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Genetic Variability Studies on Yield and Yield Component Traits of Soybean

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A B S T R A C T

A study on variability, heritability and genetic advance in 13 genotypes of soybean were carried out for yield and yield component traits. Observations on 11 characters were recorded. Analysis of variance revealed highly significant differences among the genotypes for the all the characters. The range was maximum for plant height (39.27-77.73) followed by number of pods per plant (35.87-61.40). The genotypic coefficient of variation and phenotypic coefficient of variation were high for pod weight per plant (g) followed by seed yield per plant (g) indicate the presence of wider adaptability for these traits in the genotypes studied, suggested the less influence of environment in the expression of characters. High heritability coupled with high genetic advance as percent of mean was observed for days to 50% flowering, plant height (cm), number of pods per plant, number of seeds per pod, pod weight per plant,100 seed weight, biomass and seed yield per plant indicating additive gene action and the ample scope for improvement in these traits through simple selection.

Introduction

Soybean (*Glycine max* (L.) Merrill) being a potentially high yielding crop can play an important role in boosting oil seed production in the country. It is referred as miracle crop of 20th century, as it contains 40% high quality protein and 20 % oil. It is also rich in lycine (6.4%) and Vitamin A, B and D. Quality of soy protein is next to animal protein and better than cereals and pulses. The edible oil in soybean is approximately 85 % unsaturated and contains essential fatty acids. Its oil is also used as a raw material in manufacturing antibiotics, paints, adhesives and lubricants etc. At present, soybean occupies an area of 113.10 m ha producing 283.79 mt with the productivity of 2509 kg ha^{-1} in the world (Anon., 2013). In India, it occupies an area of 12.03 m ha with the production of 12.45 mt and productivity of 1035 kg ha^{-1} (Anon., 2013). In Karnataka, soybean is grown over an area of 0.25 m ha with a production of 0.30 mt and productivity of about 1215 kg ha^{-1} (Anon., 2013).

In the absence of ample genetic variability, the existing genetic material, creation and assessment of genetic variability is a basic step in crop improvement programme. Yield being a complex character influenced by a number of yield contributing characters

controlled by polygenes and also influenced by environment. Hence, it becomes necessary to partition the observed variability into heritable and non heritable components measured as genotypic and phenotypic coefficients of variations (PCV and GCV), heritability and genetic advance to account for created variability to be used in breeding programmes.

Materials and Methods

The experimental material for the present study comprised of eight advanced breeding lines which are cross derivatives of JS 335 x EC 241778, JS 335 x EC 241780, JS 93-05 x EC 241780, DSb12 x EC 241780 developed at AICRP on soybean, University of Agricultural Sciences, Dharwad, along with five parents.

The field experiment was conducted during *kharif* 2013. The experiment consisting of 13 genotypes was laid out in a Randomized Complete Block Design with three replications. The genotypes studied are given in (Table.1). The genotypes were sown in three rows each of four meter length with spacing of 30 cm between rows and 10 cm between the plants. The recommended package of practices was followed for raising a good crop.

Five plants were selected at random in each plot to record the observations on days to 50% flowering, plant height (cm), number of branches per plant, number of pods per plant, pod length (cm), pod weight per plant (g), number of seeds per pod, 100 seed weight (g), seed yield per plant (g), biomass per plant (g) and harvest index (%). The mean data were analysed to work out the variance components and coefficient of variance following Burton (1952). The heritability in broad sense and expected genetic advance were computed as per Johnson *et al.*, (1955).

Results and Discussion

The analysis of variance revealed the presence of significant differences for all the traits studied indicating the existence of genetic differences among the genotypes (Table 2). Days to 50 per cent flowering ranged from 33 days to 50.66 days with a mean value of 42.67 days (Table 3). The plant height ranging from 39.27 cm to 77.73 cm with a mean value of 56.84 cm. The mean value for the number of branches per plant ranged from 3.27 to 4.47 with a mean value of 3.94. A wide range of variation for number of pods per plant ranged from 35.87 (JS 93-05) to 61.40 (DSb 23-2) with a mean value of 49.18, 100 seed weight from 9.50g to 13.43 g, Biomass per plant (g) ranged from 23.95g to 44.10g, Harvest index ranged from 38.98 per cent to 54.31 per cent. Seed yield per plant mean was 16.34 g with a range of 9.27 g (JS 93-05) to 23.95 g (DSb 23-2). A similar finding was reported for plant height and number of pods per plant by Parameshwar (2006). The presence of wide variability for different traits indicated the presence of variability for the traits and scope for improvement.

The phenotypic coefficient of variability was higher than genotypic coefficient of variability for all the characters studied (Table 3). Plant height, pod weight per plant, seed yield per plant exhibited high genotypic and phenotypic coefficient of variation. The results indicated existence of substantial variability for these characters. It also indicated greater scope for selection to improve these characters. Similar findings were reported Ramana *et al.*, (2000), Shivakumar *et al.*, (2011) and Radhika (2012). Moderate values of PCV and GCV were noticed for characters *viz.*, days to 50% flowering, number of branches per plant, number of pods per plant, 100 seed weight, number of seeds per pod and biomass per

plant. Pod length and harvest index exhibited low PCV and GCV. A lower value of PCV and GCV for these traits suggests that there is ample scope to enrich the variation for these characters.

The coefficient of variation indicates only the extent of variability existing for various characters, but does not give any information regarding heritable proportion of it. Hence, amount of heritability permits greater effectiveness of selection by separating out the environmental influence from the total variability and to indicate accuracy with which a genotype can be identified phenotypically. In the present study, broad sense heritability, which includes both additive and non-additive gene effects (Hanson *et al.,* 1956), was estimated. The results indicated that estimates of heritability were high for the characters under study *viz.*, days to 50 % flowering, plant height, number of branches per plant, pod length, pods per plant, number of seeds per pod, pod weight, 100 seed weight, biomass and seed yield. It thus indicated that better expression of these traits is primarily due to genetic factors and hence fixable. Similar results were reported by Shivakumar *et al.*, (2011) for days to 50% flowering, Mukesh Kumar and Singh (2009). Moderate heritability values were observed for harvest index indicating moderate influence of the environment on its expression. Hence selection for such trait should be based on the performance across locations over years.

Heritability estimates of the 13 genotypes revealed that high heritability coupled with high genetic advance as per cent mean was observed for days to 50 % flowering, plant height, number of pods per plant, pod weight, number of seeds per pod, 100 seed weight, biomass and seed yield per plant.

Table.1 Pedigree of the genotypes used in the study

Sl.No.	Genotypes	Pedigree
1	DSb 21	JS 335 x EC 241778
2	DSb 23-2	JS 335 x EC 241780
3	DSb 28-3	JS 93-05 x EC 241780
4	Line No.9-1	DSb 12 x EC241780
5	Line No.9-2	DSb 12 x EC241780
6	Line No.9-3	JS 335 x EC241780
7	Line No.30-2	JS 335 x EC241780
8	Line No.15-3-2	JS 335 x EC241780
9	EC241778(P)	An exotic germplasm line
10	EC241780(P)	An exotic germplasm line
11	DSb 12(P)	JS 335 x PS 73-7
12	JS 93-05(P)	Selection from PS 73-22
13	JS 335(P/C)	JS78-77 x JS71-05

Remarks-Among the advanced breeding lines, DSb 21 is in final stage of verification, DSb 23-2 is at different stages of testing. And the remaining are due for testing.

Table.2 Analysis of variance for different characters in advanced breeding lines of soybean

Source of variation	df	DFF	PH	NB	NPP	PL	NSP	PWT	100SW	BM	HI	SYP
Replication	2	0.179	1.10	0.06	5.11	0.008	0.016	3.46	0.14	4.06	55.56	8.77
Genotypes	12	64.83**	397.01**	0.38**	175.17**	0.300**	0.27**	153.69**	4.58**	122.64**	72.79**	56.41**
Error	24	0.26	4.80	0.047	8.52	0.039	0.015	3.84	0.052	4.08	39.24	2.71
CD at 5%		0.86	3.69	0.37	4.92	0.33	0.20	3.30	0.38	3.40	10.67	2.77
CV %		1.20	3.86	5.53	5.93	4.56	4.75	8.29	1.92	5.75	13.58	10.07

* Significant at 5%, ** Significant at 1%

DFF = days to fifty percent flowering, PH = Plant height (cm), NB = No. of branches per plant, NPP= No. of pods per plant, PL=Pod length (cm) NSP = No. of seeds per pod, PWT = pod weight per plant, 100 SW=100 seed weight (g), Biomass=BM, HI=Harvest index (%), SYP = Seed yield per plant (g).

Table.3 Estimates of variability parameters for different quantitative traits in advanced breeding lines of soybean

Sl. No.	Traits	Mean	Range	PCV	GCV	h^2 (%)	GA	GAM
1	Days to 50% flowering	42.67	33- 50.66	10.94	10.87	98.8	9.49	**22.26**
2	Plant height (cm)	56.84	39.27-77.73	20.48	20.11	96.5	23.13	**40.70**
3	Number of branches per plant	3.94	3.27- 4.47	10.08	8.43	70	0.573	**14.54**
4	Pod length (cm)	4.32	3.83 - 4.96	8.22	6.84	69.3	0.507	**11.74**
5	Number of pods per plant	49.18	35.87-61.40	16.27	15.15	86.7	14.29	**29.07**
6	Number of seeds per pod	2.56	2.10- 3.10	12.37	11.42	85.3	0.556	**21.73**
7	Pod weight per plant (g)	23.65	11.74- 34.54	31.01	29.88	92.9	14.03	**59.32**
8	100 seed weight (g)	11.84	9.50- 13.43	10.55	10.37	96.7	2.48	**21.01**
9	Biomass per plant (g)	35.14	23.95 - 44.10	18.79	17.89	90.6	12.32	**35.08**
10	Harvest index (%)	46.13	38.98 -54.31	10.67	7.25	46.1	4.67	**10.14**
11	**Seed yield per plant(g)**	**16.34**	**9.27 - 23.95**	**27.78**	**25.89**	**86.9**	**8.12**	**49.70**

The results indicated the lesser influence of environment on expression of these characters and prevalence of additive gene action in their inheritance. Similar results were reported by Bangar (2003) for seed yield per plant and Thorat *et al.*, (1999) for pods per plant and pod weight per plant. Hence they are amenable for simple selection. The high heritability with moderate genetic advance as per cent of mean was recorded for number of branches per plant, pod length and harvest index. This indicates that these characters are highly influenced by environment and they may be conditioned by both additive and non additive gene actions. Hence, selection based on phenotypic observations alone may not be effective for these traits. From the foregone discussion, it can be concluded that high genotypic and phenotypic coefficient of variation coupled with high heritability was observed for plant height, pod weight per plant and seed yield per plant indicating that there is lesser influence of environment in the expression of these characters which are amenable for phenotypic selection.

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