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Assessment of Genetic Variability, Heritability and Genetic Advance in Soybean (*Glysin max L.)* Genotypes

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted to study genetic variability, heritability, and genetic advance among 25 soybean genotypes. Analysis of variance revealed significant differences for all the thirteen tarits. For most of the features, the discrepancies between phenotypic and genotypic coefficients of variation (PCV and GCV) were small, indicating little environmental influence on their expression. For the number of pods/plant and the number of seeds/plant, high heritability and genetic advance with a high GCV were determined to be advantageous features for soybean improvement by phenotypic selection, with a high predicted genetic gain. The traits with higher heritability and GA value may indicate their variability and high selective value. Genetic variation is crucial to the effectiveness of yield improvement efforts since it is a major component in broadening gene pools in any particular crop population. As a result, the study's goals were to evaluate genetic variability.

Keywords: Genetic variability; phenotypic; genotypic coefficients.

1. INTRODUCTION

"Soybean [*Glycine max* (L.) Merrill] is the world's most important seed legume, which contributes about 25 per cent of the global edible oil [1]. It has highest protein (42 %), rich in lysine and vitamins (A, B and D) and also contains 20 % oil. Improvement of genetic architecture of any crop

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depends upon the nature and extent of genetic variability" [2]. One of the criteria for doing selection in any breeding program is the presence of genetic variability. Similarly, "genetic advance is also a useful measure to predict gain in specified selection intensity" [3]. "Pod and seed number are prerequisite yield traits of soybean such as number of pods per plant; numbers of seeds per pod and number of seeds per plant easily identifiable and contributing properties of yield" [4]. Estimates of heritability are used to decipher the pattern of quantitative character inheritance, such as seed yield. Similarly, "genetic advance is also a useful measure to predict gain in specified selection intensity" [5]. When combined with heredity, it becomes more useful in predicting response to selection than heritability estimates alone. Therefore, this study was designed to evaluate soybean genotypes for yield as well as other parameters.

2. MATERIALS AND METHODS

The current study used 25 different germplasm accessions, including 5 soybean checks, to measure various variability parameters such as mean, range of variation, genotypic and phenotypic coefficients of variation, heritability in a broad sense, genetic advance, and genetic advance as a percentage of mean. The experiment was laid-out in a Randomized Block Design with two replications at research cum instructional farm Department of Genetics and Plant Breeding, College of Agriculture/Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The observations were recorded for 13 different characters, *viz*., days to initial flowering, days to 50 per cent flowering, days to maturity, plant height (cm), number of primary branches per plant, number of pods per plant, number of seed per pod, number of seeds per plant, 100 seed weight (g), harvest index, seed yield per plant, and oil content (%).The GCV and PCV parameters estimated by Burton [5] heritability suggested by Johnson et al. [6] and genetic advance as percentage of mean calculated by Johnson et al. [6].

3. RESULTS AND DISCUSSION

3.1 Genetic Variability

"Genetic variability is the pre-requisites for genetic improvement in a systematic breeding program" [6]. The mean squares owing to genotype were found to be significant for all of the variables under research in an analysis of variance, indicating that the genetic materials analyzed had a lot of phenotypic variability (Table 1). All the 25 genotypes showed wide range of variation for most of the traits under study (Table 2), indicated the scope for selection of these traits for further breeding work. The estimates of genotypic (GCV) and phenotypic (PCV) coefficients of variability indicated that the values of PCV were higher than GCV for all the traits partly due to interaction of the genotypes with the environment or other environmental factors influencing the expression of these characters (Table 2).

Table 1. Analysis of variance for thirteen yield and yield attributing traits of soybean genotypes

S.N.	Source	Treatment	Replication	Error
	Degree of Freedom	24	1	24
1	Days to 50% flowering	10.472**	3.92	3.462
2	Days to maturity	68.932**	7.296	5.246
3	Plant height	258.484**	17.88	33.511
4	Pod bearing lenth	230.849**	91.666	17.197
5	No of primary branches/plant	1.405**	1.62	0.37
6	N of pods/plant	1340.854**	151.728	9.032
7	No of seeds/pod	0.444**	0.146	0.1
8	Biological yield	519.134**	1.217	7.91
9	No of seeds/plant	6860.384**	1,597.26	1,249.61
10	100 seed weight	6.227**	0.047	0.554
11	Harvest index	240.184**	12.4	22.473
12	Oil%	9.321**	1.828	0.628
13	Seed yield/plant	78.525**	3.277	3.805

Table 2. Genetic variability parameters for yield and yield attributing traits

S.N.	Paramet/Characters	Range		General Mean	GCV	PCV	h2 (Broad Sense)	Genetic Advance	Genetic Advances as % of Mean
		max	min						
1	Days to 50% flowering	48.50	41.00	44.56	4.20	5.92	50.31	2.74	6.14
2	Days to maturity	119.85	94.00	96.35	5.86	6.32	85.86	10.77	11.18
3	Plant height	82.40	32.05	54.13	19.59	22.32	77.05	19.18	35.43
4	P0d bearing length	69.50	25.40	45.98	22.48	24.22	86.13	19.76	42.98
5	No of primary branches/plant	5.70	2.90	4.20	17.11	22.40	58.34	1.13	26.92
6	N of pods/plant	103.15	26.80	70.26	36.73	36.98	98.66	52.80	75.15
7	No of seeds/pod	3.95	2.20	2.70	15.34	19.31	63.12	0.68	25.10
8	Biological yield	71.55	21.10	44.34	36.05	36.61	97.00	32.44	73.15
9	No of seeds/plant	251.50	37.55	137.85	38.42	46.19	69.18	90.75	65.83
10	100 seed weight	16.70	9.80	12.58	13.39	14.64	83.67	3.17	25.23
11	Harvest index	70.80	17.60	39.15	26.65	29.27	82.89	19.57	49.98
12	Oil%	22.37	13.42	18.85	11.06	11.83	87.37	4.01	21.30
13	Seed yield/plant	32.75	9.10	17.56	34.80	36.53	90.76	12.00	68.30

"In several cases, small discrepancies between the PCV and GCV suggested that these traits were less influenced by the environment. Similar results for high GCV and PCV for the characters Plant height, number of primary branches per plant, number of pods per plant and seed yield were obtained by indicating the wider adaptability of these traits in the genotypes studied. Similar results for high GCV and PCV for the characters Plant height, number of branches per plant, number of pods per plant and seed yield were obtained" by Neelima et al. [7], Karnwal and Singh [8], Malik et al. [4] indicating "the wider adapability of these traits in the genotypes studied".

3.2 Heritability and Genetic Advance

The estimates of heritability in the broad sense ranged from 50.31 percent to 98.66 percent (Table 2). In the present study, the highest heritability was recorded by number of pods per plant (98.66%), biological yield (96.99%), seed yield per plant (99.75%) and oil percentage (87.00%) similar finding were reported by Jandong et al. [3] Malek et al. [9] and Karnwal and Singh [8] for seed yield per plant, Karnwal and Singh [8] for number of pods per plant. High heritability suggests a high component of the heritable portion of variation that will be exploited by a breeder in the selection of superior genotypes on the basis of phenotypic performance of the varieties. Furthermore, days to 50% flowering (58.33) and number of primary branches per pod (50.31) indicated moderate heritability, indicating the possibility of a soybean improvement program could be successful. The finding is also confirmed by Sulistyo [10]. High genetic advance was found for the number of seeds per pod (90.74) and number of pods per plant (52.80) which is similar to the findings with Abebe [11] for number of seeds per pod. High heritability coupled with high genetic advance was observed for number of pods per plant (98.62, 75.15), Biological yield (96.99, 73.15) and for seed yield per plant (90.75, 68.30), which is due to additive gene effects and expressed in these traits. Similar results were reported by Yadawad et al. [12], Bangar et al. [2], Chandel et al. [13], Amit et al. [14] and Mahbub et al. [15]. Since they are amenable to simple selection, this indicates a lower influence of surroundings on character expression and a higher prevalence of additive gene action in their inheritance.

4. CONCLUSION

The genetic materials analysed have a lot of phenotypic diversity, according to the analysis of variance. For all of the traits, the phenotypic coefficient of variation (PCV) was greater than the genotypic coefficient of variation (GCV), demonstrating the importance of environmental factors. High estimates of heritability were observed for plant height, number of branches per plant, number of clusters per plant, and number of pods per plant, as well as high genetic advance expressed as the percentage of mean, that could be attributed to the preponderance of additive gene action and have high selective value, and therefore selection pressure could be implemented profitably on this character for rationale development.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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