Original Research Article

Studies of genetic parameters for yield, yield contributing and morphological characters in soybean (*Glycine max* (L.) Merr.)

ABSTRACT

Thirty five soybean (*Glycine max* (L.) Merr.) genotypes were studied to observe genetic variability, heritability and genetic advance for nine yield, yield contributing and morphological characters. The analysis of variance revealed that the sufficient variability was present in the material for all the characters. The value of phenotypic coefficient of variation (PCV) is greater than genotypic coefficient of variation (GCV). The high GCV and PCV were observed for number of pods per plant, number of branches per plant, seed yield per plant and plant height. High heritability estimates coupled with high expected genetic advance were observed for the characters seed yield per plant, number of pods per plant, number of branches per plant and plant height indicating the presence of additive gene action and phenotypic selection may be more fruitful and effective for desired genetic improvement.

Key words : Genetic advance, Soybean, heritability, yield, variability

1. Introduction

Soybean is often termed as 'miracle golden bean of 21st century', because it contains about 40% protein well balanced in essential amino acids, 20 per cent rich in poly unsaturated fatty acids specially omega 6 and omega 3 fatty acids, 6-7 per cent total minerals 5-6 per cent crude fiber and 17-79 per cent carbohydrates. Besides, it has good amount of iron, vitamin B complex and isoflavones such as daidzein, genistein and glycitin. Presence of good amount of calcium and iron makes it highly suitable for women who suffer with osteoporosis and anaemia. The isoflavones of soybean have been found to possess numerous health benefits as they exhibited properties like preventing cancer, combating menopausal problem and helping to recover from diabeties (Chauhan and Joshi, 2005).The development of superior variety can be based on the magnitude of genetic variability in the base material and the extent of heritability of desirable characters. To begin with any crop improvement programme, the information of genetic variability in genetic system of particular crop is sought as pre-requisite. Although increased seed yield is the ultimate aim of the plant breeders, seed yield itself is a product of

interaction of may component traits which influence it directly or indirectly. Therefore, variability existing within each component trait must be exploited by selection to realize maximum gain in seed yield (Gohil *et al*.2006).

Seed yield is very complex character being dependent on number of genetic factors interacting with environment. For improvement of crop yield, the breeder has to select superior individuals based on their phenotypic expression. Selection based on phenotypic expression is sometimes misleading as the development of the character is the result of interaction of the heritable and non-heritable factors. This highlights the imperative need for partitioning the overall variability into its heritable and non-heritable components and genetic parameters like genetic coefficient of variation (G.C.V.), phenotypic coefficient of variation (P.C.V.), heritability and expected genetic advance (E.G.A.). The development of superior variety can be based on the magnitude of the genetic variability in the base material and the extent of heritability of desirable characters (Dhillion *et al*., 2005). The existence of variability is essential for resistance to biotic and abiotic factors as well as for varietal adaptability. Selection is also effective when there is genetic variability among the individuals in the population. Hence, the magnitude of genetic variability present in a population is of prime importance to any plant breeder for starting and judicious breeding programme. In present study, efforts have been made to analyze the components of variability with reference to future breeding programme.

2. Materials and methods

The experimental material consists of thirty five newly developed promising genotypes of soybean (*Glycine max* (L.) Merr.) developed at different centers from various states of the country including three national checks *viz.*, Bragg, JS 93-05, JS 97-52 and two local checks viz., MAUS 71 and MAUS 81. The experiment was carried out in randomized block design with three replications at All India Co-ordinated Research Project on Soybean, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. All recommended agronomical package of practices were followed for satisfactory crop growth. Two sprayings were undertaken for control of leaf miner and leaf rolling caterpillar.

Observations were recorded on nine yield and yield contributing and morphological characters *viz*., days to first flowering, days to 50 percent flowering, days to maturity, plant height, number of branches per plant, number of pods per plant, 100 grain weight, oil content and

grain yield per plant. The data were collected and analyzed for genotypic and phenotypic coefficients of variation, heritability (broad sense) and expected genetic advance as percent of mean.The genotypic and phenotypic coefficient of variation (GCV and PCV) was calculated according to method suggested by Burton (1952).Heritability (broad sense) was calculated according to the method suggested by Allard (1960).The genetic advance (at 5 per cent selection intensity) was calculated for each character using the formula suggested by Johnson *et al.*, (1955).

3. Results and Discussion

In genetic improvement of soybean, the knowledge of genetic variability, heritability and genetic advance is prerequisite to develop varieties having desirable characters. The heritable variation is masked by non-heritable variation which creates difficulty in exercising selection. Hence, it become necessary to spilt overall variability into heritable and non-heritable components with the help of certain genetic parameters. This may enable the breeder to adopt proper breeding strategy since many characters of economic importance are highly influenced by environmental conditions. The analysis of variance showed significant differences among the genotypes for all the nine characters studied (Table 1).The characters under investigation were analysed for genotypic variance (σ^2g), phenotypic variance (σ^2p), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (broad sense) and expected genetic advance as percent of mean (EGA) and are presented in Table 2.

3.1 Range of variability

Wide range of variability was observed for majority of yield contributing characters. Range of variation on the basis of mean was more for traits viz., number of pods per plant, plant height, days to maturity, seed yield per plant, days to 50% flowering, days to first flowering, 100 seed weight, oil content and number of branches per plant. Similar results were obtained by Chettri *et al*. (2005), Dhillon *et al.* (2005), Gupta and Punetha (2007), Aditya *et al*.(2011) and Akram *et al.* (2016).

Estimates for phenotypic variance are higher than the genotypic variance for all the characters. High genotypic variances were observed for character number of pods per plant followed by plant height, days to maturity, days toflowering, days to 50 per cent flowering and seed yield per plant. High phenotypic variances were observed for number of pods per plant,

plant height and oil content. The present findings are in agreement with those reported by Dhillon *et al.*(2005), Gohil *et al.* (2006), Sirohi *et al.* (2007), Ghodrati (2013) and Baraskar *et al.*(2014).

3.2 Genotypic and phenotypic coefficient of variation

In the present investigation, the phenotypic coefficient of variation were greater than the genotypic coefficient of variation but the differences between them were found to be of lower magnitude indicating that there is small effect of environment on character under study and selection may be effective for important of these traits. The highest values of genotypic coefficient of variation and phenotypic coefficient of variation were recorded for characters viz., number of pods per plant, number of branches per plant, seed yield per plant and plant height indicating the possibilities of enhancement of these traits through selection. Similar observations were made by Bhairav *et al.*(2006), Gohil *et al.* (2006), Sirohi *et al.* (2007), Aditya *et al.*(2011) and Islam *et al.*(2015).The low estimates of phenotypic coefficient of variation and genotypic coefficient of variation observed for days to first flowering, days to 50% flowering, days to maturity and oil content. These results are in conformity with reports of earlier workers viz., Dhillon *et al.* (2005), Karad *et al.* (2005), Sahay *et al.* (2005), Gupta and Punetha (2007), Ghodrati (2013) and Baraskar *et al.*(2014).

3.3 Heritability and genetic advance

The knowledge about heritability of a trait is helpful to enable the plant breeder for deciding appropriate selection procedure to be followed for improvement of trait under given situation. The high heritability estimates along with expected genetic advance is more useful in predicting yield under phenotypic selection than heritability estimates alone (Johnson et al. 1955).In the present investigation, range of heritability was from 30 per cent for oil content to 99.42 for plant height. The desirable broad sense heritability (more than 60%) was observed for days to flowering (90.71%), days to 50% flowering (96.94) and days to maturity (99.30 per cent). These results are in agreement with those results obtained by Gohil *et al.* (2006) and Gupta and Punetha (2007). Bhairav *et al.* (2006), Baraskar *et al.*(2014), Islam *et al.* (2015) and Kushwantoro (2017) reported high genetic advance for number of branches per plant, pods per plant, seed yield per plant and plant height, suggesting that all these characters were governed by additive gene effects. Similar trend of results were observed in the present investigation.

High heritability estimates coupled with high expected genetic advance were observed for the characters viz., seed yield per plant, number of pods per plant, number of branches per plant and plant height indicating the presence of additive gene action on the expression of these characters. Similar trends of results were reported by Dhillon *et al.* (2005), Yadav *et al.* (2007), Islam *et al.* (2015) and Kushwantoro (2017). Selection of characters which have high heritablility with expected high expected genetic advance will be more useful than the character having low genetic gain. High heritability estimates coupled with low genetic advance was observed for characters viz., oil content, days to 50 per cent flowering, days to maturity and 100 seed weight. Similar type of findings were reported by Dhillon *et al.* (2005), Sahay *et al.* (2005), Karad *et al.* (2005), Chettri *et al.* (2005) and Baraskar *et al.*(2014) indicating the presence of poor genetic variance in the material for these characters.

4. Conclusion

It is cleared that the characters viz., seed yield per plant, number of days for first and 50 per cent flowering, number of branches per plant, number of pods per plant and plant height recorded high heritability with high expected genetic advance indicating the presence of additive gene action and phenotypic selection will be effective for these traits. Therefore, due weightage should be given for improvement these traits.

5. References

Aditya, J. P., Bhartiya, P, and Bhartiya, A. (2011).Genetic variability, heritability and character association for yield and component characters in soybean (*Glycine max* (L.) Merrill). Journal of Central European Agriculture, 12(1), 27-34.

Akram, S., Hussain, B. M. N., Bari, M. A. A., Burritt, D. J., and Hossain, M. A. (2016).Genetic variability and association analysis of soybean (*Glycine max* (l.)Merrill) for yield and yield attributing traits, Plant Gene and Trait, 7(13), 1-11.

Allard,R.W.(1960). Principles of plant breeding. John Wiley and Sons.Inc.,New York:84-85

Baraskar, V. V., Kachhadia, V. H., Vachhanl, J. H., Barad, H. R., Patel, M. B.,and Darwankar, M. S. (2014). Genetic variability, heritability and genetic advance in soybean [*Glycine max* (L.) Merrill]. Electronic Journal of Plant Breeding, 5(1), 802-806

Bhairav,B., SharmaS.P. and Ranawath B.R.(2006).Genetic variability, heritability and genetic advance in soybean (*Glycine max*L.).Natl.J.Plant Improvement.,8 (1): 94-95

Burton,G.W.(1952).Ouantitative inheritance in grasses. Proceeding of Sixth International Grassland Congress.1:277-283.

Chauhan,G.S. and Joshi O.P.(2005). Soybean (Glycine max L.).The 21st century crop. Ind. J. agric. Sci., 75 (8): 461-469.

Chettri M., MondalS.and Nath R.(2005).Studies on genetic variability in soybean (*Glycine max* L) in the mid hills of Darjeeling District.Journal of Interacademica, 9 (2): 175-178.

Dhillon,S.K.,Gurdeep Singh and Gill B.S.(2005).Genotypic and phenotypic variability and heritability of some yield and quality characters in soybean (*Glycine max* L.).Legume Research.,28 (4): 276-279.

Ghodrati, G. (2013). Study of genetic variation and broad sense heritability for some qualitative and quantitative traits in soybean (*Glycine max* L.) genotypes. Current Opinion in Agriculture, 2(1), 31-35.

Gohil,V.N.,Pandya H.M.and Mehta D.R.(2006).Genetic variability for seed and its component traits in soybean. Agric. Sci.Digest, 26:73-74

Gupta,A.K. and Punetha H.(2007).Genetic variability studies for quantitative traits in soybean (*Glycine max* L.). Agric.Sci.Digest,27 (2): 140-141.

Islam, M. A., Raffi, S. A., Hossain, M. A.and Hasan, A. K. (2015). Analysis of genetic variability, heritability and genetic advance for yield and yield associated traits in some promising advanced lines of rice. Progressive Agriculture, 26(1), 26-31.

Johnson,H.W.,Robinsan K.F. and Comstock R.F.(1955).Genotypic and phenotypic correlations in soybean and their implications in selection.Agron.J.,47: 477-485.

Karad,S.R.,Harer P.N.,Kadam D.D. and Shinde R.B.(2005).Genotypic and phenotypic variability in soybean (*Glycine max* L.) J.Maha.Agric.Univ.,30 (3): 365-367.

Kushwantoro, H. (2017). Genetic variability and heritability of acid-adaptive soybean promising lines.Biodiversitas, 18(1), 378-382.

Sahay,G,SharmaB.K.and Anna Durai A.(2005).Genetic variability and interrelationship in F2 segregating generation of soybean (*Glycine max* L.) in mid altitude of Meghalaya.Agric.Sci.Digest,25 (2): 107-110

Sirohi,S.P.S.,MalikS.,Singh S.P.,Yadav r. and Meenakshi.(2007).Genetic variability,Correlation and path coefficient analysis for seed yield and its components in in soybean (*Glycine max* L.).Prograssive Agriculture, 7(1/2): 119-123.

Yadav,R.K. (2007). Genetic variability and coheritability estimates in soybean (*Glycine max* L.).International J.Plant Sci.,2 (1): 9-11.

Table :1 Analysis of variance for yield, yield contributing and morphological characters in soybean

Source of Variation	D.F.	Mean Sum of squares								
		Morphological characters					Yield contributing characters			
		Days to first flowering	Days to 50% flowering	Days to maturity	Plant height (cm)	Number branches per plant	Number of pods per plant	100 seed weight (g)	Oil content (%)	Seed yield per plant (g)
1	2	3	4	5	6	7	8	9	10	11
Replication	2	28.981	0.476	66.860	3.634	1.675	53.434	0.224	0.759	2.929
Treatment	39	23.055**	24.29**	192.92**	156.297**	3.644**	290.289**	9.814**	10.676**	2.866**
Error	78	0.761	0.252	82.41	4.342	0.452	4.997	0.291	0.300	0.473

Table : 2 Parameters of Genetic Variability for yield, yield contributing and morphological characters in Soybean

Sr. No.	Character	Range	General mean	Genotypic variance (σ^2g)	Phenotypic variance (σ^2p)	GCV(%)	PCV(%)	Heritability (%)	Expected genetic advance (%)
1	Days to first flowering	27.00-40.00	32.96	7.43	8.19	8.26	8.68	90.71	16.22
2	Days to 50% flowering	29.00-42.66	35.92	8.01	8.26	7.88	8.06	96.94	15.98
3	Days to maturity	71.0-108.33	96.66	48.12	48.46	7.11	7.13	99.30	14.60
4	Plant height (cm)	26.33-58.00	39.64	53.45	53.76	18.46	18.52	99.42	37.93
5	Number branches per plant	2.33-6.33	4.10	1.06	1.51	25.15	30.03	70.00	43.40
6	Number of pods per plant	18.0-60.66	30.48	95.09	100.95	31.99	32.82	95.00	64.23
7	100 seed weight (g)	7.86-15.86	11.04	3.17	3.46	16.13	16.86	91.59	31.81
8	Oil content (%)	15.53-21.80	18.68	8.43	8.80	14.37	16.10	30.00	5.13
9	Seed yield per plant (g)	1.71-6.60	4.15	0.95	0.96	23.59	23.61	99.00	48.59