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GENETIC VARIABILITY AND CHARACTER ASSOCIATION FOR YIELD AND ITS COMPONENTS IN SOYBEAN

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ABSTRACT

*The 9 genotypes were planted in randomized block design with PS-1347, SL-688 and Bragg as a check, at Allahabad to study the genetic variability and character association for yield and its component characters in soybean. The analysis of variance was significant among the genotypes for all characters. Among all the traits, plant height exhibited high estimate of PCV (21.42) followed by seed yield per plant PCV (20.21) and GCV (20.20) indicating that these traits could be used for selection for crop improvement. High heritability was observed for biological yield per plant (99.80%) and seed yield per plant (99.67%). Moderate values of genetic advance was observed for plant height (17.85) followed by days to maturity (11.84). Genotypic correlation analysis indicates that number of pods per plant (0.816***), biological yield per plant (0.960***), harvest index (0.776***) and seed index (0.557*) showed positive significant correlation with seed yield per plant. Phenotypic correlation analysis indicates that number of pods per plant (0.816***), biological yield per plant (0.960***), harvest index (0.776***) and seed index (0.557*) showed positive significant correlation with seed yield per plant.*

Key words: Soybean, genetic variability, heritability, genetic advance, correlation coefficient

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is called as "Golden Bean" of the 20th century, because of its multiple uses. It contains about 37-42% of good quality protein, 6% ash, 29% carbohydrate and 17-24% oil comprising 85% unsaturated fatty acid with two essential fatty acids (lenoleic and linolenic acid) which are not synthesized by the human body (Balasubramaniyan and Palaniappan, 2003). In India, cultivation of soybean has reached about 10.18 million hectare, with the total production of about 12.28 million tones and average productivity of about 1207 kg per hectare (Government of India, 2012). Madhya Pradesh, Rajasthan, Karnataka, Uttar Pradesh, Andhra Pradesh are important soybean growing states of India. In Uttar Pradesh, it is cultivated 0.05 million hectare area whereas the production is 0.05 m/t with the productivity of 989 kg/h. The knowledge of certain genetic parameters is essential for proper understanding and their manipulation in any crop improvement programme. Genetic parameters like genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance are useful biometrical tools for determination of genetic variability. The grain yield is a complex character, quantitative in nature and an integrated function of a number of component traits. Correlation study provides a measure of association between characters and helps to identify important characters to be considered while making elucidates selection. Knowledge of correlation between grain yield and other characters is helpful in selection of suitable plant type. Therefore, these characters should be given due consideration during selection for yield improvement in soybean. The present study was conducted to estimate the genetic variability for various quantitative characters, and estimate character association between yield and its components characters in soybean.

MATERIAL AND METHODS

The present investigation was carried out at the Crop Research Centre of SHIATS (Formerly: Allahabad Agricultural Institute) Deemed-to-be University, Allahabad (U.P.). The experimental material consisted of nine soybean genotypes. These genotypes were sown in randomized block design with two replications. Each genotype was grown in four rows of 1.8 meter length. Row to row and plant to plant distance was maintained at 45 and 10 cm, respectively. Five individual plants from each genotype were randomly selected and tagged from each replication for data recording. Data were recorded on whole plot basis for days to 50% flowering, plant height, pod length, number of branches per plant, days to maturity, number of

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pods per plant, number of seeds per pod, seed index, biological yield per plant, harvest index, seed yield per plant from individual tagged plant. The mean of different characters were calculated on the basis of these individual data recorded for each character in each replication and subjected for analysis of variance (Panse and Sukhatme, 1985), coefficient of variation (Burton, 1952), heritability (Burton and Devane, 1953) and genetic advance (Johnson *et al*., 1955). Correlation coefficient at genotypic and phenotypic level was computed from the variance and covariance components as suggested by (Al-Jibouri *et al.*, 1958).

RESULTS AND DISCUSSIONS

The analysis of variance was significant among the genotypes for all characters namely days to 50% flowering, plant height, number of branches per plant, number of pods per plant, pod length, days to maturity, biological yield per plant, number of seeds per pod, seed index (100 seed weight), harvest index and seed yield per plant. Based on the mean performance of 9 genotypes, PS-1447 (11.62) and SL-778 (11.22) were found to be best genotypes for seed yield per plant.

Table 1: Analysis of variance for 11 characters in soybean genotypes

S. No.	Characters	Mean sum of square		
		Replications (df=1)	Treatments (df=8)	Error (df=8)
1.	Days to 50% flowering	0.222	25.305*	0.222
2.	Number of branches per plant	89.000	0.167*	0.043
3.	Number of pods per plant	1.742	48.577*	1.187
4.	Plant height	85.368	203.910*	20.353
5.	Pod length	0.001	0.009*	0.002
6.	Days to maturity	0.500	68.972*	1.000
7.	Number of seeds per pod	0.002	0.102*	0.007
8.	Seed index	0.012	0.507*	0.043
9.	Biological yield per plant	0.027	10.167*	0.015
10.	Harvest index	0.464	37.332*	0.404
11.	Seed yield per plant	0.014	6.139*	0.003

** Significant at 5% level of significance*

The data on estimates of phenotypic variance (V_p), genotypic variance (V_g), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance are presented in Table 2. Considerable range of variation was observed for all the traits under study indicating enough scope for bringing about improvement in the desire direction. High V_P and V_g was observed for plant height (112.13, 91.78) days to maturity (34.99, 33.99) and number of pods per plant (24.88, 23.69). Moderate value of V_P and V_g was observed for harvest index (18.87, 18.46) and days to 50% flowering (12.76, 12.54). Low value of V_P and V_g was observed for pod length (0.02, 0.01). The estimates of PCV ranged between 2.08 (pod length) to 21.42 (plant height). The estimates of high heritability was observed for plant height (21.42) followed by seed yield per plant (20.21).

Table 2: Estimation of components of variance and genetic parameter for 11 characters of soybean

Characters	Phenotypic variance (V_P)	Genotypic variance (V_g)	Phenotypic coefficient of variation (PCV)	Genotypic coefficient of variation (GCV)	Heritability (broad sense) (h^2) (%)	Genetic advance (GA)
Plant height	**112.13**	**91.78**	**21.42**	19.38	81.85	**17.85**
No. of branches per plant	0.11	0.06	5.23	4.00	54.54	0.37
Days to 50% flowering	12.76	12.54	7.67	7.61	98.27	7.10
Days to maturity	34.99	33.99	5.46	5.38	97.14	11.84
No. of pods per plant	24.88	23.69	12.51	12.20	95.21	9.78
Pod length	**0.02**	**0.01**	**2.08**	**1.58**	**50.00**	**0.14**
No. of seeds per pod	0.06	0.05	8.70	8.11	83.33	0.42
Seed index	0.28	0.24	6.69	6.14	85.71	0.93
Seed yield per plant	3.08	3.07	20.21	**20.20**	99.67	3.60
Biological yield per plant	5.09	5.08	14.58	14.56	**99.80**	4.63
Harvest index	18.87	18.46	7.80	7.71	97.82	8.75

Moderate value of PCV was recorded for biological yield per plant (14.58) and number of pods per plant (12.51). Low value of PCV was observed for days to maturity (5.46) and number of branches per plant (5.23). The estimates of GCV ranged between 1.58 (pod length) and 20.20 (seed yield per plant). High GCV was observed for seed yield per plant (20.20). Moderate values of GCV was observed for plant height (19.38) and number of pods per plant (12.20) followed by biological yield per plant (14.56). Low value of GCV was observed for days to maturity (5.38) and number of branches per plant (4.00). Similar results were also reported by Karad *et al.* (2005), Sultana *et al.* (2005) and Patil *et al*. (2011).Thus, selection based on phenotypic performance of these characters would be effective to bring about considerable improvement in these characters.

The estimates of heritability ranged between 50% (pod length) and 99.80% (biological yield per plant). The estimates of heritability was observed to be high in magnitude for harvest index (97.82%), seed yield per plant (99.67%), days to 50 % flowering (98.27%), days to maturity (97.14%), number of pods per plant (95.21%), number of seeds per pod (83.33%), seed index (85.71%) and plant height (81.85%). Similar results were also reported by Dixit *et al.,* (2002) and Thakare *et al.* (2006). A moderate value of heritability estimates were recorded for number of branches per plant (54.54%) and pod length (50%). The estimates of genetic advance ranged between pod length (0.14) and plant height (17.85). Moderate value of genetic advance was observed for days to maturity (11.84). Low values of genetic advance was observed for number of pods per plant (9.78), harvest index (8.75), days to 50% flowering (7.10), biological yield per plant (4.63), seed yield per plant (3.60), seed index (0.93), number of seeds per pod (0.42), number of branches per plant (0.37) and pod length (0.14). Similar results were reported by Gupta and Punetha (2007) and Burli *et al.* (2010). High heritability does not mean a high genetic advance for a particular quantitative character. Johnson *et al*. (1955) reported that heritability estimates along with genetic gain would be more rewarding than heritability alone in predicting the consequential effect of selection to choose the best individual. High estimate of heritability coupled with moderate genetic advances were observed for the characters viz., days to maturity and plant height which suggested that these characters can be considered as favorable attributes for the improvement through selection and this may be due to additive gene action (Panse *et al.* 1957) thus, could be improved upon by adapting selection without progeny testing. In the present investigation, the genotypic correlation coefficients were generally high in magnitude as compared to phenotypic correlation coefficients values for most of the character pairs, indicating a strong inherent association between these characters (Table 3).

Table 3: Phenotypic correlation coefficient between different pre-harvest and post-harvest characters of soybean (*Glysine max* (L.) Merrill)

Characters	Days to 50% flowering	Plant height	Branches per plant	Pods /plant	Pod length	Days to maturity	Biological yield/plant	Seeds /plant	Seed Index	Harvest Index	Seed yield/plant
Days to 50% flowering	-	0.575*	0.448	-0.651**	0.075	0.755***	-0.643**	-0.150	-0.435	-0.490*	-0.650**
Plant height	-	-	0.105	-0.270	0.068	0.796***	-0.529*	0.229	-0.318	-0.416	-0.551*
Branches/plant	-	-	-	-0.029	-0.153	0.167	-0.103	0.334	-0.532*	0.157	-0.006
Pods /plant	-	-	-	-	-0.156	-0.539*	0.683**	0.255	0.181	0.824***	0.795***
Pod length	-	-	-	-	-	-0.0746	-0.225	-0.117	0.208	-0.171	-0.252
Days to maturity	-	-	-	-	-	-	-0.560*	-0.004	-0.288	-0.628**	-0.633**
Biological yield/ plant	-	-	-	-	-	-	-	0.251	0.620**	0.559*	0.957***
Seeds /pod	-	-	-	-	-	-	-	-	-0.049	0.345	0.327
Seed Index	-	-	-	-	-	-	-	-	-	0.115	0.507*
Harvest Index	-	-	-	-	-	-	-	-	-	-	0.771***
Seed yield / plant	-	-	-	-	-	-	-	-	-	-	-

** Significant at 5% level of probability, ** Significant at 1% level of probability, ** * Highly significant at 1% level of probability*

A phenotypic correlation coefficient analysis showed that seed yield per plant had significant and positive association with number of pods per plant (0.816***), biological yield per plant (0.960***), harvest index (0.776***) and seed index (0.557*). Seed yield showed positive non-significant association with number of seeds per pod (0.327) and negative significant correlation association with days to maturity (-0.633**), days to 50% flowering (-0.650**) and plant height (-0.551*) and negative non significant association with pod length (-0.252). Genotypic correlation coefficient analysis showed that seed yield per plant had significant and positive association with number of pods per plant (0.816***),

biological yield per plant (0.960***), harvest index (0.776***) and seed index (0.557*). Seed yield showed positive non-significant association with number of seeds per pod (0.347) and negative significant correlation association with days to maturity (-0.647**), days to 50% flowering (-0.657**) and plant height (-0.604*) and negative non significant association with pod length (-0.339).

Table 4: Genotypic correlation coefficient between different pre-harvest and post-harvest characters of soybean (*Glysine max* (L.) Merrill)

Characters	Days to 50% flowering	Plant height	Branches per plant	Pods /plant	Pod length	Days to maturity	Biological yield/ plant	Seeds /plant	Seed Index	Harvest Index	Seed yield /plant
Days to 50% flowering	-	0.624*	0.514*	-0.679**	0.034	0.762***	-0.654**	-0.175	-0.498	-0.499*	-0.657**
Plant height	-	-	0.120	-0.256	0.077	0.914***	-0.600*	0.171	-0.531*	-0.432	-0.604*
Branches/ plant	-	-	-	-0.040	-0.511*	0.176	-0.154	0.413	-0.798***	0.214	-0.013
Pods /plant	-	-	-	-	-0.320	-0.570*	0.704**	0.324	0.209	0.848***	0.816***
Pod length	-	-	-	-	-	-0.145	-0.312	-0.272	0.156	-0.237	-0.339
Days to maturity	-	-	-	-	-	-	-0.567*	0.002	-0.284	-0.660**	-0.647**
Biological yield/ plant	-	-	-	-	-	-	-	0.264	0.668**	0.572*	0.960***
Seeds /pod	-	-	-	-	-	-	-	-	-0.161	0.370	0.347
Seed Index	-	-	-	-	-	-	-	-	-	0.152	0.557*
Harvest Index	-	-	-	-	-	-	-	-	-	-	0.776***
Seed yield / plant	-	-	-	-	-	-	-	-	-	-	-

**Significant at 5% level of probability, ** Significant at 1% level of probability, ** * Highly significant at 1% level of probability*

As regards inter-relationship between yield characters, it was quite interesting to observe that plant height, number of branches per plant, biological yield per plant, days to maturity, number of pods per plant, pod length, number of seeds per pod, seed index and harvest index were mutually correlated with each other. Positive and strong association of Pod length, days to maturity, number of seeds per pod, biological yield per plant, harvest index and seed index, with seed yield revealed importance of these characters in determining seed yield. Malik *et al.* (2006), Aditya *et al.* (2011), Bello *et al.* (2012) and Sarutayophat (2012) also reported similar findings for different parameters in soybean. According to and Chamundeswari *et al.* (2003) number of pods per plant, biological yield per plant, harvest index and seed index had the greatest genotypic correlation with seed yield in soybean which also confirms the results of present investigation. Basavaraja *et al*. (2005) determined the positive correlation of seed yield with harvest index. Faisal *et al*. (2007) also reported significant correlation of seed yield with number of pods per plant.

The analysis of variance revealed the prevalence of significant differences among the genotypes for all 11 characters studied. High V_P and Vg were observed for plant height moderate for harvest index and low for pod length. The estimates of phenotypic coefficient of variation (PCV) ranged between (2.08%) pod lengths to (21.42%) plant height. The estimates of genotypic coefficient of variation (GCV) ranged between (1.58%) pod lengths to (20.20%) seed yield per plant. The estimates of heritability (%) in broad sense ranged between (50%) pod length (99.80%) and biological yield per plant. The genetic advance ranged from pod length (0.09) to plant height (17.85).

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