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Correlation and path coefficient 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 correlation and path analysis. The genotypes differed significantly for all the characters studied. Seed yield per plant was positively and significantly correlated with number of branches per plant, number of pods per plant, biological yield per plant and harvest index at both phenotypic as well as genotypic levels. The characters number of branches per plant, number of pods per plant, biological yield per plant and plant height exerted high positive direct association with seed yield. Number of branches per plant and biological yield per plant showed highly positive indirect effect through on seed yield. Hence, selection based on number of pods per plant, number of seeds per pod and hundred seed weight would result in improving the seed yield of blackgram.

Keywords: Path analysis, correlation, 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) [9]. 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) [5]. 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.
Although India is the largest producer of blackgram, However its productivity is lower (469 kg/ha) than the world average. One of the factors responsible for the poor productivity of blackgram is lack of stable cultivars. In any crop breeding, selection of promising plant is important. An association study gives information about the contribution of different characters towards seed yield. Seed yield is a complex trait and is influenced by number of component traits. The study on inter-relationship between the component traits and seed yield will formulate an effective and viable breeding programme for improvement of yield in a short time. Studies on correlation values indicate the intensity and direction of association of a character with yield. Path analysis identifies the yield components with direct and indirect influence on the yield. Hence, the present research work was undertaken to assess the correlation and path coefficients estimates of economically important plant characteristics and to determine the characteristics contributing to seed yield 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) [7]. The phenotypic and genotypic correlation coefficients were calculated from phenotypic and genotypic variances and covariances and path coefficients analyses were worked out as suggested by Dewey and Lu (1959) [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. The genotypic and phenotypic correlation coefficients among different characters of blackgram genotypes are presented in Table 2. In the present study, seed yield per plant was positively and significantly correlated with number of branches per plant, number of pods per plant, biological yield per plant and harvest index at both phenotypic and genotypic level. Similar results have been reported by Gupta *et al.* (2003) [3] and Shivade *et al.* (2011) [8]. Hence, the seed yield can be improved if the characters namely number of pods per plant, number of branches per plant, number of seeds per pod, plant height and 100-seed weight were given importance during selection process. Pod length and days to maturity showed non-significant and positive correlation with seed yield.

Genotypic correlation partitioned into direct and indirect effects to specify the cause and their relative importance (Table 3), the characters namely number of branches per plant, number of pods per plant, biological yield per plant and plant height exerted high positive direct association with seed yield. Therefore selection on these characters will be useful in increasing the seed yield of blackgram. Similar results were reported by Chauhan *et al.* (2007) [1] and Lal and Singh (2014) [4]. Days to maturity, plant height, number of pods per plant, pod length and seed protein content exerted direct negative effect on seed yield. This result was similar with Panigrahi *et al.* (2014) [6]. The negative direct effect indicated that these characters had low association and selection based on these characters would not be effective. Number of branches per plant and biological yield per plant showed high positive indirect effect on seed yield. Seed yield is highly complex trait, thus indirect selection based on major component traits may increase the efficiency of breeder.

Table 1: Men squares for various characters in Blackgram

SN	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: Genotypic and Phenotypic correlation coefficients among the twelve characters of blackgram

SN	Character	Days to 50% flowering	Days to 75% maturity	Plant height	No. of branches/ plant	No. of pods/ plant	Pod length	No. of seeds/ pod	Seed yield / plant	Biological yield	Harvest index	100-Seed weight	Seed Protein content
1	Days to 50% flowering		0.54**	-0.20	-0.23	-0.06	-0.59**	-0.37	0.05	-0.10	0.04	0.12	-0.27
2	Days to 75% maturity	0.42*		-0.27	-0.18	0.32	0.01	-0.23	0.19	-0.05	0.27	0.10	-0.44*
3	Plant height	-0.16	-0.23		0.40*	0.03	0.25	0.30	0.40*	0.74**	-0.36	0.08	0.21
4	No. of branches/ plant	-0.14	-0.17	0.36		0.50**	0.40*	-0.12	0.68**	0.77**	0.15	0.11	0.48**
5	No. of pods/plant	-0.10	0.27	0.05	0.44*		0.24	0.17	0.77**	0.46*	0.66**	0.30	-0.06
6	Pod length	-0.37*	0.02	0.21	0.33	0.19		0.33	0.29	0.44*	-0.04	0.24	-0.20
7	No. of seeds/pod	-0.24	-0.18	0.25	-0.10	0.12	0.23		0.06	0.07	0.00	0.21	-0.31
8	Seed yield /plant	-0.02	0.17	0.31	0.56**	0.69**	0.20	0.04		0.82**	0.54**	0.33	0.19
9	Biological yield	-0.14	-0.03	0.60**	0.64**	0.44*	0.31	0.02	0.81**		-0.02	0.27	0.23
10	Harvest index	-0.02	0.23	-0.25	0.10	0.57**	-0.06	0.03	0.59**	0.10		0.24	0.06
11	100-Seed weight	0.05	0.06	0.08	0.09	0.25	0.14	0.16	0.27	0.22	0.17		0.11
12	Seed Protein content	-0.12	-0.28	0.13	0.32	-0.01	0.16	-0.22	0.10	0.11	-0.02	0.03	

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

Table 3: Direct and indirect effect of four quantitative characters on seed yield per plant in blackgram

SN	Character	Plant height	No. of branches/ plant	No. of pods/ plant	Biological yield	RG Genotypic correlation with Yield
1	Plant height	-0.54	0.55	-0.02	1.01	0.40*
2	No. of branches/ plant	-0.22	1.39	-0.40	1.06	0.68**
3	No. of pods/plant	-0.01	0.69	-0.81	0.62	0.77**
4	Biological yield	-0.40	1.07	-0.37	1.37	0.82**

Residual = 0.4831

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