimates of genetic variance in different environments were less consistent and the estimates of genotype \times environment interactions were of higher order for yield than for other important characters. Malhotra *et al.* (1972) reported high degree of association of yield with number of pods

per plant and primary branches. They also observed similarity between genotypic correlations and coheritability values among different characters. Studies on the germplasm material obtained from different sources at this Station during previous years revealed that the potential behaviour of soybean varieties depended much on the environment and fertility status of soil. With this background, the present study was made (i) to identify the most promising and adaptive types of soybean varieties and (ii) to evaluate the relative association of morphological characters and yield components with yield.

MATERIAL AND METHODS

Sixty soybean varieties selected from germplasm collections were evaluated at the I. A. R. I. Regional Station, Coimbatore, during *kharif* seasons of 1972 and 1973. Randomised block design with two replications was used in conducting the experiments (plot size.

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TABLE I Yield potential and other ancillary characters of 20 promising Soybean varieties.

Variety	Estimated yield (kg/ha)	100 grain weight (g)	No. of pods per plant	No. of seeds per pod	Plant height (cm)	No. of branches per plant	Days to flowering	Days to Maturity
PLSO-18	5640	13.5	26.8	2.4	50.9	2.9	35	86
UPSS 69	5480	13.5	39.6	2.5	46.1	3.9	34	96
EC 25683	5160	10.7	22.5	2.4	16.3	3.0	37	91
EC 18737	5120	8.5	36.0	2.4	46.1	3.7	35	89
EC 18226	4960	11.3	35.3	2.3	63.3	3.6	41	99
EC 95306	4760	13.5	41.4	2.3	23.7	4.3	30	86
EC 38128	4640	16.0	29.1	2.6	24.4	1.6	26	82
EC 326-1	4620	16.0	38.5	2.3	33.5	2.6	37	88
EC 16699	4560	14.6	47.2	2.5	32.5	3.7	31	88
EC 16697	4520	10.1	34.3	2.4	42.2	3.0	32	88
NANDA	4320	11.4	38.4	2.4	35.0	4.0	32	89
IC 202	4280	11.2	35.5	2.5	50.4	3.4	42	92
EC 39363	4240	10.5	37.9	2.5	28.3	3.9	31	85
EC 36895	4200	15.8	21.0	2.4	33.6	2.0	36	99
EC 50086	4180	13.3	40.7	2.5	41.7	3.9	38	100
UPSS 29	4120	11.2	37.3	2.5	30.3	5.9	36	89
EC 39821	4080	13.3	41.6	2.4	50.8	3.3	39	97
EC 13046	4040	9.9	34.0	2.4	47.0	3.1	37	104
PLSO-1	3960	9.8	34.5	2.6	40.9	2.6	36	91
EC 34071	3940	14.2	32.4	2.5	26.2	1.9	28	88
Heritability %	75.2	60.5	84.0	16.5	91.0	72.3	95.7	92.7
Genetic advance as percentage of mean	33.2	34.6	52.0	1.6	91.3	52.9	37.8	19.5
Population mean	3880	13.26	32.04	2.41	36.49	3.09	34.2	90.1

3 m × 0.6 m). Ten plants were selected at random from each replication for recording observations viz., plant height, number of branches, days to flowering, days to maturity, number of pods, 100 grain weight, number of seeds per pod and seed yield per plant. From the combined data of two years, correlation

coefficients among different characters were calculated with known statistical methods and the direct and indirect effects were calculated following the methods adopted by Dewey and Lu (1959). Heritability and genetic advance values were arrived at following the procedure of Allard (1960).

RESULTS AND DISCUSSION

The combined analysis of two seasons data showed significant difference between years as well as within varieties in respect of per plant yield, number of pods per plant, plant height and days to flowering. Varietal component alone showed significant difference in respect of days to maturity. The 100 grain weight and number of branches did not show any significant differences among the varieties during the two seasons. Varieties EC 326-1 and EC 38128 showed the highest 100 grain weight of 16.0 gm. EC 39821, EC 50086 and EC 95306 showed higher number of pods with more than 40 pods per plant. EC 38128 and EC 39363 were found to be the two earliest varieties having a duration of 82 and 85 days respectively for maturity. Variety PLSO-18 showed the highest yield potential of 5640 kg./ha. followed by UPSS 69 (5480 kg./ha.) and EC 25683 (5160 kg/ha). Out of sixty varieties tested, twenty varieties which showed desirable characters consistently for two seasons are given in Table I.

Plant height showed positive correlation with days to flowering, days to maturity and pods per plant and negative correlation with 100 grain weight, seeds per pod and yield. Number of branches showed positive correlation with days to flowering, pods per plant and yield, and negative correlation with 100 grain weight and seeds per pod. Days to flowering showed positive correlation with days to maturity and pods per plant and negative correlation with 100 grain weight and seeds per pod. Hundred grain weight showed negative correlation with number of pods per plant and yield, whereas it showed positive correlation with number of seeds per pod (Table II). These observations were in accordance with that of Byth *et al.* (1969) who concluded that lodging was the most effective trait for correlated yield selections in genetically homogenous lines. In the present studies most of the genotypic correlations were higher than that of phenotypic correlations. Webber and Moorthy (1952) also made similar observations in soybean crosses.

Following are the four equations obtained for studying the direct and indirect effects of four characters on yield.

$$r_{15} = 1.700452 + 0.477038 r_{12} + 1.634625 r_{13} - 0.255409 r_{14}$$

$$r_{25} = 0.477038 - 1.700452 r_{12} + 1.634625 r_{23} - 0.255409 r_{24}$$

$$r_{35} = 1.634625 - 1.700452 r_{13} + 0.477038 r_{23} - 0.255409 r_{34}$$

$$r_{45} = -0.255409 - 1.700452 r_{14} + 0.477038 r_{24} \pm 1.634625 r_{34}$$

1. Plant height, 2. Number of branches, 3. Days to flowering, 4. Days to maturity and 5. Yield.

TABLE II Genotypic correlation coefficient between eight characters of the 60 varieties of soybean.

Characters	Branches per plant	Days to flowering	Days to maturity	100 grain weight	Pods per plant	Seeds per pod	Yield per plant
Plant height	0.2365*	0.7745**	0.6049**	-0.7759**	0.6109**	-0.3219*	-0.4761**
Branches per plant	—	0.3271**	0.2720*	-0.5220**	0.4690**	-0.4412**	0.5401**
Days to flowering	—	—	0.8182**	-0.6855**	0.4260**	-0.4812**	0.2647*
Days to maturity	—	—	—	-0.4584**	0.3797**	-0.1107	0.1832
100 grain weight	—	—	—	—	-0.4645**	0.8820**	-0.3326**
Pods per plant	—	—	—	—	—	0.1159	0.1194
Seeds per pod	—	—	—	—	—	—	-0.0014

* Significant at 5% level.

** Significant at 1% level.

TABLE III Direct and indirect effects of (a) morphological and other characters.

Character	Direct effect	Indirect effect via				Total
		Plant height	Number of branches	Days to flowering	Days to maturity	
Plant height	-1.700452	—	0.112819	1.266017	-0.154497	-0.4761
Number of branches	0.477038	-0.402157	—	0.534686	-0.069471	0.5401
Days to flowering	1.636425	-1.317000	0.156039	—	-0.208976	0.2647
Days to maturity	-0.255409	-1.028603	0.129754	1.337450	—	0.1832
p ² x.5 (residual) =		-0.453133				

(b) Yield components on yield in 60 varieties of soybean.

Character	Direct Effect	Indirect effective via			Total
		100 grain weight	Number of pods	Number of seeds per pod	
100 grain weight	2.538704	—	-0.733689	-2.137618	-0.3326
Number of pods	1.579524	-1.179228	—	-0.280896	0.1194
Number of seeds per pod	-2.423603	2.239136	0.183067	—	-0.0014
p ² x.4 (residual) =		1.652396			

Among the four characters studied plant height showed maximum negative effect but its indirect positive effect via days to flowering acted as a buffer and was responsible for the reduction of the negative effect of correlation with yield. Though days to flowering showed the highest positive direct effect, its indirect negative effect via plant height was considerable and was responsible for reduc-

ing the degree of correlation with yield. The correlation values between days to maturity and yield were highly influenced by the negative effect via plant height and positive effect of the days to flowering. Thus, due to higher positive direct and indirect effects via other characters, number of branches and days to flowering showed significant positive correlation with yield (Table III).

Following are the three equations obtained to study the direct and indirect effects of yield components on yield.

$$r_{14} = 2.538704 + 1.579524 r_{12} - 2.423603 r_{13}$$

$$r_{24} = 1.579524 + 2.538704 r_{12} - 2.423603 r_{23}$$

$$r_{34} = -2.423603 + 2.538704 r_{13} + 1.579524 r_{23}$$

1. 100 grain weight; 2. Number of pods; 3. Number of seeds per pod and 4. Yield.

Though 100 grain weight showed maximum positive direct effect, its indirect effect via number of pods and number of seeds was highly negative. The direct effect of number of pods was positive but, owing to its negative effect via 100 grain weight and number of seeds, the total correlation was reduced to non-significant level. Though number of seeds showed maximum negative direct effect, its indirect positive effect via 100 grain weight reduced its correlation with yield to a non-significant level. Thus, due to the inter-correlated positive and negative, direct and indirect effects via other characters, yield components showed non-significant cor-

relation coefficients with yield (Table III).

Except number of seeds per pod other characters showed high values of heritability. Genetic advance was maximum for plant height (91.3%), followed by number of branches (52.9%) and number of pods (52.0%). Yield per plant showed promising genetic advance value of 33.2 per cent (Table II).

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