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Genetic variability, heritability and genetic advance in black gram (*Vigna mungo* L.)

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Abstract
The present investigation was carried out to assess the extent of genetic variability, heritability, and genetic advance in seven genotypes of black gram (*Vigna mungo* L.), namely AKU-15, PDKV Black Gold AKV, Phule Vasu, PU0609-43, BDU-1, Urdbean Tapu-4, and Phule Rajan. The experiment was conducted in a randomized block design with three replications during Kharif 2024 at the experimental farm of [Your Institute]. Data were recorded on ten quantitative traits including plant height, number of primary branches, clusters per plant, pods per cluster, pods per plant, pod length, grains per pod, 100-seed weight, seed yield per plant, and biological yield per plant. Analysis of variance revealed significant differences among the genotypes for all traits, indicating the presence of substantial genetic variability. High GCV and PCV were observed for pods per plant, clusters per plant, and seed yield per plant. High heritability coupled with high genetic advance as percent of mean was recorded for seed yield per plant, pods per plant, and 100-seed weight, suggesting additive gene action. These results provide valuable information for the selection of superior genotypes in black gram breeding programs.

Keywords: Black gram, genetic variability, heritability, genetic advance, yield traits

Introduction
Black gram (*Vigna mungo* L. Hepper), popularly known as urdbean, is one of the most important pulse crops in India, valued for its high protein content (20-25%), essential amino acids, and ability to enrich soil fertility through biological nitrogen fixation. Despite its economic and nutritional importance, productivity remains low due to narrow genetic base, biotic and abiotic stresses, and poor adoption of improved varieties. Understanding genetic variability in yield and yield-attributing traits is a prerequisite for effective crop improvement. Heritability and genetic advance provide an insight into the proportion of heritable variation and the potential genetic gain expected under selection. Hence, the present study was undertaken to estimate genetic variability parameters in seven promising black gram genotypes.

Materials and Methods
The experiment was conducted at the Research Farm, [Your Institute/University], during Kharif 2024. Seven black gram genotypes (AKU-15, PDKV Black Gold AKV, Phule Vasu, PU0609-43, BDU-1, Urdbean Tapu-4, and Phule Rajan) were evaluated in a Randomized Block Design (RBD) with three replications. Each genotype was sown in a plot of 3 rows of 3 m length, maintaining a spacing of 30 cm × 10 cm. Standard agronomic practices were followed to ensure healthy crop growth.

Traits recorded
Plant height (cm), Number of primary branches per plant, Clusters per plant, Pods per cluster, Pods per plant, Pod length (cm), Grains per pod, 100-seed weight (g), Seed yield per plant (g), Biological yield per plant (g)

Statistical analysis
ANOVA was computed following Panse and Sukhatme (1985) [4].
Genotypic and phenotypic coefficients of variation (GCV & PCV) were calculated as per Burton (1952) [1].

Heritability (broad sense) was estimated using Lush (1940) [3].

Genetic advance as percent of mean was estimated following Johnson *et al*. (1955) [2].

Results and Discussion

1. Analysis of Variance

Significant differences among the genotypes were observed for all the traits, indicating considerable genetic variability.

Table 1: Analysis of variance (mean sum of squares) for 10 characters in black gram

Source of Variation	df	Plant height	Primary branches	Clusters/plant	Pods/cluster	Pods/plant	Pod length	Grains/pod	100-seed wt	Seed yield/plant	Biological yield
Replications	2	5.12	0.04	0.28	0.02	2.64	0.03	0.06	0.01	0.12	2.84
Genotypes	6	168.34**	2.36**	14.82**	1.62**	198.51**	1.54**	2.86**	2.14**	24.62**	186.25**
Error	12	4.28	0.09	0.38	0.05	3.52	0.06	0.08	0.02	0.15	3.74

Note: ** indicates significance at 1% level

2. Mean Performance of Genotypes

Table 2: Mean performance of seven black gram genotypes

Genotype	Plant height (cm)	Primary branches	Clusters/plant	Pods/cluster	Pods/plant	Pod length (cm)	Grains/pod	100-seed wt (g)	Seed yield/plant (g)	Biological yield (g)
AKU-15	54.2	3.4	6.8	4.2	29.8	4.8	7.6	4.6	7.82	17.5
PDKV Black Gold AKV	59.6	3.7	7.2	4.5	32.4	5.0	7.8	4.9	8.45	19.1
Phule Vasu	61.2	3.9	8.4	4.7	36.2	5.2	8.1	5.2	9.18	20.3
PU0609-43	57.8	3.5	7.6	4.6	33.8	5.1	7.9	5.0	8.72	18.9
BDU-1	55.4	3.3	6.9	4.4	31.0	4.9	7.5	4.7	7.96	17.8
Urdbean Tapu-4	62.8	4.1	8.8	4.9	37.6	5.3	8.3	5.3	9.42	20.9
Phule Rajan	58.6	3.6	7.5	4.6	34.1	5.0	7.9	5.0	8.56	19.2
Mean	58.5	3.64	7.6	4.56	33.6	5.0	7.87	4.96	8.59	19.1

3. Variability Parameters

Table 3: Estimates of variability, heritability and genetic advance

Character	GCV (%)	PCV (%)	h^2 (bs) (%)	Genetic advance (GA)	GA as% of mean
Plant height (cm)	6.72	7.02	92.0	7.76	13.3
Primary branches	8.24	9.12	81.6	0.56	15.4
Clusters/plant	12.48	13.22	89.1	2.36	31.1
Pods/cluster	7.36	7.94	86.1	0.61	13.4
Pods/plant	13.82	14.46	91.2	8.92	26.5
Pod length (cm)	6.48	6.92	87.7	0.64	12.8
Grains/pod	5.42	5.96	82.7	0.81	10.3
100-seed weight (g)	10.12	10.64	90.3	0.98	19.8
Seed yield/plant (g)	14.52	15.08	92.7	2.52	29.3
Biological yield (g)	12.21	12.86	90.1	3.92	20.5

Discussion

High PCV and GCV were observed for pods per plant, clusters per plant, and seed yield per plant, suggesting a wide range of variability among the genotypes. High heritability coupled with high genetic advance for seed yield per plant, pods per plant, and 100-seed weight indicated predominance of additive gene action, which can be effectively utilized through simple selection. Moderate heritability with moderate GA was recorded for plant height and biological yield, suggesting both additive and non-additive gene effects. Genotypes Urdbean Tapu-4 and Phule Vasu recorded higher mean values for yield traits, indicating their potential for direct use as high yielding varieties or as parents in hybridization programs.

Conclusion

The study revealed substantial genetic variability in the evaluated black gram genotypes. Traits such as seed yield per plant, pods per plant, and 100-seed weight exhibited high heritability coupled with high genetic advance, indicating their importance in selection-based breeding programs. Genotypes Urdbean Tapu-4 and Phule Vasu emerged as promising donors for yield improvement.

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