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Genetic variability studies in Blackgram (*Vigna mungo* (L.) Hepper)

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Abstract
In the present investigation, twelve characters including quantitative and qualitative were evaluated in 29 genotypes of blackgram during *Kharif* 2016 to assess the genetic variability. The genotypes differed significantly for all the characters studied. The highest GCV recorded for seed yield per plant, biological yield per plant, number of pods per plant and number of branches per plant. High heritability was recorded for number of branches per plant, 100 seed weight, plant height and number of pods per plant. The highest genetic advance as percent of mean was recorded for seed yield per plant, number of branches per plant, number of pods per plant and biological yield per plant. High heritability coupled with high genetic advance was observed for number of branches per plant and number of pods per plant indicating that these characters can be improved by selection.

Keywords: Variability, heritability, genetic advance, blackgram

Introduction
Blackgram (*Vigna mungo* (L). Hepper, 2n=22), known as urdbean, is an important grain legumes for its nutritional quality and the suitability to cropping system. Center of genetic diversity for black gram is found in India (Zeven *et al.,* 1982) [10]. The major portion of blackgram is utilized in making dal, curries, soup, sweets and snacks. The food values of urdbean lie in its high and easily digestible protein. Its seeds contain approximately 25-28% protein, 1.0-1.5% oil, 3.5-4.5% fiber, 4.5-5.5% ash and 62-65% carbohydrates on dry weight basis. Like other pulses, it also enriches the soil fertility, improves the soil structure and used as green fodder for cattle. It is often used as dry season intercrop in rice or wheat as it has a beneficial effect on soil nutrient status (Parashar, 2006) [3]. Black gram is still cultivated on marginal lands under rainfed conditions and faces terminal drought which affects its productivity to a great extent. Low and uneven rainfall pattern of the state since last few years have urged the need to develop early maturing varieties of black gram to avoid yield losses due to long dry span during maturity. Though, India is the world's largest producer of blackgram, it imports a large amount to meet the growing domestic needs. Blackgram is grown in varying agro- ecological conditions and cropping systems with diverse cultural practices, so it needs appropriate plant type for each growing situation. The breeding progress has been slow and uneven because several desirable traits need to be combined for developing appropriate plant type for a particular growing region and cropping system. Development of high yielding varieties of crops requires information on nature and magnitude of genetic variability present in the available population, which is a pre-requisite to adopt an effective breeding programme.
Seed yield in blackgram is a complex character like other crops, and is determined by various components. Knowledge of genetic variability existing among different parameters is important in crop improvement. Heritability, which measures phenotypic variance and is attributable to genetic causes, is another important consideration for a successful breeding program. Heritability with genetic advance helps in understanding the mode of inheritance of quantitative traits. The genetic variability existing among morphological as well as yield parameters along with their heritability and genetic advance for understanding the mode of inheritance of quantitative traits in blackgram.

Materials and Methods
The experimental material comprised of 29 blackgram genotypes which were raised in a Randomized Block Design with three replications at Botany Farm, Department of Plant Breeding and Genetics, Rajasthan College of Agriculture, Maharana Pratap University of

Agriculture and Technology, Udaipur, during *Kharif* 2016. In each replication, genotype was sown in a two row of three meter length with spacing of 30 x 10 cm. The package of practices recommended in the crop production guide was followed. Twelve traits *viz.,* days to 50% flowering, days to 75% maturity, plant height, number of branches per plant, number of pods per plant, pod length, number of seeds per pod, seed yield per plant, biological yield per plant, harvest index, 100 seed weight and seed protein content were recorded for five randomly selected plants in each of the accessions per replication. The statistical analysis and variance due to different sources was worked out according to Panse and Sukhatme (1985). Phenotypic and genotypic coefficients of variation were calculated based on the method advocated by Burton (1952) [1]. Heritability and genetic advance as per cent of mean were estimated as per formula given by Johnson *et al*. (1955) [2].

Results and Discussion

The analysis of variance was carried out for twelve quantitative and qualitative characters and the results are presented in Table 1. The mean squares due to genotypes were significant for all twelve characters studied. This gives the evidence of magnitude of variability among genotypes which differed significantly. The estimates of phenotypic coefficient of variation were higher than the corresponding genotypic coefficient of variation for some of the characters which indicating the influence of environmental factors (Table 2). These findings are in accordance with the study done by Sowmini and Jayamani (2013) [7], Ramya *et al.*, (2014) [6] and Vinoth and Jayamani (2014) [9]. The maximum PCV expresed for seed yield per plant (29.99) followed by biological yield per plant (25.31), number of pods per plant (23.85) and number of branches per plant (21.64) suggesting that sufficient phenotypic variability was present for these traits. The results are in agreement with findings of Vijaya Kumar *et al.* (2015) [8] for number of branches per plant and seed yield per plant. The maximum GCV recorded for seed yield per plant (25.57), biological yield per plant (22.15), number of pods per plant (21.91) and number of branches per plant (21.08) indicating the presence of variation for these characters and improvement could be possible through selection of these characters. Similar results are reported by Vijaya Kumar *et al.* (2015) [8], Panigrahi *et al*. (2014) [4] for number of branches per plant, number of pods per plant and yield per plant.

Quantitative characters are influenced more by the environment. The phenotype observed will not be transmitted to another generation entirely. So, study on heritable portion of variability is necessary. Heritability is a good index of transmission of characters from parents to their offspring and helps us as a tool for selecting elite genotypes from diverse genetic population. It gives an exact idea of heritable portion of variability. In the present study, highest heritability was recorded for number of branches per plant (94.87), 100-seed weight (90.40), plant height (86.10) and number of pods per plant (84.38) indicating that these characters may serve as effective selection parameters during breeding programme for the improvement of blackgram productivity. The moderate heritability was recorded for number of seeds per pod (76.70), biological yield per plant (76.57), seed yield per plant (72.70) and pod length (71.17) indicating that selection of these characters are likely to accumulates more additive genes leading to further improvement of their performance. Similar results are reported by Vijaya Kumar *et al.* (2015) [8]. Genetic advance predicts the genetic gain under selection. Genetic advance as percentage of mean is more reliable index for understanding the effectiveness of selection in improving the traits because its estimated value is derived by involvement of heritability, phenotypic standard deviation and intensity of selection. The highest genetic advance was recorded for seed yield per plant (44.92), number of branches per plant (42.30), number of pods per plant (41.46) and biological yield per plant (39.93). Top priority should be given for these characters while formulating selection strategies and selection of these characters may be effective. Similar results were reported in blackgram by Vijaya Kumar *et al.* (2015) [8] for seed yield per plant and number of pods per plant. Moderate genetic advance as percent of mean was reported for plant height (26.48), number of seeds per pod (23.92), 100-seed weight (23.71) and harvest index (21.09). However, estimation of heritability along with genetic gain is more useful in predicting the resultant effect from selecting the best individual. In the present study, high heritability coupled with high genetic advance was observed for number of branches per plant number of pods per plant. This indicates that most likely the heritability is due to additive gene effects and hence selection may be effective for these characters. It may be suggested that for additive effects pedigree or modified pedigree method of selection is followed.

Table 1: Men squares for various characters in Blackgram

S. No	Characters	Replication	Genotype	Error
		[2]	[28]	[56]
1	Days to 50% flowering	0.0115	6.2997**	1.261
2	Days to 75% maturity	4.7931*	14.5813**	1.257
3	Plant height (cm)	3.1579	30.2737**	1.546
4	No. of branches per plant	0.1412	8.6035**	0.1523
5	No. of pods per plant	8.3437	48.0429**	2.793
6	Pod length (cm)	0.0148	0.4053**	0.04821
7	No. of seeds per pod	0.0887	1.4729**	0.1354
8	Seed yield per plant	0.9447	3.0689**	0.3414
9	Biological yield (gm)	4.8813	25.6110**	2.37
10	Harvest index (%)	6.4839	52.3857**	8.5
11	100-Seed weight (gm)	0.0409	0.8822**	0.03016
12	Seed protein content (%)	1.3409	3.3239**	0.8066

[] Degrees of freedom

*, ** Significant at 5% and 1% level of significance, respectively.

Table 2: Mean, range, phenotypic (PCV) and genotypic (GCV) coefficient of variation, heritability (broad sense) and genetic gain for quantitative and qualitative characters in blackgram

SN	Characters	Mean	Range	GCV	PCV	ECV	h^2	GG
1	Days to 50% flowering	44.18	40.33-47.33	2.93	3.88	2.54	57.10	4.57
2	Days to 75% maturity	77.79	72-82	2.71	3.07	1.44	77.94	4.93
3	Plant height (cm)	22.34	17.51-31.79	13.85	14.93	5.57	86.10	26.48
4	No. of branches/plant	7.96	4.47-10.77	21.08	21.64	4.90	94.87	42.30
5	No. of pods/plant	17.72	12.55-29.77	21.91	23.85	9.43	84.38	41.46
6	Pod length (cm)	4.27	3.34-4.84	8.07	9.57	5.14	71.17	14.03
7	No. of seeds/pod	5.04	3.73-6.27	13.26	15.14	7.31	76.70	23.92

8	Seed yield /plant	3.73	2.12-6.03	25.57	29.99	15.67	72.70	44.92
9	Biological yield (gm)	12.57	8.45-20.78	22.15	25.31	12.25	76.57	39.93
10	Harvest index (%)	29.71	21.69-40.76	12.87	16.19	9.81	63.25	21.09
11	100-Seed weight (gm)	4.40	2.92-5.26	12.11	12.73	3.95	90.40	23.71
12	Seed protein content (%)	23.11	21.22-24.83	3.96	5.55	3.89	50.99	5.83

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