Assessment Of Genetic Variability, Heritability and Genetic advance in Blackgram (*Vigna mungo* (L.) Hepper)

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***Abstract*—The present research aims to determine variability, heritability, genetic advance in eight genotypes of blackgram. At the School of Agricultural Sciences G H Raisoni University, Saikheda, the experiment was implemented using a randomized block design with three replications during kharif season (2024). Observation was recorded for nine different traits, which included days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, number of pods per plant, number of seeds per pod, pod length (cm), 100 seed weight (g), seed yield per plant (g). The analysis of variance revealed that mean squares due to genotypes were highly significant for days to 50 % flowering, days to maturity, plant height, number of pods per plant, indicating the presence of sufficient amount of variability in the experimental material used. The magnitude of PCV was slightly greater than GCV which revealed that very little influence of environmental variation was observed on all the characters and stated that a sufficient amount of variability was noticed. Seed yield per plant both shows high phenotypic coefficient of variation and genotypic coefficient of variation. The estimates of high heritability coupled with high genetic advance expressed as per cent of mean was observed for number of primary branches per plant, number of pods per plant, number of seeds per pod, 100-seeds weight and seed yield per plant. It indicates that most likely the heritability is due to additive gene action and selection may be effective for seed yield improvement.**

***Index Terms*—Blackgram, genetic advance, genetic variability, genotypic coefficient of variance, phenotypic coefficient of variance.**

I. INTRODUCTION

As stated by Bhareti et al. (2011), blackgram (*Vigna mungo* (L.) Hepper), frequently referred to as urd, mashbean, urdbean is 4th most significant pulses within India. An affiliate belonging to Fabaceae and subfamily Faboideae. A significant diploid grain legume that self-pollinates (Naga et al., 2006), and its chromosomal number is 2n=22 (Dana 1980). This is one of the most essential short-term legume crops for symbiotic nitrogen fixation, pasture reclamation, integrated agricultural systems, food, fodder, and soil conservation. In India, black gram has been grown on over 3.38 million hectares. 1.61MT of production area with 474 kg/ha average productivity. With a zone of 0.89 Mha, Rajasthan is among the biggest state. with a production of 473 kilograms per hectare as well as production in 0.42 MT. It is grown on 0.78 million hectares of land in Uttar Pradesh, yielding 500 kg/ha of productivity and 0.039 MT of output. The late 20th and early 21st century an increase in population has resulted in an inadequate supply of food grains which has caused malnutrition issues among those from economically disadvantaged groups.

Crop production can be genetically improved through enhancement and release of superior-yielding genotypes and genetic improvement. An effective breeding program, surveys of genetic diversity using appropriate measurements like GCV, heritability estimates, and genetic advancement are essential (Atta et al., 2008). Since genotypic variation serves as the foundation for selection, it can only respond to selection adequately when genetic variety is present (Lal et al., 2017). In a crop breeding program, the initial step is to collect germplasm and evaluate genetic variability. The complicated quantitative attribute of yield makes it impossible to increase by selecting individual plants based on their

performance. Degree as well as type of genetic variability in yield-contributing variables ultimately determine whether or not yield improvement is successful (Johnson et al., 1955). Running an efficient breeding program mandates the ability to estimate genetic parameters like coefficients of genotypic as well as phenotypic variation, genetic along with heritability development to analyze inheritance of various quantitative and qualitative traits. Morever, important to fully evaluate type and extent of about variation in genetic trait among individuals in order to enhance productivity as well as component qualities. Singh et al. (2016).

II. MATERIAL AND METHODS

The field trial was undertaken during kharif season in the year 2024-2025. The experiment was performed at School of Agriculture Sciences G H Raiosni University, Saikheda. The research study consists of eight genotypes, including MG-801, TAU-1, Ajeet-3, Vaman-1, NUL-7(Vishwas), AKU-10-1(Blackgold), AKU-15, Phule vasu. Eight genotypes of blackgram sown in randomized blocked design (RBD). Every variety was kept in single row with the spacing of 30 x 15 cm^2. Data for nine traits was recorded: Days to 50 percent flowering, Days to maturity, Plant height (cm), Number of primary branches per plant, Number of pods per plant, Pod length (cm), Number of seeds per pod,100-seed weight (g), Seed yield per plant (g). Five randomly plants were chosen for each genotype in each replication (except from days to maturity and days to 50% flowering, noted on plot basis). Mean values were computed from five randomly selected plants per plot. Statistical analysis included ANOVA, estimation of GCV, PCV, heritability, genetic advance. Data were analyzed using R studio software and Excel.

III. RESULTS AND DISCUSSION

1. Analysis of variance (ANOVA): -
Utilizing Randomized Block Design and 3 replications, experiment was conducted on eight genotypes for nine characters. After submitting the observations for each character to an analysis of variance, it was discovered that computed mean square values resulting from test varieties were greater significantly for each of nine characters, indicating a considerable degree of variation across test varieties in order to every character in study table no.1.

2. Mean performance and Range: -
Mean day to fifty percent flowering over test varieties were 38.12 days. The observed range of the trait varied from 35.3 days to 42 days. Average value performance of test varieties in order to day to maturity were 69.29 day. Range of the trait varied from 64.3 to 72 days. Average value performance of genotypes for height of plant was 35.76 cm. Plant height ranged from 32.97cm to 42.6cm. Average performance of all genotypes in order to primary branches per plant was 5.1. Among eight genotype, primary branches per plant ranged from 3.40 to 5.99. Mean performance of all genotypes for number of pods per plant were 21.57. Number of pods per plant ranged from 16.62 to 26.8. Mean performance of all test varieties for pod length was 4.77cm. Length of pod ranged from 3.97 to 5.40. Average number of seeds per pod were 5.97. Number of seed per pod ranged from 4.70 to 7.03. Average seed yield per plant was 5.17g. Seed yield per plant ranged from 3.9 g to 6.5 g. The 100 seed weight showed a range from 3.52g to 4.87g with a mean value of 4.1g. A maximum of 100 seeds per gram was observed in 4.87g. The mean performance according to traits (Table 2).

3. Genotypic and Phenotypic Coefficient of Variation: -
The genotypic coefficient of variation (GCV) among the characters under study ranged from 2.98% (days to maturity) to 18.77% (seed yield per plant). High GCV values were recorded for seed yield per plant (18.77%), number of primary branches (17.30%), pods per plant (15.30%), seeds per pod (13.17%), 100-seed weight (12.30%), and pod length (9.64%), while moderate values were observed for plant height (7.62%) and days to 50% flowering (6.83%). The lowest GCV was observed for days to maturity (2.98%). High GCV was recorded for seed yield per plant, primary branches, pods per plant, seeds per pod, 100-seed weight, and pod length, which is in agreement with the findings of Babu et al. (2016), Suguna et al. (2017), and Mohanlal et al. (2018). Low GCV was observed for days to 50% flowering, days to maturity, and plant height, supporting the results of Rolaniya et al. (2017).

The phenotypic coefficient of variation (PCV) ranged from 3.09% (days to maturity) to 18.77% (seed yield per plant). The highest PCV was observed for seed yield per plant (18.77%), followed by primary branches per plant (17.41%), pods per plant (15.34%), seeds per pod (13.41%), 100-seed weight (12.40%), and pod length (10.89%). Moderate PCV values were noted for plant height (7.72%) and days to 50% flowering (7.20%). The lowest PCV was observed for days to maturity (3.09%). High PCV was observed for seed yield per plant, number of primary branches, pods per plant, 100-seed weight, pod length, and plant height, which is in agreement with the findings of Sowmini and Jayamani (2013), Babu et al. (2016), Suguna et al. (2017), Mohanlal et al. (2018), and Tank et al. (2018). Low PCV was recorded for plant height, days to 50% flowering, and days to maturity, which is consistent with the results reported by Kumar et al. (2014), and Rolaniya et al. (2017).

In general, the PCV values were slightly higher than the corresponding GCV values, indicating the influence of environmental factors on the expression of these traits.

4. Heritability (h^2) (Broad sense): -

Heritability as well as genetic advance are presented in table no 2. The prediction regarding heritability in the broad sense was made as suggested by Robinson (1951) as low (50%), moderate (50-70%), and high (> 70%). Heritability (broad sense) ranged among eight genotypes of varies from 78.2% for pod length to 99.99% for seed yield per plant. The maximum heritability is recorded by the following characteristics: seed yield per plant (99.99%) after that total number of pods (99.5%), number of primary branches (98.61%), 100 seed weight (98.43%), plant height (97.5%), number of seed per pods (96.51%), day to maturity (93.2%), day to 50% flowering (89.9%), pod length (78.2%).

High heritability was observed for primary branches, pod length, seed yield per plant, pods per plant, seeds per pod, plant height, days to maturity, and days to 50% flowering. These findings are in agreement with Babu et al. (2016), Suguna et al. (2017), Panda et al. (2017).

5. Genetic Advance expressed as mean percentage:

The genetic advance as mean percentage were classified into three major classes, as proposed by Johanson et al. (1955): high (> 20%), medium (10-20%), and low (10%). The seed yield per plant (38.67%), number of primary branches (35.4%), total number of pods (31.45%), number of seeds per pod (26.65%),100 seed weight (25.15%) all had highest genetic advance as a percentage of the mean. The pod length (17.56%), plant height (15.51%) and day to 50% of flowering (13.35%) all revealed medium genetic advance as a percentage of mean. Although day to maturity (5.94%) had lowest genetic advance as mean percentage. Genetic advance expressed as mean percentage is presented in Table no 2.

Table 1. Analysis of Variance for nine characters in eight genotypes of Blackgram

Source of variance	Degree of freedom	Dt 50% F	DM	PH (cm)	No. PB/P	No. Po/P	No. Se/P	PL	100 SW (g)	SY/P (g)
MEAN SUM OF SQUARES										
Replication	2	0.001	1.16	0.61	0.00082	0.061	0.012	0.03	0.003	0.00033
Genotype	7	21.13**	13.18**	26.41**	2.34**	32.77**	1.87**	0.69**	0.73**	2.83**
Error	14	0.76	0.3	0.22	0.01	0.058	0.02	0.052	0.003	0.00015

* Significant at 5 percent, **significant at 1 percent

Characters: - 1) Dt 50% F – Days to50% flowering, 2) DM – Days to maturity, 3) PH – plant height, 4)No. PB/P – Number of primary branch / plant, 5) No. Po/P – Number of pod/plant, 6) No. Se/P -Number of seeds / pod, 7) PL – Pod length, 8) 100 SW- 100 Seed weight, 9) SY/P- Seed yield / plant.

Table 2. Parameters of genetic variability for yield and yield contributing nine traits in Blackgram

Sr.no.	Characters	Phenotypic Range		Mean	Coefficient of Variance (%)		Heritability (broad sense) (%)	GA	Genetics advance in percent of mean
		Minimum	Maximum		GCV	PCV			
1	Days to 50% flowering	35.3	42	38.12	6.83	7.2	89.9	5.09	13.35
2	Days to maturity	64.3	72	69.29	2.98	3.09	93.2	4.12	5.94
3	Height of plant(cm)	32.97	42.6	38.74	7.62	7.72	97.5	6.01	15.51
4	No. of primary branch per plant	3.40	5.99	5.1	17.3	17.41	98.61	1.8	35.4
5	No. of pods per plant	16.62	26.80	21.57	15.3	15.34	99.5	6.78	31.45
6	No. of seeds per pod	4.70	7.03	5.97	13.17	13.41	96.51	1.59	26.65
7	Length of pod (cm)	3.97	5.40	4.77	9.64	10.89	78.2	0.83	17.56
8	100 seed weight (g)	3.52	4.87	4.01	12.3	12.4	98.43	1.01	25.15
9	Seed yield per plant (g)	3.9	6.5	5.17	18.7733	18.7743	99.99	2	38.67

IV. CONCLUSION

The study revealed significant variability among genotypes for most traits, with maximum variation observed for seed yield per plant, followed by pods per plant, plant height, primary branches, seeds per pod, 100-seed weight, pod length, and phenological traits. Genotypes such as AKU-10-1 (Blackgold), Ajeet-33, Phule Vasu, and Vishwas NUL-7 performed superior for seed yield and its contributing traits, indicating their potential as promising sources for yield improvement. In general, PCV values were slightly higher than GCV values, suggesting environmental influence, while high heritability coupled with high genetic advance for seed yield per plant, pods per plant, primary branches, seeds per pod, and 100-seed weight indicated the predominance of additive gene action, making these traits effective for selection in blackgram improvements programs.

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