

Research Note

Genetic variability, heritability and genetic advance in soybean [*Glycine max* (L.) Merrill]

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Abstract

Sixty one genotypes of soybean were evaluated to determine genetic variability, heritability and genetic advance for 15 contributing characters. The analysis of variance revealed significant variations for all characters. The estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation indicated that the values of PCV were higher than that of GCV, but the differences were closer between these two estimates for all the traits. This indicated that expression of characters under study was less influenced due to environmental factors. The high values of GCV and PCV were observed for number of clusters per plant, seed yield per plant, biological yield per plant, number of pods per plant and plant height indicating presence of sufficient genetic variability for selection in these traits. High heritability accompanied by high genetic advance for plant height, number of clusters per plant, number of primary branches per plant, seed yield per plant, biological yield per plant and number of pods per plant suggested selection could be effective for these traits.

Key words

Soybean, genetic advance, heritability, variability.

Soybean [*Glycine max* (L.) Merrill] is considered a miracle crop because of its dual qualities viz., protein and oil content in seed. These two parameters in one crop have thus, gained considerable importance in the agricultural economy of the World. It is considered as a wonder crop due to its dual qualities viz., high protein (40-44%) and oil content (20%). Improvement through selection depends upon the variability existing in the available genotypes, which may be either due to different genetic constitution of cultivars or variations in the growing environments. Selection is effective only when the observed variability in the population is heritable in nature. Genetic variability in a group of germplasm is a pre-requisite for a successful breeding programme. Since, most of the characters influencing yield are polygenic, it is essential for plant breeders to estimate the type of variation available in the germplasm. The type of breeding programme for developing suitable varieties depends largely on the availability of genetic variability in a given species. Heritability estimates give a measure of transmission of characters from one generation to the other, as consistency in the performance of the selection depends on the heritable portion of the variability. Thus, enabling the plant breeder for the variation and the estimates of the heritability and genetic advance are the important parameters on which the success of selection lines. With this background in view, the present study was undertaken to assess and estimate the magnitude and nature of variation among 61 genotypes of soybean with respect to various yield attributes

which could be utilized in crop improvement programme.

The present investigation was conducted at the Instructional Farm, Junagadh Agricultural University, Junagadh, during *kharif* 2012. The experiment consisted of 61 genotypes, which were evaluated in a randomized block design with three replications. The entries were sown in a single row of 4 m length adopting inter row spacing of 45 cm and intra row spacing of 10 cm. The recommended package of practices was followed for raising a healthy crop. The data were recorded on five randomly selected competitive plants in each replication and each genotype for 15 characters viz., days to 50 % flowering, days to maturity, plant height (cm), number of primary branches per plant, number of clusters per plant, number of pods per plant, number of pods per cluster, pod length (cm), number of seeds per pod, 100-seed weight (g), biological yield per plant (g), harvest index (%), protein content (%), oil content (%) and seed yield per plant (g). Observations of days to 50% flowering and days to maturity were recorded on plot basis. The mean and standard errors were worked out as per standard methods and coefficients of variation were computed. Heritability (h^2) and genetic advance as percentage of mean (GA %) were calculated as per the formula suggested by Allard (1960). The genotypic (GCV) and phenotypic (PCV) coefficients of variation were estimated according to the formula given by Burton (1952).

The analysis of variance revealed that mean squares due to genotypes were significant for all the 15 characters indicating varietal differences for all the characters studied (Table 1). The estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation (Table 2) indicated that the values of PCV were higher than that of GCV, but the difference was closer between these two estimates for all the cases. These indicated that greater role of genetic components and expression of characters under study was less influenced due to environmental factors. Karnwal and Singh (2009) also reported similar results. The perusal of the data revealed that higher PCV and GCV were recorded for number of clusters per plant followed by seed yield per plant, biological yield per plant, number of pods per plant, plant height and 100-seed weight indicated that selection with these characters may be a good approach for enhancing seed yield of the genotypes. However GCV and PCV were lower for oil content, days to 50% flowering, days to maturity and protein content. High values of genotypic and phenotypic coefficients of variation were reported in soybean for number of pods per plant by Mahajan *et al.* (1994) and Gohil *et al.* (2007); for seed yield per plant by Gohil *et al.* (2007) and for number of primary branches per plant by Mahajan *et al.* (1994) whereas, low magnitudes for days to 50% flowering and days to maturity were reported by Agrawal *et al.* (2000) and Bangar *et al.* (2003).

With the help of genotypic coefficient of variation alone, it is not possible to determine the extent of variation which is heritable. Thus, the knowledge of heritability of a character helps the plant breeder in predicting the genetic advance for any quantitative characters and aids in exercising necessary selection procedure. Burton (1952) suggested that genotypic coefficient of variation together with heritability estimate would give the best picture expected for selection than the heritability value alone.

In the present study, the estimates of heritability were observed to be high for plant height (79.60%) and number of primary branches per plant (69.70%), medium for oil content (59.60%), harvest index (54.70%), biological yield per plant (47.30%), seed yield per plant (47.10%), number of pods per plant (37.00%) and days to 50% flowering (34.10%). This indicated that selection based on phenotypic levels would be useful for the improvement of the traits. Earlier workers also reported high magnitude of heritability for seed yield and its components (Bangar *et al.*, 2003; Malik *et al.*, 2006).

The magnitudes of genetic advance were observed to be high (> 20%) for number of clusters per plant,

plant height, seed yield per plant, number of primary branches per plant, biological yield per plant and number of pods per plant; moderate (10-19%) for harvest index and low (< 10%) for days to maturity, protein content, days to 50% flowering, pod length, oil content, number of pods per cluster, number of seeds per pod and 100-seed weight. The high magnitude of genetic advance was also earlier reported by Mahajan *et al.* (1994), Rajarathinam *et al.* (1996), Taware *et al.* (1997), Bhandarkar (1999), Bangar *et al.* (2003), Gohil *et al.* (2007) and Karnwal and Singh (2009) for seed yield and its components. Our results for low genetic advance for oil content are in agreement with those reported by Ramteke *et al.* (2010). High magnitude of genetic advance is helpful in identifying the appropriate character for selection and enabling the breeder to applying selection on said character.

The estimate of heritability along with genetic advance gives the idea about the genetic architecture of the population. High heritability accompanied by high genetic advance for plant height, number of clusters per plant, number of primary branches per plant, seed yield per plant, biological yield per plant and number of pods per plant suggested that selection can be effective for these traits based on phenotypic expression. Our results are in partial agreement with those reported by Rajarathinam *et al.* (1996), Bhandarkar (1999) and Gohil *et al.* (2007).

High magnitude of heritability and low to moderate magnitude of genetic advance was observed for days to 50% flowering, days to maturity, number of seeds per pod, protein content and oil content may due to lack of genetic variability for these characters. In such a situation, improvement in these traits through simple selection may not be effective. However, recombination breeding and recurrent selection is advocated for improvement of such characters.

References

- Agarwal, A. P., Patil S. A. and Salimath, P. M. 2000. Identification of potential soybean genotypes for pod shattering resistance and seed yield. *Crop Improv.*, **27**: 236-239.
- Allard, R. W. 1960. *Principles of Plant Breeding*. John Wiley and Sons, New York. Pp. 20-24 and 88-89.
- Bangar, N. D., Mukhekar, G. R., Lad, D. B. and Mukhekar, D. G. 2003. Genetic variability, correlation and regression studies in soybean. *J. Maharashtra agric. Univ.*, **28**(3): 320-321.
- Bhandarkar, S. 1999. Studies on genetic variability and correlation analysis in soybean (*Glycine max* L. Merrill). *Mysore J. agric. Sci.*, **33**(3): 130-132.
- Burton, G. W. 1952. Quantitative inheritance in grasses. *Proceedings: 6th Int. Grassland Cong.*, **1**: 277-283.



- Gohil, V. N., Pandya, H. M. and Mehta, D. R. 2007. Genetic variability for seed yield and its component traits in soybean. *Agric. Sci. Digest*, **26**(1): 73-74.
- Karnwal, M. K. and Singh, K. (2009). Studies on genetic variability, character association and path coefficient for seed yield and its contributing traits in soybean [*Glycine max* (L.) Merrill]. *Legume Res.*, **32**(1): 70-73.
- Mahajan, C. R., Patil, P. A., Mehete, S. S. and Gohatage, R. D. 1994. Genotypic and phenotypic variability and heritability of some quantitative characters in soybean [*Glycine max* (L.) Merrill]. *Ann. Agric. Res.*, **15**(1): 41-44.
- Malik, M. F. A., Qureshi, A. S., Muhammad, A. and Ghafoor, A. 2006. Genetic variability of the main yield related characters in soybean. *Int. J. Agri. Biol.*, **8**(3): 815-819.
- Rajarithnam, S., Muppudathi, N. and Pandian, R. S. 1996. Variability and character association in soybean during *rabi* season. *Madras Agric. J.*, **83**(12): 776-777.
- Ramteke, R., Kumar, V., Murlidharan, P. and Agarwal, D. K. 2010. Study on genetic variability and traits interrelationship among released soybean varieties of India [*Glycine max* (L.) Merrill]. *Electron. J. Plant Breed.*, **1**(6): 1483-1487.
- Singh, C. 1996. *Modern Techniques of Raising Field Crops*. Oxford publishing Co. Pvt. Ltd., pp-245.
- Taware, S. P., Halvankar, G. B. and Raut, V. M. 1997. Variability, correlation and path analysis in some germplasm lines of soybean (*Glycine max*) with high oil content. *Indian J. Agri. Sci.*, **67**(10): 476-477.



Table 1. Analysis of variance for various characters in soybean

Characters	Mean sum of squares		
	Replications	Genotypes	Error
d. f.	2	60	120
Days to 50% flowering	7.95	7.04**	2.76
Days to maturity	9.18	34.42*	23.60
Plant height (cm)	42.45	185.04**	14.03
No. of primary branches per plant	0.92*	1.83**	0.23
No. of pods per plant	151.86	144.86**	52.44
No. of clusters per plant	0.92	44.56**	3.50
No. of pods per cluster	0.99	0.52*	0.35
Pod length (cm)	0.01	0.18*	0.13
No. of seeds per pod	0.11	0.21**	0.11
Seed yield per plant (g)	9.76	12.49**	3.40
100-seed weight (g)	0.25	0.19**	0.10
Biological yield per plant (g)	75.20	94.59**	25.65
Harvest index (%)	15.66	30.07**	6.49
Oil content (%)	0.04	0.86**	0.16
Protein content (%)	26.24	14.93*	10.42

*, ** significant at 5% and 1% levels, respectively



Table 2. Mean, range, phenotypic (PCV) and genotypic (GCV) coefficient of variation, heritability (h^2) in broad sense and genetic advance (GA) as a percentage of mean for fifteen characters in soybean

Characters	Mean	Range		PCV (%)	GCV (%)	h^2 (%)	GA as % mean
		Minimum	Maximum				
Days to 50% flowering	38.97	37.00	42.33	5.25	3.06	34.10	3.68
Days to maturity	96.60	90.00	106.66	5.39	1.96	13.30	1.47
Plant height (cm)	36.70	23.00	55.13	22.96	20.57	80.20	37.95
No. of primary branches per plant	4.48	3.13	7.00	19.50	16.28	69.70	28.01
No. of pods per plant	33.50	22.20	60.26	27.23	16.56	37.00	20.75
No. of clusters per plant	9.70	4.86	18.69	42.73	38.12	79.60	70.07
No. of pods per cluster	3.33	2.60	4.40	19.19	7.13	13.80	5.46
Pod length (cm)	2.74	2.00	3.00	14.12	5.02	12.70	3.68
No. of seeds per pod	2.20	2.00	3.00	17.35	8.54	24.20	8.66
Seed yield per plant (g)	7.58	3.19	11.41	33.46	22.95	47.10	32.44
100-seed weight (g)	1.65	1.04	2.12	22.55	10.28	20.80	9.66
Biological yield per plant (g)	25.13	14.88	35.75	27.74	19.07	47.30	27.00
Harvest index (%)	29.83	19.62	34.70	12.70	9.39	54.70	14.31
Oil content (%)	19.81	18.00	21.00	3.17	2.45	59.60	3.90
Protein content (%)	37.42	31.91	41.66	9.22	3.27	12.60	2.39