RESEARCH ARTICLE

GENETIC VARIABILITY STUDIES FOR YIELD, OIL AND MORPHO-PHYSIOLOGICAL TRAITS IN SOYBEAN (*GLYCINE MAX* (L.) MERRILL)

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Abstract: Thirty five different elite germplasm lines of soybean along with five checks were sown during kharif, 2011 in an experiment laid out at experimental farm of All India Coordinated Research Project on soybean, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during kharif, 2011 with a view to study the genetic variability for yield, oil and morpho-physiological traits in soybean. The study revealed that the genotypes viz., EC 3412, EC 257303, MACS 609, JS 20-29, JS 93-05, MAUS 162, NRC 87, SL 778, MACS 1281, NRC 86, Swarna Vasundhara, VLS 77, MACS 1259, AMS-MB 5-19, Monetta and MACS 1201 exhibited better performance for number of branches per plant, number of pods per plant, 100 seed weight, harvest index, leaf area index, oil content. High genetic coefficient of variation was observed for seed yield per plant, number of pods per plant, number of branches per plant, leaf area index, plant height and harvest index. High heritability coupled with high expected genetic advance was observed for number of pods per plant, seed yield per plant, number of branches per plant and 100 seed weight. Hence, direct selection for these characters in soybean will increase the breeding efficiency. The promising genotypes viz., EC 3412, EC 287303, MAUS 609, JS 20-29, JS 93-05, MAUS 162, NRC 87, SL 778, MACS 1281, NRC 86, Swarna Vasundhara, VLS 77, MACS 1259, AMS-MB 5-19, Monetta, MACS 1201 should be further evaluated for yield and other characters in future.

Keywords: Genetic variability, Heritability, Soybean, Yield

INTRODUCTION

Soybean has emerged as one of the major oilseed crop in India with the coverage of above 10.12 million hectare with estimated production of over 10.22 million tonnes during 2011-12. In Maharashtra state, soybean crop is grown on an area of 30.6 lakh hectare with total production 38.45 million tonnes with average productivity of 1256 kg/ha(Anonymous, 2012). Soybean occupies the central Indian niche predominantly in Madhya Pradesh, Maharashtra and Rajasthan.

Crop improvement is based on magnitude of the genetic variability in the base material and extent of heritability of desirable characters (Dhillion *et al*., 2005). 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 may be due to 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 (GCV), phenotypic coefficient of variation (PCV), heritability and expected genetic advance (EGA). Knowledge of genetic variability and genetic advance is essential for a breeder to choose best genotype and to decide the correct breeding methodology for crop improvement. Therefore, the present study was carried out to study the genetic variability and genetic advance for yield, oil and morpho-physiological traits in soybean.

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MATERIAL AND METHOD

The experimental material for the present investigation comprised of 35 genotypes of soybean (*Glycine max* (L.) Merrill) collected from Directorate of Soybean Research, Indore and germplasm lines maintained at All India Coordinated Research Project on Soybean, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. These germplasm lines were selected on the basis of their diverse geographical origin and variation in yielding ability.

Thirty five different elite germplasm lines of soybean along with five checks were sown during *kharif*, 2011 in an experiment laid out at experimental farm of All India Coordinated Research Project on Soybean, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani on 15th July, 2011. The experiment was conducted in Randomized Block Design with two replications with 45 cm row to row distance, 5 cm plant to plant distance and 30:60:30 NPK (kg/ha) fertilizer dose was applied. All recommended agronomic package of practices and plant protection measures were followed for satisfactory crop growth. Five competitive plants were selected randomly from each treatment in each replication for recording of observations. Observations were recorded on morphological characters *viz.*, days to 50% flowering, days to maturity, plant height (cm) and number of branches per plant. Physiological traits *viz.*,leaf area index, chlorophyll content (mg) and harvest index (%) and yield contributing characters *viz.*, number of pods per plant, 100 seed weight (g), oil content (%), protein content (%) and seed yield per plant (g). The data

recorded on these characters was analyzed for the means and genetic variability. The genotypic and phenotypic variances were calculated by using the respective mean squares from variance table (Johnson *et al.,* 1955). The genotypic and phenotypic coefficient of variation (GCV) and (PCV) were calculated according to method suggested by Burton (1952).

RESULT AND DISCUSSION

Analysis of variance showed significant genetic variability for all the characters studied which is depicted in the table-1. The mean performance of 35 genotypes along with five checks for twelve characters is presented in table 2. Early maturity was recorded in the genotypes *viz.*, EC 3412 (82.0 days) and SL 871 (88.0 days). The genotypes *viz.,* EC 257303 (5.9), MACS 609 (5.7), PS 1476 (5.6), MACS 1281 (5.5), EC 3412 (5.0), SL 778 (5.0) and JS 20-29 (5.0) recorded maximum number of branches per plant. Number of pods per plant were found higher in the genotypes *viz.,* EC 257303 (53.4), MACS 609 (48.7), JS 20-29 (43.1), KDS 344 (41.90), NRC 86 (41.01) and JS 93-05 (42.2). Highest 100 seed weight were recorded in genotype Suwarna Vasundhara (26.0 g) indicating its bold size followed by SL 778 (18.0 g), and JS 20-29 (16.1 g). High oil content recorded in genotype Swarna Vasundhara (22.59 %) followed by DS 28-11 (22.23 %). The strains *viz*., Swarna Vasundhara (21.86 g), EC 25 7303 (19.09 g), JS 93-05 (17.50g), JS 20-29 (16.25g) and MACS 609 (15.49 g) recorded highest seed yield per plant. Highest protein content was recorded in genotype NRC 87 (42.83 %) followed by KS 103 (41.69 %) and NSO 81 (41.12 %) while highest LAI was recorded in genotype NSO 81 (2.51) followed by NRC 87 (2.30) and Suwarna Vasundhara (2.22).

Range of variability

Wide range of variability was observed for majority of yield contributing characters (Table-3). Range of variation on the basis of mean was found more for the traits *viz.,* number of pods per plant, plant height, harvest index, days to maturity, seed yield per plant, days to 50 per cent flowering, 100 seed weight, chlorophyll content, leaf area index, protein content, oil content and number of branches per plant. Similar trend of results were obtained by Dhillion *et al*. (2005) and Gupta and Punetha (2001).

Estimates for phenotypic variance were found higher than the genotypic variance for all of the characters (Table-3). High genotypic variances were observed for the character plant height followed by number of pods per plant, harvest index, days to maturity, seed yield per plant, days to 50 per cent flowering, leaf area index, chlorophyll content, 100 seed weight, protein content, oil content and number of branches per plant. High phenotypic variance was observed for plant height, number of pods per plant and days to maturity. These findings are in agreement with those results reported by Malik *et al.,* (2006) and Sirohi *et al.,* (2007).

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 difference between them were found to be at lower magnitude indicating that there is small effect of environment on the characters under study and selection may be effective for improvement of these traits.

The highest values of genotypic coefficient of variation and phenotypic coefficient of variation were recorded for the characters *viz.,* seed yield per plant, number of pods per plant, number of branches per plant, leaf area index and plant height indicating the possibilities of enhancement of these traits through selection. Similar observations were made by Karnwal and Singh (2009). Low estimates of phenotypic coefficient of variation and genotypic coefficient of variation was observed for the traits *viz.,* protein content, oil content, days to maturity, days to 50 per cent flowering and chlorophyll content. These results are in conformity with reports of earlier workers *viz.,* Sahay *et al*. (2005) and Karnwal and Singh (2009).

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 35.40 per cent for days to maturity to 91.22 per cent for seed yield per plant. The desirable broad sense heritability (More than 60%) was observed for days to 50 per cent flowering (61.04 %), number of branches per plant (69.94 %), plant height (70.21 %), chlorophyll content (75.97 %), number of pods per plant (86.43 %), harvest index (78.91 %) and seed yield per plant (91.22 %). These results are in agreement with those results obtained by Dixit *et al.* (2002). Karnwal and Singh (2009) and Patil *et al.* (2011) reported high genetic advance for the traits *viz.,* number of pods per plant, seed yield per plant, number of branches per plant, plant height, 100 seed weight and leaf area index suggesting that these characters were governed by additive gene effects. Similar trend of results were found 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 in expression of these characters. Similar results were reported by Sahay *et al*. (2005) and Karnwal and Singh (2009). In the present investigation, high heritability coupled with low genetic advance was observed in traits *viz.*, days to 50 per cent flowering, days to maturity, leaf area index, chlorophyll content, harvest index, oil and protein content. Similar type of results were reported by Sahay *et al*. (2005) and Karad and Kadam (2005) indicating the presence of poor genetic variance in the material for these characters.

Thus, from the foregoing discussion, it is clear that characters *viz.*, seed yield per plant, number of days to 50 per cent flowering, number of branches per plant, number of pods per plant, plant height, and harvest index recorded high heritability with high expected genetic advance indicating the presence of additive gene action and phenotypic selection will be effective for these traits while formulating a breeding programme.

Table 1. Analysis of Variance for the studied morphological, yield contributing and physiological traits in soybean

S. V.	D. F.	Mean Sum of Square											
		Morphological Characters					Yield Contributing Characters				Physiological Traits		
		Days to 50% Flowering	Days to Maturity	Plant Height (cm)	No. of branches/ plant	No. of pods/ plant	100 seed weight	Oil content	Protein content	Seed yield/ plant	Harvest index	Leaf area index	Chlorophyll content
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Replication	1	7.200	14.450	52.035	0.084	53.284	0.276	0.635	0.003	0.159	10.138	0.003	0.075
Treatment	39	21.364**	69.200**	257.449**	1.428**	207.209**	14.481**	4.656**	11.718**	30.342**	101.038**	0.175**	0.152**
Error	39	5.174	32.014	45.046	0.252	39.444	4.197	1.659	4.452	1.39	11.907	0.040	0.020

Table 2. Mean performance of soybean genotypes for morphological, physiological and yield and yield contributing traits in soybean

Sr. No.	Genotype	Morphological traits				Physiological traits			Yield and yield contributing traits				
		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/ plant	Leaf Area Index	Chlorophyll Content (mg)	Harvest index (%)	No. of pods/ plant	100 seed weight (g)	Oil content (%)	Protein content (%)	Seed yield per plant (g)
		1	2	3	4	5	6	7	8	9	11	12	10
1	AMS-MB-5-19	39.50	100.50	55.34	4.5	1.84	3.37	47.59	40.04	11.65	21.53	36.22	10.69
2	PS 1480	38.50	105.50	64.43	3.8	1.17	2.95	42.16	21.91	13.25	17.11	37.46	7.71
3	JS(SH)2003-8	42.00	104.50	72.00	3.6	1.42	3.18	52.96	22.13	14.0	18.11	38.44	7.74
4	CSB-08-08	44.00	102.00	71.84	3.2	1.05	2.90	26.16	15.78	11.40	18.19	38.28	3.68
5	EC 3412	35.50	82.00	38.36	5.0	1.24	3.28	35.07	34.80	15.05	18.01	38.19	13.56
6	MAUS 162	45.50	98.50	81.13	4.3	1.37	3.31	49.52	33.40	14.55	18.21	35.48	14.01
7	KSO 245	38.50	100.50	53.14	3.6	1.99	3.22	45.03	27.30	13.85	17.86	34.82	6.58
8	VLS 77	38.00	105.50	55.78	4.1	1.78	3.37	33.55	34.32	15.50	19.35	36.13	13.27
9	AMS-MB-5-18	38.00	104.50	53.27	2.6	1.35	3.04	33.56	38.02	12.25	18.56	38.16	10.61
10	KS 103	38.00	103.00	72.11	4.5	1.73	3.27	45.57	32.95	12.25	17.09	41.69	7.93
11	DSB 18	41.00	103.00	75.99	3.6	1.98	3.23	39.42	25.30	13.80	18.19	42.83	7.53
12	NRC 87	40.50	97.50	46.99	4.1	2.27	4.16	49.74	33.10	13.90	19.06	39.13	12.48
13	CSB-08-09	48.50	106.50	80.44	2.3	2.00	3.50	29.54	14.50	9.95	17.13	39.28	3.67
14	SL 871	38.50	88.00	56.11	4.5	1.38	3.06	50.71	25.80	13.35	19.44	32.71	9.37
15	Swarna Vasundhara	40.50	98.00	57.09	4.7	2.16	3.79	56.81	29.70	26.00	22.59	33.47	21.86
16	Monetta	35.50	94.50	59.89	3.2	1.94	3.72	44.55	34.60	12.55	20.54	36.81	12.00
17	NRC 2008 F 1	36.50	98.00	48.53	4.3	1.55	3.16	42.87	27.10	12.20	20.50	40.55	8.55
18	PS 1476	40.00	102.50	66.10	5.6	1.32	3.10	47.44	24.70	13.40	19.23	34.52	9.36
19	JS 93-05	37.00	94.50	46.49	4.9	1.49	3.28	46.29	42.20	15.65	19.82	37.31	17.50
20	SL 778	35.50	95.00	61.27	5.0	1.48	3.33	56.68	33.80	18.00	19.99	32.53	15.18
21	RKS 61	42.00	95.00	55.00	3.1	1.58	3.16	43.97	26.00	9.35	18.79	40.47	5.09
22	MACS 1259	36.50	99.00	80.13	3.3	1.71	3.34	48.17	24.30	12.40	21.26	38.77	7.49
23	MACS 1311	37.50	98.00	58.07	4.3	1.55	3.25	41.50	36.80	14.55	21.50	35.37	10.54

24	DS 27-11	40.00	104.00	56.53	3.5	1.24	3.13	41.80	30.80	14.45	22.23	38.86	9.29
25	MACS 1281	41.50	100.00	71.11	5.5	1.47	3.15	49.52	40.40	13.55	21.09	34.35	11.45
26	Kalitur	42.50	105.00	81.36	4.2	1.90	3.40	39.94	30.10	12.35	19.79	39.10	7.45
27	NSO 81	35.50	102.00	56.98	3.5	2.20	3.75	42.74	20.05	12.75	20.66	41.12	7.70
28	EC 257203	39.50	103.00	50.30	5.9	1.47	3.44	57.00	53.40	15.35	21.51	37.93	19.09
29	MACS 1201	42.50	98.50	62.31	3.7	1.84	3.47	49.39	26.50	15.60	20.80	34.34	10.14
30	KDS 344	43.00	104.50	69.01	3.2	1.55	3.34	39.99	41.90	10.60	19.01	37.27	9.74
31	NRC 86	35.50	89.50	48.95	4.3	1.78	3.67	45.02	41.50	12.65	21.76	33.58	11.35
32	Bragg	42.00	102.50	56.83	4.7	1.56	3.40	49.99	37.95	12.45	21.17	35.15	11.02
33	JS 20-29	37.00	93.50	59.74	5.0	1.32	3.39	50.07	43.10	16.10	20.43	37.05	16.25
34	VLS 76	33.00	105.50	48.96	2.9	1.57	3.17	53.97	22.20	14.35	21.29	36.26	6.78
35	MAUS 609	38.00	96.00	54.97	4.3	1.61	3.66	51.01	48.70	15.25	21.59	36.56	15.49
	CHECKS												
36	MAUS 47	36.50	82.50	41.07	4.3	1.66	3.46	41.44	30.20	14.00	18.45	37.88	10.35
37	MAUS 71	38.00	98.00	49.05	4.0	1.27	3.15	52.10	30.40	11.90	20.22	38.80	10.62
38	MAUS 158	40.00	94.50	62.71	4.7	1.75	3.62	46.75	40.30	12.95	19.79	37.34	12.32
39	JS 335	37.50	97.50	53.17	4.7	2.00	3.73	50.07	38.00	14.45	20.36	36.18	12.34
40	JS 97-52	44.00	99.50	68.02	4.0	1.70	3.59	49.42	42.60	9.75	21.87	38.21	9.92
	G. mean	39.35	98.80	60.13	4.14	1.63	3.37	45.48	32.47	13.69	19.85	37.21	10.69
	SE +	1.60	4.06	4.74	0.35	0.14	0.10	2.44	2.34	1.44	0.91	1.49	0.83
	CD at 5%	4.57	11.54	13.49	1.01	0.40	0.28	6.93	6.65	4.11	2.58	4.24	2.37
	CD at 1%	6.09	15.39	17.98	1.34	0.53	0.38	9.24	8.87	5.49	3.45	5.65	3.16

Table 3. Parameters of genetic variability for morphological, physiological and yield and yield contributing traits in soybean.

Sr. No.	Character	Range	Mean	Genotypic variance (σ^2g)	Phenotypic variance (σ^2p)	GCV (%)	PCV (%)	Heritability (%)	Expected genetic advance (%)
1	Days to 50% flowering	33.00-48.5	39.35	8.09	13.26	7.23	9.25	61.04	11.63
2	Days to maturity	82-106.5	98.80	18.09	51.10	4.30	7.23	35.40	5.27
3	Plant height (cm)	38.36-81.36	60.13	106.20	151.24	17.13	20.45	70.21	29.58
4	Number of branches per plant	2.3-5.9	4.14	0.58	0.84	18.48	22.10	69.94	31.85
5	Number of pods per plant	14.5-53.4	32.47	69.89	80.86	25.74	27.68	86.43	49.30
6	100 seed weight (g)	9.35-26.00	13.69	5.14	9.33	16.56	22.32	55.05	25.31
7	Leaf area index	1.17-2.27	1.63	6.74	10.76	15.89	20.07	62.65	25.91
8	Chlorophyll content (mg)	2.90-4.16	3.37	6.57	8.64	7.60	8.72	75.97	13.65
9	Harvest index (%)	26.16-57.00	45.48	44.56	56.47	14.67	16.52	78.91	26.86
10	Oil content (%)	17.09-22.59	19.85	1.49	3.15	6.16	8.95	47.45	8.7
11	Protein content (%)	32.53-42.83	37.21	3.63	8.08	5.12	7.64	44.93	7.07
12	Seed yield per plant (g)	3.67-21.86	10.69	14.47	15.86	35.57	37.24	91.22	69.99

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