



## Research Article

# CORRELATION AND PATH COEFFICIENT ANALYSIS FOR YIELD AND YIELD COMPONENTS IN BLACKGRAM (*VIGNA MUNGO* (L.) HEPPER)

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**Abstract:** The experimental material was consisting of 24 Black gram genotypes, check as PU-30, during *kharif* 2019. The experiment was laid out in Randomized Complete Block Design with 3 replications at Field Experiment Centre of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences. The study were logged on 5 randomly taken plants to each treatment and replication for 13 quantitative characters viz. days to 50% flowering, days to 50% pod setting, days to maturity, plant height, number of primary branches per plant, clusters per plant, pods per plant, pod length, seeds per pod, seed index, biological yield, harvest index and seed yield to estimate the variability, heritability and genetic advance as % mean, character association and path analysis. High heritability coupled with high genetic advance as percent of mean was recorded for plant height, biological yield and harvest index represents additive gene effects and effective selection. The correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with harvest index at both genotypic and phenotypic levels. The path analysis revealed that characters days to 50% flowering, days to maturity, plant height, clusters per plant, seeds per pod at both genotypic and phenotypic levels.

**Keywords:** Blackgram, GCV, PCV, Correlation and Path analysis

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## Introduction

Blackgram (*Vigna mungo* (L.) Hepper) is the second important pulse crop of India in terms of area and production next to pigeon pea. It is one of the most important legumes of India which belongs to family leguminosae, sub order Papilionaceae and the tribe phaseoleae with chromosome number (2n=22) and has genome size of 560 mb [1]. It is self-pollinated, annual crop, erect or sub-erect plant having trifoliate with papilionaceous flowers. Inflorescence is an axillary raceme. Flowers are cleistogamous, bisexual, papilionaceous, small, pale yellow, born in clusters of the pods are long cylindrical being about 4-6 cm in 45 on a short hairy peduncle, stamens 10 (9+1), monocarpellary, unilocular and superior ovary. There are four to ten seeds in a pod. The seeds are generally black, dark grey or very dark brown. The split seed is white in colour. The germination of seed is epigeal type. India is the largest producer and consumer of black gram, with an area about 50.31 lakhs hectares, production of 32.84 lakhs tonnes and productivity of 653 kg ha<sup>-1</sup>. In Uttar Pradesh, it is grown in an area about 5.88 lakh hectares with a production of 3.05 lakh tonnes and a productivity of 520 kg ha<sup>-1</sup>. The nutritive value of Black gram lies in its high and easily digestible protein and contains approximately 24 % Protein, 1.0-1.5 % Oil, 3.5 % - 4.5 % Fibre, 4.5-5.5 % Ash and 62-65 % Carbohydrates on dry weight basis. The per capita availability of pulses has declined from 60.7 g/day in 1951 to 35.5 g day<sup>-1</sup> in 2007 as against the FAO/WHO's recommendation of 80 g/day. In this regard the production potential of Black gram crop can be enhanced by developing high yielding genotypes through planned hybridization programmes. Black gram is grown as a sole crop under inter cropping, mixed cropping systems and also grown as catch crop, sequential crop. In north India it is grown in *kharif* and summer, while in south it is grown as sole crop under residual moisture conditions after the harvest of rice. Like other pulses, it also enriches the soil fertility, improves the soil structure and used as green fodder for cattle. The crop not only fixing free atmospheric nitrogen but also enrich the soil with residual nitrogen for growth of succeeding crops.

## Materials and Methods

The research experiment was carried out during *Kharif*-2019 comprising 24 genotypes of black gram [*Vigna mungo* (L.) Hepper] 2019 at the field experimentation centre, Department of Genetics and Plant Breeding, SHUATS, Prayagraj, U.P., India. The technique of random sampling was adopted for recording the observations of various quantitative characters of Black gram. Five plants of each treatment from each replication were selected at random at the time of recording the data on various characters. Recommended package of practices was applied to raise a good crop. Data of five plants were averaged replication wise and mean data was used for statistical analysis. Statistical parameters were calculated for presentation of data on different quantitative attributes i.e., Analysis of variance [2], Coefficient of variation [3], Heritability Broad Sense [4], Genetic Advance [5], Correlation coefficient analysis [6], Path coefficient analysis [7].

## Results and Discussion

The analysis of variance revealed that the mean sum of squares for genotypes showed highly significant to all the characters studied except seed index [Table-1]. In the present study, variability is a measure of Genotypic Coefficient Variability (GCV), Heritability (H<sub>2</sub>), Genetic advance (GA) and Genetic advance as percent mean (GA as % mean). The PCV was higher than GCV for all the characters which indicates the extent of variability present due to genotype as well as environment in the population. Moderate GCV, PCV were recorded for plant height (13.089 and 13.107), number of clusters per plant (11.491 and 11.873), number of pods per plant (12.158 and 12.456), biological yield (18.115 and 18.222), harvest index (16.894 and 17.169) and genetic parameters revealed that heritability coupled with genetic advance as percent mean values are high for plant height (99.7 and 26.924), no. of cluster per plant (93.7 and 22.911), no. of pods per plant (95.3 and 24.445), biological yield (98.8 and 37.098) & harvest index (96.8 and 34.244) [Table-2].

Table-1 Analysis of variance for 13 characters in 24 Black gram genotypes

Characters	Degree of freedom	Days to 50% flowering	Days to 50% pod setting	Days to maturity	Plant height (cm)	No. of branches per plant	No. of clusters per plant	No. of pods per plant	No. of seeds per pod	Pod length (cm)	Seed index (g)	Biological Yield per plant (g)	Harvest index (%)	Seed yield (g)
Replication	2	0.722	1.013	2.625*	0.085	0.055	0.018	0.126	0.019	0.004	0.019	0.731*	4.889*	0.037
Treatment	23	10.115**	8.666**	5.543**	219.822**	0.349**	2.003**	20.981**	0.759**	0.015*	0.175**	39.829**	89.904**	0.759**
Error	46	0.751	0.579	0.711	0.211	0.054	0.044	0.341	0.044	0.008	0.023	0.156	0.973	0.015

\*\*\* Significance at 1% and 5% level respectively

Table-2 Correlation coefficient between yield and its related traits in 24 Black gram genotypes at Phenotypic and Genotypic levels

Characters		Days to 50% flowering	Days to 50% pod setting	Days to maturity	Plant height (cm)	No. of branches per plant	No. of clusters per plant	No. of pods per plant	No. of seeds per pod	Pod length (cm)	Seed index (g)	Biological Yield per plant (g)	Harvest index (%)	Seed yield per plant (g)
Days to 50% flowering	rp	1	0.789**	-0.0721	0.309**	0.0907	-0.217	-0.008	0.235*	0.390**	0.421**	-0.039	0.11	0.073
	rg	1	0.946**	-0.03	0.345**	0.115	-0.258*	-0.017	0.280*	0.432**	0.510**	-0.041	0.118	0.071
Days to 50% pod setting	rp		1	-0.059	0.282*	0.078	-0.226	-0.037	0.163	0.196	0.236*	-0.209	0.299*	0.126
	rg		1	-0.0225	0.304**	0.077	-0.265*	-0.026	0.261*	0.268*	0.330**	-0.222	0.328**	0.144
Days to maturity	rp			1	0.082	-0.041	0.124	-0.252*	0.149	-0.114	-0.106	0.078	-0.227	-0.174
	rg			1	0.1	-0.083	0.172	-0.664**	0.332**	-0.192	-0.222	0.084	-0.263**	-0.214
Plant height (cm)	rp				1	0.319**	-0.026	0.083	0.134	0.377**	0.380**	-0.376**	-0.233*	-0.245*
	rg				1	0.330**	-0.031	0.167	0.176	0.416**	0.467**	-0.379**	0.240*	-0.248*
No. of branches per plant	rp					1	-0.356**	0.252*	0.051	0.247*	0.353**	-0.102	0.069	-0.038
	rg					1	-0.372**	0.638**	0.013	0.281*	0.444**	-0.104	0.078	-0.027
No. of clusters per plant	rp						1	-0.078	-0.083	-0.186	-0.186	0.09	-0.146	-0.208
	rg						1	-0.173	-0.087	-0.205	-0.225	0.093	-0.158	-0.23
No. of pods per plant	rp							1	0.087	0.182	0.234*	0.0208	-0.117	-0.224
	rg							1	0.398**	0.598**	0.461**	0.009	-0.21	-0.508**
No. of seeds per pod	rp								1	0.192	0.137	0.003	-0.059	-0.157
	rg								1	0.240*	0.282*	-0.016	-0.041	-0.179
Pod length (cm)	rp									1	0.574**	-0.016	-0.006	-0.075
	rg									1	0.637**	-0.009	-0.029	-0.114
Seed index (g)	rp										1	-0.081	0.018	-0.207
	rg										1	-0.109	0.012	-0.299*
Biological Yield per plant (g)	rp											1	-0.869**	0.141
	rg											1	-0.875**	0.147
Harvest index (%)	rp												1	0.334**
	rg												1	0.317**

\*\*\* Significance at 1% and 5% level respectively

Characters		Days to 50% flowering	Days to 50% pod setting	Days to maturity	Plant height (cm)	No. of branches per plant	No. of clusters per plant	No. of pods per plant	No. of seeds per pod	Pod length (cm)	Seed index (g)	Biological Yield per plant (g)	Harvest index (%)	Seed yield per plant (g)
Days to 50% flowering	rp	0.033	0.026	-0.002	0.01	0.003	-0.007	-0.0003	0.0079	0.013	0.014	-0.001	0.003	0.073
	rg	0.399	0.378	-0.012	0.138	0.046	-0.103	-0.007	0.112	0.172	0.203	-0.016	0.047	0.071
Days to 50% pod setting	rp	-0.079	-0.101	0.006	-0.028	-0.007	0.022	0.003	-0.016	-0.019	-0.023	0.021	-0.03	0.126
	rg	-0.43	-0.455	0.01	-0.138	-0.035	0.12	0.011	-0.119	-0.122	-0.15	0.101	-0.149	0.144
Days to maturity	rp	-0.01	-0.008	0.14	0.011	-0.005	0.017	-0.035	0.021	-0.016	-0.014	0.011	-0.031	-0.174
	rg	-0.002	-0.001	0.078	0.007	-0.006	0.013	-0.052	0.026	-0.015	-0.017	0.006	-0.02	-0.214
Plant height (cm)	rp	0.008	0.008	0.002	0.028	0.009	-0.0008	0.002	0.003	0.01	0.01	-0.01	0.006	-0.245
	rg	0.001	0.011	0.0004	0.003	0.001	-0.0001	0.0006	0.0006	0.001	0.0017	-0.001	0.0009	-0.248
No. of branches per plant	rp	0.0003	-0.0003	0.0001	-0.001	-0.003	0.001	-0.0009	-0.0002	-0.0008	-0.001	0.0003	-0.0002	-0.038
	rg	0.01	0.007	-0.007	0.031	0.094	-0.035	0.0604	0.001	0.026	0.042	-0.009	0.0074	-0.027
No. of clusters per plant	rp	0.03	0.032	-0.017	0.003	0.05	-0.142	0.011	0.011	0.026	0.026	-0.012	0.02	-0.208
	rg	0.0368	0.038	-0.024	0.004	0.053	-0.142	0.024	0.012	0.029	0.032	-0.013	0.022	-0.23
No. of pods per plant	rp	-0.0001	-0.005	-0.003	0.001	0.003	-0.001	0.012	0.001	0.002	0.002	0.0003	-0.001	-0.224
	rg	0.001	0.002	0.061	-0.015	-0.059	0.016	-0.092	-0.036	-0.055	-0.042	-0.0008	0.019	-0.508
No. of seeds per pod	rp	-0.015	-0.01	-0.01	-0.008	-0.003	0.005	-0.005	-0.066	-0.012	-0.009	-0.0002	0.004	-0.157
	rg	-0.005	-0.004	-0.006	-0.003	-0.0003	0.001	-0.007	-0.018	-0.004	-0.005	0.0003	0.0008	-0.179
Pod length (cm)	rp	0.013	0.006	-0.003	0.013	0.008	-0.006	0.006	0.006	0.034	0.019	-0.0006	-0.0002	-0.075
	rg	0.039	0.024	-0.017	0.037	0.025	-0.018	0.054	0.021	0.09	0.057	-0.0009	-0.002	-0.114
Seed index (g)	rp	-0.051	-0.029	0.013	-0.046	-0.043	0.022	-0.028	-0.016	-0.07	-0.122	0.009	-0.002	-0.207
	rg	-0.131	-0.854	0.057	-0.12	-0.114	0.058	-0.119	-0.073	-0.164	-0.258	0.028	-0.003	-0.299
Biological Yield per plant (g)	rp	-0.07	-0.378	0.141	-0.681	-0.184	0.163	0.0376	0.005	-0.029	-0.146	1.809	-1.572	0.141
	rg	-0.07	-0.38	0.144	-0.648	-0.178	0.159	0.015	-0.027	-0.016	-0.186	1.708	-1.495	0.147
Harvest index (%)	rp	0.214	0.58	-0.44	0.452	0.135	-0.283	-0.227	-0.112	-0.013	0.036	-1.685	1.938	0.334
	rg	0.223	0.62	-0.498	0.454	0.147	-0.3	-0.397	-0.078	-0.056	0.023	-1.654	1.889	0.317

Residual Effect at Phenotypic level = 0.2761, Residual Effect at Genotypic level = 0.2339; Diagonals = Direct effect; off diagonals = Indirect effects

Correlation coefficient analysis revealed that seed yield per plant exhibited positive significant association with harvest index at both genotypic and phenotypic levels ( $g = 0.317^{**}$ ) ( $p = 0.334^{**}$ ). Hence, these could be utilized in indirect selection so as to improve the seed yield per plant. Similar kind of positive association of harvest index with seed yield was reported earlier in blackgram by Chauhan *et al.*, (2007) [8] and Isha Parveen *et al.*, (2011) [9].

Path coefficient analysis revealed that characters days to 50% flowering (0.3994), days to maturity (0.0784), plant height (0.0036), number of clusters per plant (0.0947), number of seeds per pod (0.0902), biological yield (1.7081), harvest index (1.8899) have positive direct effect on seed yield per plant at genotypic level. Phenotypic path in revealed that character Days to 50% flowering (0.0336), Days to maturity (0.1403), plant height (0.0287), pod length (0.0125), number of seeds per pod (0.0344), biological yield (1.8096), harvest index (1.9388) have positive direct effect on seed yield per plant. Hence selection based on would be effective in increasing seed yield. These positive direct effects observed with seed yield were in accordance with the reports of Patil and Deshmukh (1989), Govindaraj and Subramanian (2001) [10] for seeds per pod, Konda *et al* (2008) [11] for days to maturity Chauhan *et al.* (2007) for harvest index. The characters days to 50% pod setting ( $g = -0.4550$ ), Number of pods per plant ( $g = -0.1428$ ), Pod length ( $g = -0.0927$ ), Number of Primary branches ( $g = -0.0181$ ), Seed index ( $g = -0.2583$ ) have negative direct effect on the seed yield per plant at genotypic level. While the characters Days to 50% pod setting ( $p = -0.1012$ ), Number of clusters per plant ( $p = -0.0034$ ), Number of pods per plant ( $p = -0.1421$ ), Number of primary branches ( $-0.0666$ ), Seed index ( $-0.1225$ ) have negative direct effect on

seed yield per plant at phenotypic level. On the contrary, number of pods per cluster recorded negative direct effect on seed yield followed by pod length and seed index. These findings were in accordance with the reports of Santha and Paramasivam (1999b) [12] for number of clusters per plant, Gopikrishan *et al* (2002) [13] and Chauhan *et al.* (2007) for pods per cluster and Umadevi and Meenakshi Ganesan (2005) [14] and Veeranjanyulu *et al.* (2007) [15] for seed index. Hence for increasing the seed yield, direct selection based on these characters would be rewarding [16].

## Conclusion

From present investigation it is concluded that among 24 genotypes of black gram on the basis of mean performance U-5 was found to be superior in grain followed by SU-Urd-107 (Mash338 × VBG-11-016) (Advance breeding line, ABR), showed higher yield over check. Biological yield, harvest index, plant height & number of pods per plant, number of clusters per plant, primary branches exhibited high GCV, PCV and genetic parameters revealed that heritability and genetic advance as percent mean values are high for plant height, biological yield & harvest index. Correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with harvest index at genotypic and phenotypic levels. Characters days to 50% flowering, days to maturity, plant height, no. of cluster per plant, no. of seeds per pod, biological yield and harvest index have positive direct effect on seed yield per plant at genotypic and phenotypic levels. Hence utmost importance would be given to these characters during selection for improving seed yield in black gram.

**Application of research:** To boost up the income of farmers with limited resources and fulfil hunger needs of increasing population.

**Research Category:** Genetics and Plant breeding

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**Study area / Sample Collection:** Prayagraj, 211007, Uttar Pradesh

**Cultivar / Variety / Breed name:** Blackgram (*Vigna mungo* (L.) Hepper)

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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