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Genetic Variability and Heritability Studies in Relation to Seed Yield and its Component Traits in Black Gram (*Vigna mungo* L.)

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ABSTRACT

Diversity is the prerequisite in any crop improvement and varietal development programme in order to obtain the desirable recombinants in segregating generations. The current study was intended with an objective to check accessions for genetic variability, heritability and genetic advance in black gram. The experiment was conducted at EB-2 section of the Dept. of Plant Breeding and Genetics, OUAT during *rabi* 2015-2016. The experimental material consisted of 50 black gram genotypes which were tested in randomized block design (RBD) with two replications. Twelve yield attributing characters were observed namely: days to 50% flowering, days to maturity, plant height, number of branches/plant, number of clusters/plant, numbers of pods/plant, pod length, pod girth, number of seeds/pod, number of seeds/plant, hundred Seed weight and seed yield/plant. Highly significant differences ($p < 0.05$) were observed in all characters which illustrated significant variation. The magnitudes of heritability in broad sense were found to be low for number of seeds/pod, pod girth and pod length; moderate for days to maturity, days to 50% flowering and number of branches per plant; high for number of clusters/plant, hundred seed weight, plant height, number of pods/plant, number of seeds/plant and seed yield/plant. The high heritability in conjunction with high genetic advance was noted in number of seeds/plant and seed yield/plant, which gave the evidence that these traits were under the control of additive gene action which will be more useful in predicting the gain under selection than heritability alone.

Key words *Black gram, Genetic variability, GCV, PCV, Heritability, Genetic advance*

Black gram supplies a major share of protein requirement in vegetarian diet, which is an essential supplement of cereal based diet. The biological value improves when wheat or rice is combined with pulse like black gram because of the complementary relationship of the essential amino acids such as arginine, leucine, lysine, isoleucine, valine and phenylalanine etc. (Goyal *et al.*, 2010). In India the annual production of black gram is much lower than its consumption. In order to meet the demand the country imports black gram from other countries, which leads to high price. Hence, it is vital to develop black gram cultivars with high seed yield coupled with stable performance across different environments through selection based on genetic parameters.

Yield is a complex trait, polygenic in inheritance which is more prone to environmental fluctuations (Novoselovic *et al.*, 2004). Heritability is an effective mean to measure the relative contribution of genes and environment in the expression of a trait, which shows a good index of transmission from parents to their offsprings (Marwede *et al.*, 2004). Genetic advance is a measure of genetic gain under selection which expresses the direct relationship between heritability and response to selection (Shukla *et al.*, 2004). Understanding of heritability and genetic advance is a pre-requisite for making effective selection (Akbar *et al.*, 2003). Panse and Sukhatme (1967) expressed that high heritability coupled with high genetic advance is an indication of additive gene effects (Aytaf and Kinaci, 2009), whereas high heritability associated with low genetic advance is an indication of dominance and epistatic effects.

MATERIALS AND METHODS

The present study was conducted at EB-2 section of the department of Plant Breeding and Genetics, OUAT, Odisha during *rabi* season, 2015 and 2016. The experimental material consisted of 50 black gram genotypes including released varieties, elite cultures, selected varieties from crosses and promising local varieties of Odisha. These genotypes were tested in a randomized block design (RBD) with two replications having intra and inter-row distance of 10 cm and 30 cm respectively. Observations on twelve yield attributing characters were noted namely: days to 50% flowering, days to maturity, plant height, number of branches/plant, number of clusters/plant, numbers of pods/plant, pod length, pod girth, number of seeds/pod, number of seeds/plant, hundred Seed weight and seed yield/plant. For collection of these data, five randomly selected plants of each treatment were used and the mean value of each character was taken for statistical analysis. Phenotypic and genotypic coefficients of variation were calculated based on the method advocated by Burton (1952). Heritability in broad sense and genetic advance as percent of means were estimated as suggested by Jhonson *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance revealed that all the 50 genotypes differed significantly in respect of 10 out of 12 characters studied which signified the existence of high genetic variability (Table 1). This finding suggested that adequate scope is available for selection of superior genotypes aimed at enhancing genetic yield potential of black gram. Hence genetic parameters *viz.*, mean, heritability (h^2) and genetic advance as percent of mean (GAM) were studied to examine genetic worth of yield related traits. The high genetic variability among the genotypes for different traits is because of their diverse origin and geographical adaptation. Similar wide range of variation for different traits in black gram with different sets of collection have been earlier reported by Arulbalachandran *et al.* (2010) and Begum *et al.* (2012).

Table 1. Analysis of variance (mean squares) for 12 biometrical traits

Character	Replication MSS	Genotype MSS	Error MSS
Days to 50% flowering	0.814	1.430**	0.443
Days to maturity	1.945	0.849**	0.368
Plant height	1.257	26.642**	1.591
No. of branches/plant	0.211	0.412**	0.105
No. of clusters/plant	0.006	4.150**	0.397
No. of pods/plant	5.450	58.761**	2.794
Pod length	0.038	0.164*	0.085
Pod girth	0.000	0.012	0.009
No. of seeds/pod	0.901	0.346	0.260
No. of seeds/plant	234.100	2698.719**	125.156
100 seed wt.(g)	0.273	0.709**	0.050
Seed yield/plant (g)	1.458	5.747**	0.179

*Significant at 5% level of probability, ** Significant at 1% level of probability

Genetic parameters

The candidacy of a quantitative character as a potential selection criterion is primarily judged on the yardstick of values of the genetic parameters it assumes. The estimates of parameters like phenotypic co-efficient of variation (PCV), genotypic co-efficient of variation, heritability % (h^2) and genetic advance as percent of mean (GA %) from selection have been presented in Table 2.

In the present experiment the values of PCV were found to be higher than the corresponding GCV for all the characters under study, but with a very small difference (Table-2) *i.e*., there exists a close correspondence between GCV and PCV. Therefore, in spite of higher PCV than GCV, the expression of characters are less influenced by the environment because of the close proximity between these two. This indicates that characters exhibiting high variability; a worthwhile selection on the basis of phenotype will not be deceiving. In the present study Seed yield/plant (g) exhibited highest value for both PCV and GCV followed by number of seeds/plant, number of pods/plant. High PCV for seed yield/plant was earlier reported in chickpea by Yaqoob *et al.* (2010). High GCV for seed yield/plant, seeds per plant, pods/plant was also reported earlier by Panigrahi *et al.* (2014) and Kumar *et al.* (2015).

The coefficient of variation does not offer the full scope of heritable variation. It can be determined with greater degree of accuracy when heritability in conjunction with genetic advance is studied. In the present study, the heritability in broad sense (h^2 in %) ranged from 24.71% in number of seeds/pod to as high as 96.89% in seed yield/ plant. The magnitudes of heritability were found to be low for number of seeds/pod, pod girth and pod length; moderate for days to maturity, days to 50% flowering and number of branches for plant; high for number of clusters/plant, hundred seed weight, plant height, number of pods/plant, number of seeds/plant and seed yield/plant. In conformity with the present findings, several workers have reported high heritability percentage in 100-seed weight (Yadav and Dahiya 2000; Issacs *et al.*, 2000), plant height (Arulbalachandran *et al.*, 2010), seed yield/plant (Yadav and Dahiya 2000; Issacs *et al.*, 2000, Sohel *et al.*, 2016), number of pods/plant (Issacs *et al.*, 2000, Arulbalachandran *et al.*, 2010), number of branches/plant (Kumar *et al.*, 2000).

Johnson *et al.* (1955) opined that heritability estimates along with genetic gain would be more useful than the heritability estimate alone in predicting the efficiency of selection. The data on genetic advance for different characters expressed as percentage of the population mean, ranged from 0.89% in case of days to maturity to as high as 51.67% in case of seed yield/plant. Number of seeds/plant and seed yield/plant revealed higher values of GAM. Number of branches/plant, number of clusters/plant, number of pods/plant were found to be moderate, whereas the rest of the characters like days to 50% flowering, days to maturity, plant height, pod length, pod girth and number of seeds/pod showed low GAM. Issacs *et al.*, 2000, Arulbalachandran *et al.*, 2010, had earlier reported high heritability coupled with high genetic advance for yield/ plant, while Konda *et al.*, (2007) had reported the same for 100 seed weight.

According to Panse and Sukhatme (1967), combination of moderate or high values of heritability and genetic advance substantiates the role of additive gene action in effective selection of the concerned characters. In this study, high heritability coupled with high genetic advance in characters like number of seeds/plant and seed yield/plant indicates the role of additive gene action highlighting the importance of those traits for effective selection. Characters like number of branches/plant, number of clusters/plant, number of pods/plant showed combination of high heritability and moderate genetic advance indicating the role of additive gene action too providing ample scope for selection, while the rest of the characters showed high heritability and low genetic advance indicating the role of non-additive gene actions.

Table 2. Estimates of genetic parameters for different biometrical traits of black gram

Characters	Range	Grand Mean	CV	PCV%	GCV%	h^2 (%)	GA	GA % 0f population mean (GAM)
Days to 50% flowering	33.00-37.00	34.79	1.91	2.43	2.02	69.06	1.028	2.95
Days to maturity	72.00-74.50	73.06	0.83	0.89	0.67	56.62	0.650	0.89
Plant height	20.30-39.60	30.56	4.13	11.94	11.58	94.03	6.040	19.76
No. of branches/plant	1.88-4.15	2.97	10.90	15.29	13.21	74.60	0.596	20.08
No. of clusters/plant	4.00-9.60	7.09	8.89	20.31	19.32	90.42	2.292	32.33
No. of pods/plant	15.65-43.70	26.76	6.44	20.25	19.74	94.94	9.057	33.84
Pod length	4.00-5.80	5.04	5.79	5.68	3.94	48.06	0.242	4.80
Pod girth	1.55-1.85	1.72	5.43	4.43	2.21	24.96	0.034	1.95
No. of seeds/pod	5.70-7.10	6.43	7.93	6.47	3.21	24.71	0.181	2.81
No. of seeds/plant	54.05-223.00	133.90	8.36	27.43	26.79	95.36	61.653	46.05
100 seed wt.(g)	2.793-5.339	4.173	5.35	14.27	13.76	92.98	0.974	23.35
Seed yield/plant (g)	1.974-9.136	5.595	7.56	30.30	29.83	96.89	2.891	51.67

CONCLUSION

A close correspondence was observed between GCV and PCV indicating less influence of the environment on the studied characters. The high heritability coupled with high genetic advance was noted in seed yield/plant and number of seeds/plant, which gave the evidence that these traits were under the control of additive gene action which will be more useful in predicting the gain under selection than heritability alone.

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