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Genetic variability for yield and its component traits in grain and vegetable type soybean

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Abstract
Fourteen soybean genotypes including seven each of grain and vegetable types were evaluated for fourteen characters. Analysis of variance indicated significant differences among the genotypes for different traits. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV). The high values of GCV and PCV observed for 100 seed weight, seed yield and harvest index. High heritability coupled with high genetic advance was observed for days to 50% flowering, days to maturity, plant height, number of branches, number of seed, green pod weight, 100 seed weight, seed yield and harvest index showed preponderance of additive gene effects in expression of these traits.

Keywords: Vegetable soybean, genetic variability, heritability, genetic advance

Introduction
Soybean (*Glycine max* (L.) Merrill) is recognized as an important legume crop in India in terms of total production, being an important source of protein and oil. It contains about 37-42% of good quality protein, 6% ash, 29% carbohydrate and 17-24% oil comprising 85% unsaturated fatty acid. Soybean can be divided into two categories: vegetable soybean, which is harvested between reproductive stages 6 (R6) and 7 (R7) of growth when the seeds have developed to fill 80% - 90% of the pod, and grain soybean, which is harvested at reproductive stage 8 (R8) when the pod has reached full maturity. Grain soybean is primarily used for manufacturing oil and protein products. Vegetable soybean, however, is consumed mainly as a vegetable or snack. Like grain soybean, vegetable soybean is also rich in protein, oil, and other nutritious constituents. Vegetable soybean is good source of vitamin A, carbohydrates, protein and iron and is more nutritious than vegetable green peas (Gu *et al.* 2002) [8]. Vegetable soybeans are also used in the preparation of innovative products such as green milk, green tofu and green noodles. A wide range of vegetable soybean varieties have been cultivated and there is an increased consumption of vegetable soybean in south-East Asian countries. Considering the nutritional importance of vegetable soybean, efforts are being made to breed vegetable soybean varieties. In order to increase yield, genetic variability is the prerequisites since it is the source of variation and raw material for yield improvement work.
The assessment of variability present in the crop helps in successful utilization of plant characters for developing suitable variety for yield and stability. Variability studies enable the breeder in determining most suitable genotypes for selection using genetic parameters like, genetic coefficient of variation, heritability and genetic advance. Realizing the importance of the above facts, the present study was carried out to estimate the genetic variability among grain and vegetable type soybean genotypes for yield and its component traits.

Materials and Methods
The material under study consisted of seven grain (JS-335, JS (SH) 93-37, JS-93-05, MACS-450, MACS-1037, MACS-1188 and NRC 37) and seven vegetable type (Swarna vasundhara, GC-84501-32-01, AGS-339, AGS-450, AGS-457, AGS-459 and Himso-1563) soybean genotypes. Genetic variability studies carried out using all fourteen soybean genotypes. These genotypes were sown in randomized block design in three replications in the experimental field of Department of Agricultural Botany, Dr. PDKV, Akola during Kharif 2017.

The data was recorded on five randomly selected competitive plants from each genotype in each replication. Characters studied were days to 50% flowering, leaf area index, chlorophyll content index, days to maturity, plant height, number of branches per plant, number of seeds per pod, number of pods per plant, green pod weight per plant, 100 green seed (bean) weight, 100 seed (matured) weight, green seed (bean) yield per plant, seed (matured) yield per plant and harvest index.

Results and Discussion

Analysis of variance: The analysis of variance was carried out for all characters under study and presented in Table 1. The analyzed data indicated that the treatment mean sum of square were found to be highly significant for all the fourteen characters studied. The variation among the treatments showed highly significant which indicate the presence of high genetic variation amongst the genotypes selected for study. Based on the mean performance of fourteen genotypes, Swarna vasundhara was found promising for green pod yield, seed yield per plant and harvest index.

Table 1: Analysis of variance for various characters in soybean

Sr. No.	Characters	Replication	Treatment	Error
	Degree of freedom	2	13	26
1	Days to 50% flowering	0.881	130.075**	1.163
2	Leaf area Index	0.075	0.244**	0.072
3	Chlorophyll content Index	2.502	16.110**	0.550
4	Days to maturity	0.381	188.368**	1.176
5	Plant height (cm)	2.931	383.467**	4.692
6	Number of branches/plant	0.881	14.800**	0.778
7	Number of pods/plant	142.571	405.729**	69.059
8	Number of seeds/pod	0.003	0.431**	0.026
9	Green pod wt./plant (g)	342.331	1169.460**	152.766
10	100 green seed wt. (g)	2.835	1271.040**	3.967
11	Green seed yield/plant (g)	159.206	858.094**	69.389
12	100 seed wt. (g)	0.309	320.058**	0.440
13	Seed yield/plant (g)	40.074	237.633**	21.037
14	Harvest Index (%)	95.741	543.261**	49.638

** Significant at 1% level

The genotypic (Vg), phenotypic (Vp) and environmental (Ve) variance components for all the characters are given in Table 2. It is revealed that phenotypic variance were greater than genotypic variance for all characters. The estimates of phenotypic variance were found to be the highest for 100 green seed weight (1273.685) and lowest for leaf area Index (0.292). The environmental component of variance was highest for green pod weight per plant (152.766).

Table 2: Estimates of genotypic, phenotypic and environmental variance

Sr. No.	Characters	Genotypic variance	Phenotypic variance	Environmental variance
1	Days to 50% flowering	129.687	130.850	1.163
2	Leaf area Index	0.220	0.292	0.072
3	Chlorophyll content Index	15.926	16.476	0.550
4	Days to maturity	187.976	189.152	1.176
5	Plant height (cm)	381.903	386.595	4.692
6	Number of branches/plant	14.541	15.319	0.778
7	Number of pods/plant	382.709	451.768	69.059
8	Number of seeds/pod	0.422	0.448	0.026
9	Green pod wt./plant (g)	1118.538	1271.304	152.766
10	100 green seed wt. (g)	1269.718	1273.685	3.967
11	Green seed yield/plant (g)	834.964	904.353	69.389
12	100 seed wt. (g)	319.911	320.351	0.440
13	Seed yield/plant (g)	230.621	251.657	21.037
14	Harvest Index (%)	526.715	576.353	49.638

Analysis of genotypic and phenotypic coefficient of variance

It is essential to assess the genetic components of variability in the total variation, before the variability can be utilized for further genetic improvement. The additive genetic variance will be the constant inheritance portion of the total variation. The data on estimates of phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance are presented in Table 3. The phenotypic coefficient of variation (PCV) was observed higher than the genotypic coefficient of variation (GCV) for all characters, indicating the substantial modifying effect of environment in the expression of the all traits studied. Similar results were recorded by Dilnesaw *et al.* (2013) [7]; Malek *et al.* (2014) [10]; Akkamahadevi and Basavaraja (2017) [2] and Bhakuni *et al.* (2017) [5].

The results revealed that, 100 green seed (bean) weight had the highest GCV (95.05%) followed by 100 seed (matured) weight (92.10%), seed yield per plant (58.39%), green seed yield per plant (57.50%) and harvest index (57.42%). The estimated GCV was found to be moderate for days to 50% flowering, leaf area index, chlorophyll content index, days to maturity, plant height, number of branches per plant, number of pods per plant, number of seeds per pod and green pod weight per plant. Similarly, 100 green seed weight had highest PCV (95.20%) followed by 100 seed weight

(92.16%), seed yield per plant (60.99), harvest index (60.06%) and green seed yield per plant (59.85%). The high magnitude of GCV and PCV value was observed for 100 green seed (bean) weight, 100 seed weight, green seed (bean) yield per plant, seed yield per plant and harvest index indicating the presence of high degree of variability and better scope for the improvement of these characters through selection.

Table 3: Range, mean and estimates of genetic parameters in soybean

Sr. No.	Characters	Range	Mean	GCV%	PCV%	h^2 %	GA as % of mean 5%
1	Days to 50% flowering	23.67-42.67	36.97	30.80	30.94	99.11	63.17
2	Leaf area Index	2.53-3.72	2.92	16.05	18.51	75.23	28.68
3	Chlorophyll content Index	28.43-36.47	32.61	12.24	12.45	96.66	24.79
4	Days to maturity	74.33-97.00	89.74	15.28	15.33	99.38	31.38
5	Plant height (cm)	33.5-63.1	49.96	39.12	39.36	98.79	80.09
6	Number of branches/plant	10.00-17.00	13.45	28.35	29.10	94.92	56.90
7	Number of pods/plant	42.67-83.33	62.14	31.48	34.20	84.71	59.69
8	Number of seeds/pod	2.0-3.0	2.50	25.99	26.79	94.16	51.93
9	Green pod wt./plant (g)	47.89-115.19	72.77	46.00	49.04	87.98	88.89
10	100 green seed wt. (g)	22.00-86.78	37.49	95.05	95.20	99.69	195.49
11	Green seed yield/plant (g)	28.40-88.63	50.25	57.50	59.85	92.33	113.83
12	100 seed wt. (g)	10.80-36.40	19.42	92.10	92.16	99.86	189.59
13	Seed yield/plant (g)	15.27-45.49	26.01	58.39	60.99	91.64	115.14
14	Harvest Index (%)	23.05-65.89	39.97	57.42	60.06	91.39	113.08

The similar results were reported earlier by Basavaraja *et al*. (2005) [2], Kavithamani *et al*. (2010) [9], Dilnesaw *et al.* (2013) [7]; Khanande *et al.* (2016); Akkamahadevi and Basavaraja (2017) [2] and Bhakuni *et al.* (2017) [5] in vegetable and grain type soybean. Basavaraja *et al*. (2005) [2], Nwosu *et al.* (2013) [11] reported high magnitude of GCV, PCV value for green pod yield per plant. High estimates of GCV and PCV reported by Swathi (2009) [12] for plant height and 100 seed weight in vegetable soybean genotypes.

Moderate range of GCV and PCV values were observed for days to 50% flowering, leaf area index, chlorophyll content index, days to maturity, plant height, number of branches per plant, number of pods per plant, number of seeds per pod and green pod weight per plant. Similar findings were reported by Aditya *et al*. (2011) [1], Malek *et al.* (2014) [10] and Bhakuni *et al*. (2017) [5] for plant height. For number of pods per plant similar findings were recorded by Swathi (2009) [12] and Malek *et al.* (2014) [10]. Low differences between GCV and PCV for these traits indicate lower influence of environment and reflect on reliability of selection based on phynotypic performance. Narrow differences between GCV and PCV were reported by Bhat *et al.* (2012) [6] and Akkamahadevi and Basavaraja (2017) [2].

Analysis of heritability and genetic advance

The heritability estimates was ranged from 71.39% to 99.86%. Considerably very high estimates of heritability were obtained for 100 seed weight (99.86%), 100 green seed (bean) weight (99.69%), Days to maturity (99.38), days to 50% flowering (99.11%), plant height (98.79%), number of branches per plant (94.92%), number of seeds per plant (94.16%), green seed (bean) yield per plant (92.33%), seed yield per plant (91.64%) and harvest index (91.39%). High heritability was also observed for green pod weight per plant (87.98%) and number of pods per plant (84.71%). These result confirmed with earlier findings of Aditya *et al.* (2011) [1]; Akkamahadevi and Basavaraja (2017) [2] and Bhakuni *et al.* (2017) [5]. Alt *et al*. (2002) [3] revealed that, high heritability was hundred fresh seed weight, seeds per pod and green pod yield per plant. The findings of Basavaraja *et al*. (2005) [2] confirmed the highest magnitude of heritability observed for plant height. A moderate value of heritability were recorded for leaf area index (75.23%). Similar result was reported earlier by Aditya *et al.* (2011) [1] for dry matter weight per plant and harvest index.

Highest magnitude of genetic advance was observed for 100 green (bean) seed weight (195.49) followed by 100 seed weight (189.59), seed yield per plant (115.14), green seed (bean) yield per plant (113.83), harvest index (113.08), sugar content (92.00), green pod weight per plant (88.89), plant height (80.09). Medium magnitude of genetic advance was observed for days to 50% flowering (63.17), number of pods per plant (59.69), number of branches per plant (56.90), number of seeds per plant (51.93), and days to maturity (31.38). Leaf area index (28.68) showed low magnitude of genetic advance. These results confirmed with the earlier findings of Aditya *et al.* (2011) [1]; Nwosu *et al*. (2013) [11], Akkamahadevi and Basavaraja (2017) [2] and Bhakuni *et al.* (2017) [5] for number of pods per plant, 100 seed weight, dry matter weight per plant and plant height.

High heritability accompanied with high genetic advance were observed for days to 50% flowering, days to maturity, plant height, number of branches per plant, number of seed per pod, green pod weight per plant, 100 green seed (bean), 100 seed (matured) weight, green seed (bean) yield per plant, seed (matured) yield per plant and harvest index indicating the presence of additive gene action and direct selection for such traits is rewarding in crop improvement. These result are in accordance with results reported by Swathi (2009) [12]; Malek *et al.* (2014) [10] and Akkamahadevi and Basavaraja (2017) [2]. Similar results for high heritability coupled with high genetic advance was reported by Aditya *et al.* (2011) [1]; Bhat *et al.* (2012) [6] and Bhakuni *et al.* (2017) [5] for number of pods per plant. Aditya *et al.* (2011) [1] and Dilnesaw *et al.* (2013) [7] also reported for plant height.

Leaf area index showed high heritability accompanied with low generic advance indicating non additive gene action. Similar results was reported by Aditya *et al.* (2011) [1] for number of primary branches per plant, 100 seed weight and days to 50 per cent flowering. High heritability being exhibited due to favorable influence of environment rather than genotype and selection of such traits may not be rewarding and hence such traits can be improved through hybridization.

Conclusion

From the present study, the data shows highly significant variations among all grain and vegetable type soybean genotypes. Among the traits *viz*., days to 50% flowering, days to maturity, plant height, number of branches per plant,

number of seed per pod, green pod weight per plant, 100 green seed (bean), 100 seed weight, green seed (bean) yield per plant, seed yield per plant and harvest index were controlled by additive gene action and such traits could be used in crop improvement.

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