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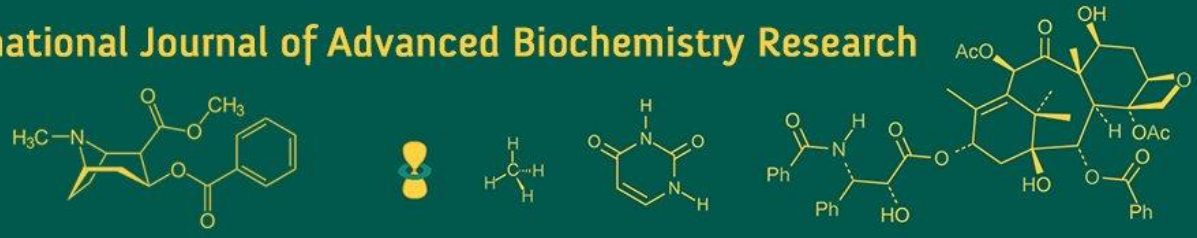

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Genetic variability, heritability and genetic advance studies in soybean [*Glycine max* (L.) Merrill] genotypes

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Abstract
The study was conducted on 100 soybean germplasm lines along with 5 check varieties, evaluated using an augmented block design comprising four blocks in Kharif 2024. In this experiment, the results of variance analysis revealed a substantial amount of genetic variation across the genotypes for all ten traits studied. For each of the ten traits, PCV were higher than GCV values with small difference, suggesting that environmental influenced on trait expression was relatively low. The current investigation revealed that the number of branches and pod cluster per plant recorded high GCV and PCV. The highest heritability was observed for number of pod cluster per plant, followed by seed weight. The traits exhibiting significant heritability (h^2) and genetic advance (GA) serve as reliable indicators for effective selection in breeding programmes.

Keywords: Soybean, genetic variability, heritability, PCV, GCV, breeding

1. Introduction
Soybean (*Glycine max* (L.) Merrill] is a member of the Fabaceae family and belongs to the genus Glycine. It is a short day, self pollinated, plant having chromosome number of 2n = 40. Soybean contains 20% oil, 40% protein and contains significant amount of vitamins and minerals. Soybean accounts for approximately 25% of to the world's edible oil production and serves as the primary source of protein concentrate for livestock feed. The successful crop breeding initiatives are highly dependent on the availability and extent of genetic variation within the germplasm. Therefore, evaluating variability is essential for crop improvement programme. In this context, the present study evaluated genetic variation and broad sense heritability among soybean genotypes to support future breeding programmes.

2. Material and Methods
The experiment was carried out at Regional Research Centre Amravati during Kharif-2024 on 100 genotypes along with 5 checks of soybean laid out in an Augmented with 4 blocks design to evaluate genetic variability, GCV and PCV, heritability (h^2), genetic advance (GA) and genetic advance percent of mean (GAM). The study involved ten traits *viz*., days to 50% flowering, days to maturity, plant height, number of branches per plant, number of pod clusters per plant, number of pods per plant, number of seed per pods, 100-seed weight (g), seed yield per plant (g) and oil content (%). The PCV and GCV was calculated using Burton *et al.* (1952) formula. whereas, heritability and genetic advance was calculated by Johnson *et al.* (1955) formula.

3. Results and Discussions
3.1 Genotypic and phenotypic coefficient of variation
The traits number of branches per plant (24.95% & 25.43%), number of pod clusters per plant (24.12% & 24.64%), yield per plant (20.63% & 23.56%), number of pods per plant (15.25 & 17.23) exhibited high estimates of PCV and GCV followed by plant height (13.50% & 15.72%), 100-seed weight (12.78% & 13.18%) and number of seeds per pod (12.02% & 12.47%).

Similar high estimates of GCV and PCV for these traits have also been reported by Rasaily *et al.* (1986) [8], Reni *et al.* (2013) [9], Chandrawat *et al.* (2017) [2] and Jain *et al.* (2018) [4].

3.2 Heritability
The number of pod clusters per plant showed the maximum heritability (95.81%), followed by 100-seed weight (94.07%), number of seeds per pod (92.89%) and number of branches per plant (89.06%), number of pods per plant (78.38) and seed yield per plant (76.88%). Heritability was relatively lower for days to maturity (61.31%), oil content (68.67%), and plant height (73.75%)

3.3 Genetic advance
Plant height (10.68), number of pods per plant (8.76), days to 50 percent flowering (7.06), and days to maturity (4.87) recorded high estimates of genetic advance, while a low values were recorded for number of seeds per pod (0.47), number of branches per plant (1.32) followed by oil content (1.40), seed yield per plant (1.91), 100-seed weight (2.50) and number of pod clusters per plant (2.70).

3.4 Genetic advance as (%) of mean
The traits number of branches per plant (48.50%) recorded highest GAM followed by number of pod clusters per plant (48.64%), seed yield per plant (37.27%), 100-seed weight (25.54%), number of pods per plant (27.82%), plant height (23.89%), number of seed per pod (23.86%) and days to 50% flowering (16.66%) recorded higher GAM than oil content (7.63%) and days to maturity (5.10%) exhibited low estimates of GAM.

Table 1: Analysis of variance in soybean genotypes

Source of variation	df	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/plant	No. of pod clusters/ plant	No. of pods/plant	No. of seed/pod	100 seed weight (g)	Seed yield/plant (g)	Oil content (%)
Blocks	3	0.067	9.133	3.694	0.050	0.045	9.656	0.005	0.232	0.109	0.032
Treatment	104	18.828**	19.255**	60.112**	0.611**	2.287**	42.625**	0.103**	2.133**	2.039**	1.121**
Checks	4	46.925**	90.425**	173.872**	0.589**	3.672**	271.158**	0.612**	4.959**	3.282**	1.321**
Germplasm	99	17.881**	16.452**	55.761**	0.597**	2.189**	33.429**	0.072**	1.940**	1.663**	1.103**
Germplasm vs check	1	0.202	12.042	35.818*	4.034**	6.469**	38.913*	1.315**	9.995**	34.311**	2.158*
Error	12	2.025	5.758	12.993	0.057	0.079	6.369	0.004	0.099	0.340	0.309

Table 2: Estimates of genetic parameters in soybean genotypes

Sr. No.	Characters	Mean	Range		Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)	Heritability (h^2) (BS) (%)	Genetic Advance (GA)
			Min	Max				
1	Days to 50% flowering	42.37	34	53	8.67	9.30	86.98	7.06
2	Days to maturity	95.49	87	104	3.16	4.04	61.31	4.87
3	Plant height (cm)	44.61	30.2	63.4	13.50	15.72	73.75	10.68
4	No. of branches/plant	2.69	1.6	4.6	24.95	25.43	89.06	1.32
5	No. of pod clusters/plant	5.53	3.2	9.2	24.12	24.64	95.81	2.70
6	No. of pod/plant	31.57	20.8	45.2	15.25	17.23	78.38	8.76
7	No. of seed/pod	1.99	1.40	2.90	12.02	12.47	92.89	0.47
8	100 seed weight (g)	9.84	6.62	13.59	12.78	13.18	94.07	2.50
9	Seed yield per plant (g)	5.21	2.77	8.22	20.63	23.56	76.88	1.91
10	Oil content	18.40	16.76	20.09	4.47	5.40	68.67	1.40

4. Conclusion
Among the ten traits studied, Variation among genotypes was found highly significan, indicating substantial genetic variability within the material .The study showed that the PCV was exceeding GCV for all the traits with small difference, suggesting that these traits were largely governed by genetic factors rather than environmental conditions. The trait plant height and number of pods per plant showed higher heritability and genetic advance. Indicating that simple selection may be effective for improving these traits.

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