EUROPEAN ACADEMIC RESEARCH
Vol. III, Issue 10/ January 2016

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Correlation and Path Coefficients Analysis of Blackgram (*Vigna mungo* L)

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Abstract:

Ten blackgram (Vigna mungo L) 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

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(99.43) and seed pod^{-1} had the lowest heritability (53.10). Relationship between physiological and yield contributing characters was studied through analysis of correlation between them. In the present study, out of 55 associations 38 associations were highly significant. Among them, 22 associations were positively significant and the rest 16 were negatively significant. Yield plant^{-1} was positively and significantly associated with pod 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 had indicated that number of pod plant^{-1}, pod length and 100-seed weight were most important characters which exhibited positive correlation with yield plant^{-1}. It was observed that biomass plant^{-1} (0.73) had maximum positive direct effects on yield plant^{-1} followed by pod plant^{-1} (0.37), Seed pod^{-1} (0.19) by path coefficient analysis. Plant height had negative direct effect on seed yield followed by dry weight, 100-seed weight and branch plant^{-1}. Hence for increasing the seed yield in parental generation, direct selection based on these traits would be more effective.

Key words: *Vigna mungo*, correlation coefficient, physiological and yield contributing traits

INTRODUCTION

Blackgram (*Vigna mungo* L. Hepper, 2n=22) is a self-pollinating and widely cultivated grain legume (Naga *et al*., 2006) belongs to the family Leguminosae, sub-family Papilionaceae. It is one of the most important pulse crop grown in Bangladesh. 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). Blackgram is one of the rich source of vegetable protein and some essential mineral and vitamins for human body. It has the ability to fix atmospheric nitrogen symbiotically with the nodule producing bacteria, *Rhizobium sp.*It 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).

The average yield of blackgram in Bangladesh is around 883.36 kg ha^{-1} (BBS, 2010). 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. Association studies give an idea about the contribution of different characters towards seed yield and it reveals the type, nature and magnitude of correlation between yield components with yield and among themselves. Path analysis identifies the yield components which directly and indirectly influence the yield. That's why, the present research was taken with the objectives of (i) to study the correlation coefficients and path coefficients in order to formulate selection criteria for evolving high yielding genotypes and (ii) to estimate the contribution of yield component on yield and their association in blackgram.

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).

Plant materials

Ten Blackgram genotypes1 were used as experimental materials among which BARIMASH-1 BARIMASH-2 were collected from Pulse Research Division, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur and the rest of eight germplasm (BD-10033, BD-10034, BD-10035, BD-10036, BD-10037, BD-10039, BD-10042 and BD-10047) were collected from Plant Genetic Resource Centre (PGRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

Experimental design

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The plot size was 100cm x 50cm with 3 rows. The distance regarding block to block was 50cm, plot to plot was 25cm, line to line was 15cm and plant to plant within rows was 3 cm.

Data collection

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.

Data analysis

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).

RESULTS AND DISCUSSION

Analysis of variance and performance of the ten genotypes

The analyses of variance of ten blackgram genotypes for all characters under study are shown in Table 1. 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.

Table 1: Analysis of variance for eleven traits of ten genotypes of Blackgram

Source of variation	df	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	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 **	2006.9**	104.61**	10.911 **	110.92**	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

Analysis of heritability

The heritability (h^2_b) for all the characters for 10 blackgram genotypes under study is presented in Table 2. 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. Seed pod^{-1} showed the lowest heritability (53.10) and grain yield plant^{-1} showed highest heritability (99.43).

Ghafoora *et al.*, (2000) observed heritability in Grain yield plant^{-1} (49.00) and heritability in seed pod^{-1}(43.00). On the other hand, Arulbalachandran *et al.*, (2010) observed the highest heritability in podsplant^{-1} and the lowest in no. of leavesplant^{-1}among all mutant genotypes.

Table 2: Heritability analysis of ten Blackgram genotypes

Characters	Minimum	Maximum	Grand mean	σ^2g	σ^2p	GCV	PCV	h^2b	GA	GA (%)
Plant height (cm)	38.27	123.73	87.32	846.71	863.16	33.32	33.65	98.09	59.37	67.99
Fresh weight (g)	23.99	101.04	60.83	667.37	672.20	42.47	42.62	99.28	53.03	87.17
Dry weight (g)	6.29	25.62	14.76	34.76	35.10	39.94	40.14	99.03	12.09	81.88
Branch plant^{-1}	7.47	12.07	9.58	3.52	3.87	19.58	20.54	90.93	3.69	38.47
Pod plant^{-1}	5.00	20.40	11.98	36.86	37.21	50.68	50.92	99.07	12.45	103.91
Seed pod^{-1}	6.07	7.00	6.54	0.07	0.12	3.92	5.38	53.10	0.38	5.88

Pod length(cm)	3.75	4.55	4.22	0.05	0.08	5.26	6.50	65.49	0.37	8.77
Pod weight (g)	0.25	0.42	0.30	0.002	0.003	15.01	18.38	66.67	0.08	25.24
100-seed weight (g)	2.73	4.51	3.22	0.28	0.31	16.56	17.36	91.04	1.05	32.55
Harvest Index	4.33	74.18	26.55	692.31	696.51	99.10	99.40	99.40	54.04	203.54
Grain yield(g)	0.99	6.13	2.65	2.95	2.96	64.77	64.96	99.43	3.53	133.05

σ^2g : Genotypic Variance, σ^2p : Phenotypic Variance, GCV: Genotypical Co-variance,
PCV : Phenotypical Co-variance, h^2b : Heritability and GA: Genetical Ability

Correlation coefficients

Relationship between physiological and yield contributing characters was studied through analysis of correlation between them. In the present study, out of 55 associations 38 associations were highly significant. Among them 22 associations were positively significant and the rest 16 were negatively significant. Rest of the 17 associations were non-significant (Table 3). 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 pod plant$^{-1,}$ pod length, weight pod^{1}, harvest index and 100-seed weight but negative significance association had found among plant height, fresh weight and dry weight. 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 MeenakshiGanesan (2005) and Chauhan *et al.* (2007). Whereas, Wanjari (1988), BabuR. (1998) and Chauhan *et al.* (2007) revealed significant positive association of pods per cluster with seed yield while, Patil and Deshmukh (1989), Pooran Chand and Rabhunanda (2002) and

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 highly significant negatively association with pod 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 (NagarjunaSagar and ReddiSekhar, 2001).

Table 3. Correlation coefficient among different yield components of 10 Black gram genotypes

Characters	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	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 weight(g)		0.985 **	0.551 **	-0.768 **	0.011	-0.486 **	-0.444 **	-0.566 **	-0.778 **	-0.751 **
Dry weight(g)			0.564 **	-0.750 **	-0.045	-0.519 **	-0.410 **	-0.512 **	-0.751 **	-0.719 **
Branch plant^{-1}				-0.049	-0.213	-0.061	-0.075	-0.050	-0.142	-0.068
Pod plant^{-1}					-0.01	0.627 **	0.542 **	0.618 **	0.906 **	0.944 **
Seed pod^{-1}						0.204	0.237	-0.063	-0.085	0.069
Pod length(cm)							0.618 **	0.483 **	0.605 **	0.645 **
Pod weight(g)								0.804 **	0.681 **	0.729 **
100-seed weight(g)									0.822 **	0.800 **
Harvest index										0.958 **

** = Significant at 1% level of probability

Table 4: Path coefficient analysis of 10 Blackgram genotypes

Characters	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	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**
Branch plant^{-1}	-0.209	-0.174	0.412	**-0.028**	-0.181	-0.041	-0.006	-0.001	0.016	-0.017	-0.068
Pod plant^{-1}	0.715	0.243	-0.548	0.0014	**0.369**	-0.0019	0.063	0.011	-0.019	0.111	0.944**
Seed pod^{-1}	-0.105	-0.003	-0.033	0.006	-0.004	**0.191**	0.021	0.005	0.0020	-0.010	0.069
Pod	0.426	0.154	-0.379	0.0017	0.232	0.039	**0.101**	0.012	-0.015	0.074	0.645**

length(cm)											
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**

** = Significant at 1% level of probability

Path co-efficient analysis

The path coefficient analysis was performed using correlation coefficient to determine 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,) branch plant^{-1}, pod plant^{-1}, seed 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 4. It was observed that biomass plan^{-1} (0.731) had maximum positive direct effects on yield plant^{-1} followed by pod plant^{-1} (0.369), seed pod^{-1} (.191), harvest index (0.122), pod length (0.10) and pod weight (0.02). 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 Ganesan (2005) for seeds pod^{-1}, pods plant^{-1}and for harvest index.On the contrary, plant height recorded negative direct effect on seed yield followed by dry weight, 100-seed weight and branch plant^{-1}. These findings were similar with the reports of MeenakshiGanesan (2005), Parveen*et. al.,* (2011), and 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 plant^{-1}, pod length and pod weight, whereas 100-seed weight influenced the seed yield through its high positive indirect effects via pod plant^{-1}, pods length and pod weight.

SUMMARY AND 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,) branch plant^{-1}, pod plant^{-1}, 100-seed weight (g), harvest index and grain yield were highly heritable and seed pod^{-1} showed the lowest heritability and pod length (cm), pod weight (g) showed medium heritability. Analysis of correlation revealed that, the yield plant^{-1} was directly and significantly correlated with pod plant^{-1}, pod length and 100-seed weight but negative significant relation had observed between plan height, fresh weight and dry weight. Number of pod 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 pod 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}, pod plant^{-1}, seed 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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