Indian J. Genet., 75(3): 382-385 (2015)
DOI: 10.5958/0975-6906.2015.00060.7

Short Communication

Morpho-agronomic characterization of Indian soybean for grouping and varietal protection

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(Received: May 2014; Revised: May 2015; Accepted: June 2015)

Abstract

Eighty-six soybean varieties differing for various morphological characters were characterized for DUS traits during the *kharif* seasons from 2007 to 2010 to protect these varieties under Protection of Plant Varieties and Farmers Rights Act (PPV&FRA) 2001. Results of their PCA revealed that days to 50 % flowering, plant height and nodes per plant traits accounted for the most variability. The cluster analysis grouped 86 varieties in to 13 groups. The present study proposes sets of hybridization between the high and low mean yield clusters to achieve yield gain in soybean.

Key words: Cluster analysis, DUS traits, genetic variability, PCA

Soybean [*Glycine max* (L.) Merrill], a high energy legume crop with 38-44 per cent protein and 18-22 per cent oil has occupied the number one position in area and production among the oilseed crops in India. However, low productivity is attributed to both genetic and non-genetic factors like susceptibility to biotic and abiotic stresses, lodging, pod shattering, the non availability of quality seeds coupled with poor crop management practices (Dupare et al. 2010; Saahu et al. 2013). The low productivity issues may be well addressed through the genetic improvement of soybean crop by understanding the genetic diversity, variability, its nature and magnitude and character association studies which helps in formulating the selection criteria for different traits to gain higher productivity. Principal component analysis explains the contribution of the most important traits that account for the total genetic variability. Hence, the present work was carried out to study the genetic variability and inter-relationship among the diverse soybean varieties using DUS traits.

Eighty-six soybean varieties released in India were grown at Directorate of Soybean Research during *kharif* for four consecutive years from 2007 to 2010 in Randomized Block Design with three replications. Each one of the variety was sown in 6 rows of 5 meter length with a spacing of 45 x 10 cm. The observations were recorded on five randomly selected plants from each plot on days to 50 % flowering, days to maturity, plant height (cm), branches per plant, nodes per plant, pods per plant, 100-seed weight (g) and yield per plot (Kg) to find out genetic variability, diversity and character association.

The analysis of the variance indicated significant differences among the varieties for all the characters studied. Significant difference also observed for years and varietal interaction with year. Out of nine, three principle components (PCs) were selected with Eigen value > 1. These three PCs contributed 72.03% of the total variability among the studied soybean varieties assessed for the nine quantitative traits, while remaining six components contributed 27.97% towards the total morphological diversity. The PC1 contributed maximum (33.71%) followed by PC2 (25.89%) and PC3 (12.43%) respectively. Further analysis of factor loading of the characters indicated that PC1 was due to variation among the varieties mainly for yield

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Published by the Indian Society of Genetics & Plant Breeding, F2, First Floor, NASC Complex, PB#11312, IARI, New Delhi 110 012
Online management by indianjournals.com

attributing traits like days to 50% flowering, plant height, nodes/plant, branches/plant and days to maturity. The PC2 was related to diversity due to yield/plot, days to maturity, 100 seed weight, number of seeds, number of pods, branches and nodes/plant, plant height and days to flowering. Similarly, PC3 was explained by variation due to nodes/plant, plant height, yield/plot, pods/plant and seeds/plant. Therefore, the principle component analysis clearly demonstrates the amount of the diversity for characters among the soybean varieties.

High estimates of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for no. of pods/plant, no. of seeds/plant and seed yield/plant. This suggests that the selection based on these characters would facilitate successful isolation of desirable types. The estimates depicting the genetic variability including mean, PCV, GCV, heritability (h^2), genetic advance (GA) and genetic advance in percent of mean (GAM) are presented in Table 1. Moderate estimates of GCV were recorded for days to 50 % flowering, plant height, nodes/plant, branches/plant and 100-seed weight while both PCV and GCV were recorded low for days to maturity. However, these traits exhibited high to low PCV and GCV in a number of similar studies earlier (Shivakumar et al. 2010; Banger et al. 2013; Ramteke et al. 2010). The differences between PCV and GCV observed here indicated more influence of environment in expression of these traits.

Genetic contribution to phenotypic expression of a trait is better reflected by the estimates of heritability, indicating presence of more fixable variability. High heritability was recorded for yield and moderate heritability for plant height, pods/plant, seeds/plant and 100-seed weight demonstrating better expressions of these traits, which is primarily due to the genetic factors and hence fixable. Traits with low heritability estimate *viz*., days to 50% flowering, nodes/plant branches/plant and days to maturity indicates influence of the environment on its expression. Prediction of successful selection becomes more accurate if it is based on estimates of heritability coupled with genetic advance, because it gives estimates not only of genetic contribution but of expected genetic gain out of selection as well. Moderate heritability coupled with high genetic advance was recorded for pods/plant and seeds/plant. These traits are thus controlled by additive gene action and hence selection based on phenotypic observations would be effective. However, high heritability with low genetic advance recorded for yield indicated involvement of both additive and non additive gene action and hence selection for these traits based on phenotypic observation alone may not be effective. Depending upon the positive or negative effect of each interacting traits, the yield may either be high or low. Therefore, it is imperative to study the correlation

Table 1. Estimates of variability parameters for different quantitative traits in eighty six varieties of soybean

Genetic variability parameters	50% flowering	Plant height	Nodes/ plant	Branches/ plant	Pods/ plant	Seeds/ plant	100 seed weight	Days to maturity	Yield/ plot (kg)
Var. Environmental	185.72	132.48	5.85	2.30	150.78	760.84	2.31	19.55	0.38
ECV	30.31	22.43	19.06	31.87	38.77	36.91	14.41	4.46	47.55
Var. Genotypical	12.54	61.08	1.70	0.51	121.99	848.73	3.35	2.51	0.74
GCV	7.87	15.23	10.29	15.04	34.87	38.98	17.34	1.60	66.59
Var. Phenotypical	198.26	193.57	7.55	2.81	272.78	1609.58	5.67	22.06	1.13
PCV	31.31	27.11	21.66	35.24	52.14	53.69	22.55	4.74	81.83
h^2 (Broad Sense)	0.06	0.31	0.22	0.18	0.44	0.52	0.59	0.11	0.66
Genetic Adv. at 5%	1.83	9.04	1.28	0.63	15.21	43.58	2.90	1.10	1.45
Genetic Adv. at 1%	2.35	11.59	1.64	0.80	19.50	55.85	3.71	1.4	1.85
Gen. Adv. as % of Mean 5%	4.08	17.62	10.08	13.23	48.04	58.32	27.48	1.11	111.64
Gen. Adv. as % of Mean 1%	5.23	22.59	12.92	16.95	61.57	74.74	35.22	1.42	143.07
General Mean	44.96	51.31	12.69	4.76	31.67	74.72	10.55	99.04	1.29
Exp. Mean next Generation	46.79	60.35	13.97	5.39	46.88	118.30	13.46	100.15	2.74

Var. = Variance; Gen. Adv. = Genetic advancement among the yield attributing traits. The present study showed positive and significant correlation of braches/ plant, pods/plant, seeds/plant and 100-seed weight with yield. Thus, selection based on these traits is expected to contribute towards yield enhancement. While estimating the associations among the yield attributing traits, it was observed that branches/plant had significantly positive association with pods/plant, nodes/plant, seeds/plant and 100 seed weight. Similarly, pods/plant had highly significant and positive association with braches/plant, nodes/plant, seeds/ plant and 100-seed weight. Seeds/plant were found to have significant and positive correlation with nodes/ plant, branches/plant, pods/plant and 100-seed weight. The negative and significant association of yield was observed with traits *viz*., days to 50% flowering, plant height and days to maturity. Therefore the correlation study indicates that yield improvement would be achieved through the improvement in positively associated traits.

An attempt was also made to study the pattern of genetic diversity present among 86 soybean varieties using quantitative traits. Euclidian distance was calculated for yield and yield related traits to construct dendrogram using Wards linkage in unweighted pair-groups averages (UPGMA) method. Cluster analysis based on similarity index in UPGMA classified 86 soybean varieties into 13 clusters. The lists of 86 varieties grouped in to 13 clusters are presented in Table 2. The number of varieties among cluster varied from 1 to 13. The maximum number included in cluster II and there was only one variety in cluster IX and around 10 clusters found more than six genotypes. Cluster 2 consistste varieties including MACS-57, MAUS 2, MAUS 32 and MAUS 71 developed at Agarkar Research Institute, Pune, JNKV, Jabalpur (JS 75-46, JS72-280 and JS72-44) and IARI, New Delhi (Pusa-20, Pusa-22). JS 335 variety which ruled over several decades in India was included in cluster 11 along with another popular variety JS 9752. Cluster 12 represented most popular varieties *viz*., NRC 2, NRC 7 and NRC 12 released from the Directorate of Soybean Research, Indore along with JS 9560 a short duration and popular variety among the farmers of Madhya Pradesh. Cluster No. III (1.50 Kg/plot), VII (1.51 Kg/plot), VIII (1.44 Kg/plot) XI (1.42 Kg/plot) and XII (1.99 Kg/plot) recorded higher mean yield than total mean yield. Whereas, cluster No. IV (0.68 Kg/plot), VI (0.48 Kg/plot) and XIII (1.03 Kg/plot) recorded lower mean yield than the total mean yield.

The results of the diversity analysis revealed that future soybean yield improvement may be accomplished by affecting the following sets of hybridization programme between Cluster III, VII, VIII, XI, XII (high mean) and Cluster I, II, IV, VI and XIII (low mean) particularly, between the popular varieties JS9560, JS9752, JS335, DS9712, NRC37 (high mean) and Lee, Kalitur (low mean). Further, for disease

Table 2. Cluster analyses of 86 soybean varieties released in India

Cluster	No. of varieties	Name of the variety	Mean yield (kg)/plot
1.	8	Ankur, Co Soya 3, Guj. Soya 1, Guj. Soya 2, JS 80-21, Lee, MACS 124 and MACS 450	1.18
2.	13	Birsa Soya 1, Co Soya 2, Indira Soya 9, Imp. Pelican, JS 75-46, MACS 57, MAUS 2, MAUS 32, MAUS 71, PS 1241, Punjab -1, Pusa 20 and Pusa 22	1.20
3.	9	Durga, Gaurav, Monetta, PK 262, PS 1024, PS 1092, Pusa 16, Shivalik and VL Soya 47	1.50
4.	7	Alankar, DS 228, JS 76-205, Kalitur, KB -79, SL 525 and TAMS 38	0.68
5.	2	PK 327 and PS 1029	2.78
6.	7	JS 90-41, MACS 13, MACS 58, MAUS 47, Pusa 37, RAUS 5 and TAMS 98-21	0.48
7.	6	JS 79-81, PK 308, PK 471, PK 472, Pusa 40 and Shilajeet	1.51
8.	9	Bragg, DS 97-12, Hara Soya, JS 93-05, PK 416, PS 1042, PS 1347, SL 295 and VL Soya 1	1.44
9.	1	PS 564	2.55
10.	3	JS 2, LSb-1 and VL Soya 2	1.24
11.	9	Hardee, JS 71-05, JS 97-52, JS 335, MAUS 81, NRC 37, Pusa 24, RKS 18 and SL 688	1.42
12.	6	JS 95-60, NRC 2, NRC 7, NRC 12, Palam Soya and VL Soya 21	1.99
13.	6	ADT-1, C o 1, KHSb-2, MAUS 61, MAUS 61-2 and Type 49	1.03

resistance in general and YMV resistance in particular, the resistance genes may be incorporated to the number of popular but susceptible varieties namely JS 335, JS 93-05, JS 95-60, NRC 7, NRC 12, NRC 37 by transferring YMV resistance gene from the DS 97-12 and SL 525 which are found to be resistance for YMV disease.

Acknowledgments

Authors are thankful to PPV&FR Authority for financial support and to Director DSR, Indore for institutional support provided to conduct the experiment.

References

Dupare B. U., Billore S. D. and Joshi O. P. 2010. Farmers' problems associated with cultivation of soybean in Madhya Pradesh. Indian J. agric. Sci. Tech., **4**(6): 71-78.

Shaahu A., Bello L. and Vange T. 2013. Correlation, path coefficient and principal component analysis of seed yield in soybean genotypes. Inter. J. Adv. Res., **1**(7): 1-5.

Shivakumar M., Basavaraja G. T., Salimath P. M., Patil P. V. and Talukdar A. 2011. Identification of rust resistant lines and their genetic variability and character association studies in soybean [*Glycine max* (L.) Merr.]. Indian J. Genet., **71**(3): 235-240.

Ramteke R., Vineet K., Murlidharan P. and Agarwal D. 2010. Study on Genetic Variability and Traits Interrelationship among Released Soybean Varieties of India [*Glycine max* (L.) Merrill]. Electronic J. Plant Breed., **1**(6): 1483-1487.

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**: 320-321.