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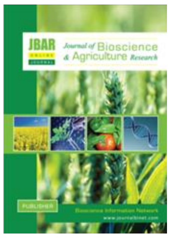

Correlation and path coefficient analysis of Blackgram (*Vigna mungo* L.)

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ABSTRACT

Blackgram (Vigna mungo L.) has the potential of supplying a major portion of protein demand and restoring the soil health at the same time. Research on genetic variability and correlation study between yield components of the genotypes of this crop may increase the opportunity to exploit its potential which will help meet the demand of high yield and nutrition supply. Current aim is to study the correlation coefficients and path coefficients between the genotypes to establish the selection criteria which might help to develop genotypes of high yielding potential. Moreover, studying the contribution of the yield components towards yield is also the purpose of this study. The experiment was conducted at Bangladesh Agricultural University in the summer season of 2012. Ten germplasms were evaluated through 11 morphological traits. Among the morphological traits pod weight (g) 8.81%, harvest index (7.72%), number of branches plant^{-1} (6.18%) and 100-seed weight (g) 5.24% had shown the highest level of coefficient of variation. Grain yield plant^{-1} had the highest heritability (99.43) and seed pod^{-1} had the lowest heritability (53.10). Relationship between physiological characters and yield contributing attributes was studied through analysis of correlation. In the present study, out of 55 associations, 22 associations were positively significant and the rest 16 were negatively significant. Yield plant^{-1} was positively and significantly associated with pods plant^{-1}, pod length, weight pod^{-1}, harvest index and 100-seed weight but negatively associated with plant height, fresh weight and dry weight. The result of the present experiment indicated that number of pod plant^{-1}, pod length and 100-seed weight were the most important characters which exhibited positively to yield plant^{-1}. It was observed that biomass plant^{-1} (0.73 g) had maximum positive direct effects on yield plant^{-1} followed by pods plant^{-1} (0.37), seeds pod^{-1} (0.19) by path coefficient analysis. Hence, for increasing the seed yield, direct selection of genotypes based on positively correlated traits will be more fruitful.

Key Words: *Vigna mungo L., Genetic variability, Germplasm evaluation and Yield components*

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I. Introduction

Blackgram (*Vigna mungo* L. Hepper, 2n=22) is a self-pollinating and widely cultivated grain legume (Naga *et al*., 2006). It is one of the most important pulse crops grown in Bangladesh. The cultivated blackgram belongs to the family *Leguminosae*, sub-family *Papilionaceae*. It is mainly a day neutral warm season crop commonly grown in semi-arid to sub-humid low land tropics and sub-tropics. This crop is grown in cropping systems as a mixed crop, cash crop, sequential crop besides growing as sole crop under residual moisture conditions after the harvest of rice and also before and after the harvest of other summer crops under semi irrigated and dry land conditions (Parveen *et al*., 2011). The crop is resistant to adverse climatic conditions and improves the soil fertility by fixing atmospheric nitrogen in the soil. This pulse originated in south and southeast Asia (Indian sub-continent) but widely grown in India, Pakistan, Bangladesh, Myanmar, Thailand, Philippines, China and Indonesia (Poehlman, 1991). Different kinds of pulses are grown and consumed by the people of Bangladesh. Blackgram locally known as maskalai grows well in north or north-west part of Bangladesh, especially in Rajshahi and Chapai Nowabganj districts.

Blackgram is one of the rich sources of vegetable protein and some essential mineral and vitamins for human body. It is mainly grown for human consumption and also used as fodder for cattle and green manure for soil fertility. Seeds are mainly cooked, as “Dal” in our country. Being a legume crop, blackgram has the ability to fix atmospheric nitrogen symbiotically with the nodule producing bacteria*, Rhizobium sp.* Bangladesh is a developing country and there is a serious nutritional problem in the cereal-based diet for her common people. Blackgram forms one of the important constituents in the dietary practices of the local population blackgram is the cheapest source of protein for the poor and has long been known as the poor men's meat (Main, 1976). Pulses contain a remarkable amount of proteins, minerals, vitamins and carbohydrates. Among the various pulses, blackgram is an important one which contains approximately 25-28% protein, 4.5-5.5% ash, 0.5-1.5% oil, 3.5-4.5% fibre and 62-65% carbohydrate on dry weight basis (Kaul, 1982). It contains sulphur containing amino acids, methionine and cysteine and also contains lysine, which are excellent component of balanced human nutrition. The dried seeds are used to make dal, soups, and curries and added to various spiced or fried dishes. In spite of its various uses, its cultivation is decreasing day by day both in acreage and yield (BBS, 2010) which badly effects on human health. The daily consumption of pulses in Bangladesh is only 12.27 g per capita compared to 45.0 g, recommended by Food and Agriculture Organization (FAO, 2003). However, the country produced only 220786 metric tons of pulses of which blackgram only 28356 metric tons. Blackgram is an important pulse ranking the third both in acreage and production among the pulses (BBS, 2010). In Bangladesh, it can be grown both in summer and winter seasons. However, summer cultivation is better because excessive growth with less number of pods and seeds occurs when the crop is grown in summer.

Pulse crop covers the area of about 593384 acres of land where blackgram occupies 79287 acres. In Bangladesh, yield of blackgram is lower than any other pulses. The average yield is around 883.36 kg ha^{-1} (BBS, 2010). It is generally recognized that pulses offer the most practical means of solving protein deficiency in Bangladesh but there is an acute shortage of grain legumes in relation to its requirements. Increase of pulse production is urgently needed to meet up the demand of the people to reduce import, to save foreign currency and to increase price consumption. Increase of pulse production can also minimize the scarcity of fodder because the whole plant or it’s by products can be used as good animal feed. Considering the significance of Blackgram in Bangladesh context, it is therefore, of utmost necessity to improve this pulse crop both in terms of its quantitative and qualitative values.

The major constraints in achieving higher yield of this crop are lack of genetic variability, absence of suitable ideotypes for different cropping system, poor harvest index and susceptibility to disease. Lack of suitable varieties and genotypes with adaptation to local condition is among the factors that affects the production. Identification of different genotypes of crop species is essential when diverse accessions of crop germplasm are to be characterized, newly developed cultivars are to be registered and purity of the variety is to be determined. Association studies give an idea about the contribution of

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different characters towards seed yield and it reveals the type, nature and magnitude of correlation between yield components with yield and among themselves. Knowledge of inter-relationships existing among yield components is essential when selection for improvement is to be effective. Path analysis identifies the yield components which directly and indirectly influence the yield. The present study aimed at to evaluate the correlation coefficients and path coefficients in order to formulate selection criteria for evolving high yielding genotypes and to estimate the contribution of yield components on yield and their association in blackgram.

II. Materials and Methods

The experiment was carried out at the experimental farm, Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh during the period of February to May 2012. The place is geographically located at about 24^{0}75' North latitude and 90^{0}50' East longitude (Khan, 1997). The soil of the experimental area was a medium high land belonging to the Old Brahmaputra Floodplain Agroecological Zone-9 (UNDP and FAO, 1988). The texture of the soil was silty loam having pH 6.7 (Bhuiya, 1984), low in organic matter and fertility level. The climate of the location was characterized by relatively high temperature and heavy rainfall during Kharif or summer season (April to October) and low temperature and little rainfall during Rabi or winter season (November to March). Ten blackgram genotypes (Table 01) were used as experimental material.

Table 01. Genotypes used as planting material and their corresponding seed collection source

Serial no.	Genotypes	Seed Source
1.	BARIMASH-1	Pulse Research Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
2.	BARIMASH-2	Pulse Research Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
3.	BD-10033	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
4.	BD-10034	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
5.	BD-10035	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
6.	BD-10036	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
7.	BD-10037	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
8.	BD-10039	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
9.	BD-10042	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh
10.	BD-10047	Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh

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Experimental design: The experiment was laid out with a randomized complete block design (RCBD) with three replications. The plot size was 100 cm x 50 cm with 3 rows. The distance regarding block to block was 50 cm, plot to plot was 25 cm, line to line was 15 cm and plant to plant within rows was 3 cm.

Seed sowing and harvesting: The seeds were sown on 10 February, 2012 in continuous rows keeping the row-to-row distance of 15 cm. Finally plants in a row were kept at a distance of about 5 cm. The plants were harvested at full maturity. Harvesting was begun on 06 May, 2012 completed on 07 May, 2012. The variation in harvesting date was due to genotypes.

Data analysis: Five plants were randomly selected from each unit plot for collecting data. The selected plants were marked and the following characters on plot and individual plant basis were taken. The criteria used in recording of data were as follows: plant height (cm), fresh weight (g), dry weight (g,) branch plant^{-1}, pod plant^{-1}, seed pod^{-1}, pod length (cm), pod weight (g), 100-seed weight (g) and harvest index. The data were analyzed for variance, heritability and correlation and path coefficient analysis. Simple phenotypic correlation coefficients were calculated using PLABSTAT software version 2N (Utz, 2007) as

$$r_{p1.2} = \frac{Cov_{p1.2}}{\sigma_{p1} \times \sigma_{p2}}$$

Where, $Cov_{p1.2}$ is phenotypic covariance between the variables X_1 and X_2, σ_{p1} *is* phenotypic standard deviation of the variable X_1 and σ_{p2} is phenotypic standard deviation of the variable X_2.

Direct and indirect path coefficients were calculated as described by Lynch (1998) as

$$\boldsymbol{r_{yi} = P_{yi} + \sum_{\substack{i'=1 \\ i'\neq 1}}^{k} r_{ii'} P_{yi'}}_{\ \boldsymbol{for\ i \neq 1}}$$

Where, $\boldsymbol{r_{yi}}$ is the correlation coefficient between the i-th causal variable (X_i) and effect variable (y), $\boldsymbol{r_{ii'}}$ is the correlation coefficient between the i-th and i'-th causal variables, $\boldsymbol{P_{yi}}$ is the path coefficient (direct effect) of the i-th causal variable (X_i), $\boldsymbol{r_{ii'}}$ $\boldsymbol{P_{yi}}$ is the indirect effect of the i-th causal variable via the i'-th causal variable. To determine the direct effect, square matrices of the correlation coefficients between independent traits in all possible pairs were inverted and multiplied by the correlation coefficients between the independent and dependent traits.

III. Results and Discussion

Variations and performance of the genotypes

Analyses of variance of ten black gram genotypes for all characters under study are shown in Table 02. It was observed that genotypic effects were highly significant for characters viz. plant height (cm), fresh weight (g), dry weight (g,) branch plant^{-1}, pod plant^{-1}, seed pod^{-1}, pod length (cm), pod weight (g), 100-seed weight (g) and harvest index. For morphological traits, coefficient of variation was calculated to check the level of variation among the genotypes of black gram. All the quantitative traits studied showed plant height (4.65) cm, fresh weight (3.62) g, dry weight (3.95) g, branch plant^{-1} 6.18, pod plant^{-1} 4.19, seed pod^{-1} 3.68, pod length (3.78) cm, pod weight (8.82) g, 100 seed weight (5.24) g, harvest index 7.72 and grain yield plant^{-1} 4.91 of coefficient of variation (CV) (Table 03). Varietal differences in 11 characters are presented in Table 03. It was observed from the result that BD 10039 had the highest plant height (123.70 cm) and was significantly different from others. BARIMASH-1 (38.27 cm) and BARIMASH-2 (39.60 cm) had lowest plant height. Both Fresh weight and Dry weight were highest for BD10039 (101.00g and 25.62 g) which were significantly different from those of other genotype. Dry matter accumulation was lowest in BARIMASH-1 (6.29 g) which was not significantly different from BARIMASH-2 (9.85 g). On the other hand, branch plan^{-1} was highest in BD10035 (12.07) which was not significantly different from BD10039 (11.20), BD10037 (11.47) and BD 10047 (11.95). The highest number of pod plant^{-1} was observed in BARIMASH-1 (20.4) which was not significantly different from BARIMASH-2 (20.07) and BD 10047 (20.15) (Table 03).

Table 02. Mean sum of squares for eleven traits of ten genotypes and their analysis of variance

Source of variation	d.f.	Plant Height (cm)	Fresh weight (g)	Dry weight (g)	Branch / Plant	Pod/ plant	Seed /pod	Pod length (cm)	Pod weight (g)	100 seed weight (g)	Harvest index	Grain yield (g)
Replication	2	9.91	3.64	0.025	0.117	1.334	0.056	0.032	0.001	0.006	0.38	0.021
Genotypes	9	2556.58**	2006.95**	104.61**	10.911**	110.927**	0.255**	0.174**	0.007**	0.881**	2081.13**	8.856**
Error	*18*	*16.45*	*4.83*	*0.340*	*0.351*	*0.346*	*0.058*	*0.026*	*0.001*	*0.028*	*4.20*	*0.017*

** = Significant at 1% level of probability; d.f.=degree of fredom

Table 03. Varietal difference in eleven characters of ten blackgram genotypes

Variety	Plant height (cm)	Fresh weight (g)	Dry weight (g)	Branches/ Plant	Pods/ plant	Seeds /pod	Pod length (cm)	Pod weight (g)	100 seed weight (g)	Harvest index	Grain yield (g)
BARIMASH-1	38.27g	23.99 h	6.29h	8.26 c	20.40 a	6.06 d	4.34 ab	0.31 b	3.76 b	74.18 a	4.67 b
BARIMASH-2	39.60g	35.57 g	9.85g	9.73 b	20.07 a	6.80 ab	4.54 a	0.42 a	4.51 a	72.24 a	6.13 a
BD 10033	88.53e	42.69 f	10.75fg	7.46 c	8.88 d	6.36 bcd	4.29 ab	0.29 bc	3.28 c	17.22 d	1.87 f
BD 10034	104.60c	67.95 c	15.30d	7.93 c	10.93 c	7.00 a	4.28 ab	0.28 bc	2.83 de	16.30 d	2.17 e
BD 10035	113.90b	90.89 b	21.13b	12.07 a	5.00 f	6.44 bcd	4.05 bc	0.27 bc	3.09 cd	5.06 f	0.99 h
BD 10036	86.27e	48.88 e	11.69ef	8.20 c	12.07 b	6.91 a	4.41 a	0.31 b	3.08 cd	22.33 c	2.57 d
BD 10037	106.80c	89.35 b	19.99c	11.47 a	9.73 d	6.38 bcd	4.28 ab	0.27 bc	2.78 de	12.66 e	1.82 f
BD 10039	123.70a	101.00 a	25.62a	11.20 a	5.66 f	6.33 cd	3.92 cd	0.28 bc	3.08 cd	4.33 f	1.10 gh
BD 10042	97.38 d	60.05 d	14.79d	7.60 c	6.94 e	6.62 abc	3.74 d	0.24 c	2.72 e	5.47 f	1.26 g
BD 10047	74.13 f	47.85 e	12.20e	11.95 a	20.15 a	6.46 bcd	4.32 ab	0.27 bc	3.04 cd	35.80 b	3.96 c
$LSD_{0.05}$	*6.96*	*3.77*	*1.00*	*1.02*	*1.01*	*0.41*	*0.27*	*0.05*	*0.287*	*3.52*	*0.22*
SE(±)	*9.23*	*8.18*	*1.87*	*0.60*	*1.92*	*0.09*	*0.08*	*0.01*	*0.17*	*8.33*	*0.54*
ST. Dev.	*29.19*	*25.86*	*5.91*	*1.91*	*6.08*	*0.29*	*0.24*	*0.05*	*0.54*	*26.34*	*1.72*
Sig.	**	**	**	**	**	**	**	**	**	**	**
CV %	*4.65*	*3.62*	*3.95*	*6.18*	*4.91*	*3.68*	*3.78*	*8.82*	*5.24*	*7.72*	*4.91*

Analysis of heritability

Heritability (h^2_b) for all the characters for 10 blackgram genotypes under study is presented in Table 04. Plant height (cm), fresh weight (g), dry weight (g,) branch plant^{-1}, pod plant^{-1}, seed pod^{-1}, pod length (cm), pod weight (g), 100 seed weight (g), harvest index and grain yield were highly heritable and it was 98.06, 99.28, 99.03, 90.93, 99.07, 53.10, 65.49, 66.67, 91.01, 99.40, and 99.43, respectively. Seeds pod^{-1} accounted the lowest heritability (53.10) and grain yield plant^{-1} showed highest heritability (99.43). According to Ghafoor *et al.* (2001), heritability in grain yield plant^{-1} was 99.00 and heritability in seeds pod^{-1} was 43.00 which are in accordance with our finding. Arulbalachandran *et al.* (2010) observed the highest heritability in pods per plant where we also found similar results.

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Table 04. Estimation of genetic parameters of 10 blackgram genotypes

Characters	Minimum	Maximum	Grand mean	h²b*
Plant height (cm)	38.27	123.73	87.32	98.09
Fresh wt. (g)	23.99	101.04	60.83	99.28
Dry wt. (g)	6.29	25.62	14.76	99.03
Branches/plant	7.47	12.07	9.58	90.93
Pods/plant	5.00	20.40	11.98	99.07
Seeds/pod	6.07	7.00	6.54	53.10
Pod length (cm)	3.75	4.55	4.22	65.49
Pod wt. (g)	0.25	0.42	0.30	66.67
100 seed wt. (g)	2.73	4.51	3.22	91.04
Harvest index	4.33	74.18	26.55	99.40
Grain yield (g)	0.99	6.13	2.65	99.43

* h²b= Heritability

Table 05. Correlation coefficient among different yield components of 10 Black gram genotypes

Characters	Fresh wt. (g)	Dry wt. (g)	Branchs / plant	Pods /plant	Seeds /pod	Pod length (cm)	Pod wt.(g)	100 seed wt. (g)	Harvest index	Grain yield (g)
Plant Height(cm)	0.896**	0.869**	0.260	-0.887**	0.130	-0.529**	-0.621**	-0.783**	-0.952**	-0.922**
Fresh wt. (g)		0.985**	0.551**	-0.768**	0.011	-0.486**	-0.444**	-0.566**	-0.778**	-0.751**
Dry wt. (g)			0.564**	-0.750**	-0.045	-0.519**	-0.410**	-0.512**	-0.751**	-0.719**
Branch/ plant				-0.049	-0.213	-0.061	-0.075	-0.050	-0.142	-0.068
Pod/plant					-0.010	0.627**	0.542**	0.618**	0.906**	0.944**
Seed/pod						0.204	0.237	-0.063	-0.085	0.069
Pod length (cm)							0.618**	0.483**	0.605**	0.645**
Pod wt. (g)								0.804**	0.681**	0.729**
100 seed wt. (g)									0.822**	0.800**
Harvest index										0.958**

** = Significant at 1% level of probability

Correlation coefficients

Relationship between physiological and yield contributing characters was studied through analysis of correlation between them. Out of 55 associations 38 associations were significantly correlated. Among them, 22 associations were positively correlated and the rest 16 associations were negatively correlated. Rests of the 17 associations were non-significant (Table 05). Significant and positive associations among the characters were suggested additive genetic model there by less affected by the environmental fluctuation. Besides, 5 relationships were positive and non-significant and 12 relationships were negative and non-significant. The positive and non-significant association referred information of inherent relation among the pairs; while the negative and non-significant association referred a complex linked of relation among the pair of combinations. It appears from that yield plant^{-1} was positively and significantly associated with pods plant^{-1} (0.944), pod length (0.645 cm), weight pod^{-1} (0.729g), harvest index (0.958) and 100 seed weight (0.800) but negative significance association had found among plant height (0.922 cm), fresh weight (0.751 g) and dry weight (0.719 g)

(Table 05). Similar kind of significant positive association of pods per plant with seed yield was reported earlier in Blackgram by Patel and Shah (1982); Natarajan and Rathinaswamy (1999), Umadevi and Meenakshi Ganesan (2005); Chauhan *et al.* (2007). Whereas, Wanjari (1988), Babu (1998); Chauhan *et al.* (2007) revealed significant positive association of pods per cluster with seed yield while, Patil and Deshmukh (1989), Poran Chand and Rabhunanda (2002); Netam *et al.* (2010) found significant positive association of 100-seed weight with seed yield. Among the yield contributing characters, plant height was positively correlated with fresh weight and dry weight. It indicates that selection of tall plant could result in attaining higher vegetative growth. On contrary, plant height showed significantly negative association with pods plant^{-1}, pod length (cm), pod weight (g), 100 seed weight (g) indicating that selection of tall plants reduces the harvest index. Similar kind of association of plant height with pod length was reported earlier by Goud *et al.* (1977) with seeds per pod (Santha and Paramasivam, 1999), with 100-seed weight (Natarajan and Rathinaswamy, 1999) and with days to maturity (Nagarjuna et al., 2001).

Path co-efficient analysis

Path coefficient analysis was performed using correlation coefficient to determine the direct and indirect influence of 11 characters. Harvest index being the complex outcome of different characters, was considered as the resultant variable and other characters as causal variable. The causal variables were plant height (cm), fresh weight (g), dry weight (g,) branches plant^{-1}, pods plant^{-1}, seeds pod^{-1}, pod length (cm), pod weight (g), 100 seed weight (g). Estimation of direct and indirect effects of 11 yield contributing characters is shown in Table 06. It was observed that biomass plant^{-1} (0.731 g) had maximum positive direct effects on yield plant^{-1} followed by pods plant^{-1} (0.369), seeds pod^{-1} (0.191), harvest index (0.122), pod length (0.10 cm) and pod weight (0.02 g). Hence, selection based on these traits would be effective in increasing the seed yield. These positive direct effects observed with seed yield were in accordance with the reports of Parveen *et al.,* (2011); Patil and Deshmukh (1989); Govindaraj and Subramanian (2001); Chauhan et al. (2007); Umadevi and Meenakshi (2005) for seeds per pod, pods per plant and for harvest index. On the contrary, plant height recorded negative direct effect on seed yield followed by dry weight, 100-seed weight and branches plant^{-1}. These findings were similar with the reports of Parveen *et al.,* (2011); Veeranjaneyulu *et al.* (2007) for 100-seed weight. Though, plant height had negative direct effect on seed yield but it influenced the seed yield through its high positive indirect effects on pods per plant, Pod length and pod weight, whereas, 100-seed weight influenced the seed yield through its high positive indirect effects via pods plant^{-1}, pod length and pod weight.

Table 06. Path coefficient analysis of 10 blackgram genotypes

Characters	Plant height (cm)	Fresh weight (g)	Dry weight (g)	Branches /plant	Pods/ plant	No. of seeds /pod	Pod length (cm)	Pod weight (g)	100 seed weight (g)	Harvest index	Grain yield (g)
Plant height (cm)	**-0.806**	-0.283	0.635	-0.007	-0.328	0.025	-0.053	-0.012	0.025	-0.117	0.922**
Fresh weight (g)	-0.722	**-0.316**	0.720	-0.016	-0.284	0.002	-0.049	-0.009	0.018	-0.095	-0.751**
Dry weight (g)	-0.700	-0.312	**0.731**	-0.016	-0.277	-0.008	-0.052	-0.008	0.016	-0.092	-0.719**
Branches /plant	-0.209	-0.174	0.412	**-0.028**	-0.181	-0.041	-0.006	-0.001	0.016	-0.017	-0.068
Pods /plant	0.715	0.243	-0.548	0.0014	**0.369**	-0.0019	0.063	0.011	-0.019	0.111	0.944**
No. of seeds /pod	-0.105	-0.003	-0.033	0.006	-0.004	**0.191**	0.021	0.005	0.0020	-0.010	0.069
Pod length (cm)	0.426	0.154	-0.379	0.0017	0.232	0.039	**0.101**	0.012	-0.015	0.074	0.645**
Pod weight (g)	0.500	0.140	-0.299	0.002	0.200	0.045	0.0623	**0.020**	-0.025	0.083	0.729**
100 seed weight (g)	0.631	0.179	-0.374	0.014	0.228	-0.012	0.049	0.016	**-0.031**	0.101	0.800**
Harvest index	0.767	0.246	-0.549	0.004	0.335	-0.016	0.061	0.013	-0.026	**0.122**	0.958**

IV. Conclusion

Correlation and path coefficients analysis were carried out for ten Blackgram genotypes. Genotypic effects were highly significant for all the characters in analysis of variance. Plant height (cm), fresh weight (g), dry weight (g), branches plant^{-1}, pods plant^{-1} 100-seed wt. (g), harvest index and grain yield were highly heritable and seeds pod^{-1} showed the lowest heritability, whereas, pod length (cm), pod weight (g) showed medium heritability. Analysis of correlation revealed that the yield plant^{-1} was positively and significantly correlated with pod plant^{-1}, pod length and 100-seed weight but negatively related with plant height, fresh weight and dry weight. Number of pods plant^{-1} was significantly increased with pod length, pod weight, 100 seed weight. Among the yield contributing characters, plant height was directly correlated with fresh weight, dry weight and negatively but significantly correlated with pods plant^{-1}, pod length, pod weight, 100-seed weight. Dry weight was directly correlated with branches plant^{-1}, plant height. The highest positive direct effect was found between seed yield and pods plant^{-1}, biomass plant^{-1} had maximum positive direct effects on yield plant^{-1}, pods plant^{-1}, seeds pod^{-1}, pod length, pod weight. So, increasing the seed yield in parental generation, direct selection based on these traits would be more effective.

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