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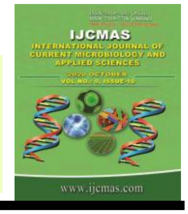

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Correlation and Path Coefficient Analysis in Blackgram [*Vigna mungo* (L.) Hepper] Across Seasons

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A B S T R A C T

Information on the mutual association of traits is important for effective selection in plant breeding programme. In present investigation, a number of phenological and other yield components traits and their relationship with yield as well as among themselves was examined using correlation analysis. Twenty-five blackgram genotypes of diverse nature including two local checks were evaluated during *kharif* and summer seasons across three locations to study the nature of association and direct and indirect effects of phenological and yield component traits on seed yield per plant. The data obtained over six environments were subjected to correlation and path coefficient analysis on pooled basis. Out of 10 characters six characters *viz*., plant height, number branches per plant, number of pods per plant, clusters per plant, pod length and 100-seed weight were highly significant and positively correlated with seed yield across seasons. The important yield related traits like branches per plant, pods per plant and clusters per plant exhibited significant positive association among themselves. The characters which showed high positive correlation with yield like branches per plant, clusters per plant, pods per plant showed high positive direct effects on yield. These results implied the association of these characters with yield is more valuable. Moreover, the indirect effects of these characters through each other are also positive and high indicating the inter-dependent interactions of these characters to form yield.

Introduction

Pulses are indispensable source of protein for predominantly vegetarian population of our country and they constitute a major part in our daily diet. Pulses are also known to increase the soil fertility and productivity of succeeding crop. Blackgram [*Vigna mungo* (L.) Hepper] is third most important pulse crop both in acreage and production it is grown over an area of 4.49 million ha with an annual production of 2.93 million tonnes (Anon., 2017). Seed yield is a complex quantitative trait that is influenced by a number of yield contributing characters. Development of improved cultivar with capability of producing better yield under various agro-climatic conditions depends upon the amount of genotypic variability present in a population for the traits.

Correlations are of value to indicate the degree to which various characters are associated with productivity. A correlation coefficient is useful in quantifying the magnitude and direction of components influence in the determination of main characters. However, it did not provide the relative importance of direct and indirect effects of such components. Selections based on simple correlation coefficients without considering interactions among yield and yield components may mislead the breeders to reach their main breeding purposes.

Path analysis can be used to calculate the quantitative impact on seed yield through direct and indirect effects caused by one or the other component traits. It provides an effective means of partitioning correlation coefficients into direct and indirect effects and illuminates the relationship in a more meaningful way. Path analysis thus permits a critical examination of specific factors that produce a given correlation and can be successfully employed in formulating an effective selection strategy. So far, many studies on trait associations of blackgram have been done generally for particular season and not across the different seasons/environments. Keeping all these things in view, investigations were carried on a set of selected blackgram genotypes to assess the relationship between yield and yield components and to determine the direct and indirect effects of different yield-related traits on seed yield and evolve a suitable selection strategy for seed yield improvement.

Materials and Methods

The study material for the present investigation consisted of 25 blackgram genotypes collected from different sources *viz.,* Agricultural Research Station, Bidar; Nuclear Agriculture and Biotechnology Division, BARC, Trombay, Mumbai; Indian Institute of Pulse Research, regional station, Dharwad and Regional Agricultural Research Station, LAM, Guntur. They were evaluated during *kharif*-2018 and summer-2019 across three locations *viz.,* Agricultural Research Station, Bidar, Agricultural Research Station, Kalaburagi and Agricultural Research Station, Bheemarayanagudi. The experimental trial was laid out in Randomized Block Design with two replications. Each genotype in each replication was represented by a plot size of 4 rows of 4 meter length with a spacing of 30 cm between rows and 10 cm between plants within a row. All the recommended agronomic practices were followed to raise a good crop. Observations on 11 quantitative traits were recorded. Observations on plant height, branches per plant, clusters per plant, pods per plant, seeds per pod, pod length, 100-seed weight and seed yield per plant were recorded on five competitive plants selected at random per genotype in each replication. Whereas, observations on days to 50 per cent flowering, days to maturity and reproductive period were recorded on plot basis. Days to 50 per cent flowering was recorded as number of days from sowing to the opening of the flower in 50 per cent of the plants, days to maturity was recorded as number of days from sowing to 50 per cent pod maturity and reproductive period was recorded as number of days from flowering to maturity in each of the genotype. The data obtained over six environments were subjected pooled correlation analysis (Burton and Devane, 1953) and path coefficient analysis (Dewey and Lu, 1959).

Results and Discussion

The analysis of variance revealed highly significant differences among the genotypes for all the traits suggesting presence of sufficient variability in the material used for the investigation (Table 1).

Table.1 Pooled ANOVA for 11 quantitative traits in selected 25 genotypes of blackgram

Source of Variations	df	Days to 50% flowering	Days to maturity	Reproductive period	Plant height (cm)	Number of branches per plant	Number of pods per plant	Number of clusters per plant	Number of seeds per pod	Pod length (cm)	100- seed weight (g)	Seed yield per plant (g)
Varieties	24	3.38 **	15.73 **	13.42 **	44.69**	0.46 **	48.38**	2.07*	0.18	0.07	0.67 **	4.52**
Environments	5	24.12 **	121.01 **	123.77 **	242.35**	27.46 **	322.08**	84.36**	11.71**	2.89**	2.40 **	42.59**
Env.+ (Var. x Env.)	125	2.76 **	12.60 **	13.24 **	30.77*	1.31 **	25.44**	4.39**	0.59**	0.19**	0.17 **	2.67**
Pooled Error	144	0.00	0.00	0.00	3.28	0.09	2.60	0.16	0.09	0.03	0.01	0.20

* Significant at 5% probability ** Significant at 1% probability

Table.2 Phenotypic correlation coefficients between different traits in blackgram genotypes in pooled analysis

	DFF	DM	RP	PHT	NBP	NPP	NCP	NSP	PL	HSW	SYPP
DFF	**1.000**	0.461*	0.005	-0.056	0.188	0.058	-0.012	-0.076	0.599**	-0.035	0.094
DM		**1.000**	0.889**	0.009	0.076	-0.020	-0.051	0.306	-0.032	0.044	-0.049
RP			**1.000**	0.039	-0.011	-0.053	-0.052	0.384	-0.345	0.068	-0.104
PHT				**1.000**	0.554**	0.686**	0.734**	0.563**	0.895**	0.534**	0.723**
NBP					**1.000**	0.963**	0.967**	0.307	0.527**	0.514**	0.956**
NPP						**1.000**	0.965**	0.281	0.623**	0.544**	0.985**
NCP							**1.000**	0.247	0.728**	0.703**	0.895**
NSP								**1.000**	0.935**	-0.516**	0.373
PL									**1.000**	0.023	0.842**
HSW										**1.000**	0.546**
SYPP											**1.000**

* Significant at 5% probability ** Significant at 1% probability

DFF - Days to 50% flowering
DM - Days to maturity
RP - Reproductive period
PHT - Plant height (cm)
NBP - Number of branches per plant
NPP - Number of pods per plant
NCP - Number of clusters per plant
NSP - Number of seeds per pod
PL - Pod length (cm)
HSW - Hundred seed weight (g)
SYPP - Seed yield per plant (g)

Table.3 Direct and indirect effects of 10 yield components on seed yield per plant at phenotypic level in blackgram in pooled analysis

	DFF	DM	RP	PHT	NBP	NPP	NCP	NSP	PL	HSW	rp
DFF	**0.1451**	0.0669	0.0007	-0.0082	0.0272	0.0084	-0.0017	-0.0110	0.0869	-0.0050	0.094
DM	-0.1162	**-0.2518**	-0.2240	-0.0022	-0.0192	0.0051	0.0129	-0.0770	0.0081	-0.0111	-0.049
RP	0.0008	0.1437	**0.1616**	0.0062	-0.0018	-0.0085	-0.0083	0.0620	-0.0557	0.0109	-0.104
PHT	-0.0449	0.0068	0.0308	**0.7980**	0.4421	0.5474	0.5855	0.4490	0.8416	0.4265	0.723**
NBP	0.1178	0.0477	-0.0069	0.3473	**0.6270**	0.6312	0.6061	0.1924	0.3304	0.3222	0.956**
NPP	0.1137	-0.0397	-0.1034	1.3472	1.9772	**1.9639**	2.0290	0.5508	1.2234	1.0674	0.985**
NCP	0.0127	0.0545	0.0548	-0.7811	-1.0291	-1.0999	**-1.0646**	-0.2634	-0.7751	-0.7481	0.895**
NSP	0.0266	-0.1076	-0.1351	-0.1981	-0.1081	-0.0988	-0.0871	**-0.3521**	-0.3762	0.1818	0.373
PL	-0.1403	0.0076	0.0808	-0.2471	-0.1235	-0.1459	-0.1705	-0.2503	**-0.2343**	-0.0053	0.842**
HSW	0.0181	-0.0231	-0.0354	-0.2794	-0.2687	-0.2841	-0.3674	0.2699	-0.0119	**-0.5228**	0.546**

* Significant at 5% probability
** Significant at 1% probability
rp- correlation with seed yield per plant
Bold figures represents direct effect

DFF - Days to 50% flowering
DM - Days to maturity
RP - Reproductive period
PHT - Plant height (cm)
NBP - Number of branches per plant
NPP - Number of pods per plant
NCP - Number of clusters per plant
NSP - Number of seeds per pod
PL - Pod length (cm)
HSW - 100-seed weight (g)

The results of phenotypic correlations on pooled data over six environments (Table-2) revealed that seed yield per plant was significant and positively associated with plant height, number branches per plant, number of pods per plant, clusters per plant, pod length and 100-seed weight and non-significant positive association with days to 50 per cent flowering and number of seeds per pod and non-significant negative association with days to maturity and reproductive period. With respect to association among the component traits, days to 50 per cent flowering recorded significant positive association with days to maturity and pod length, but showed non-significant negative association with plant height and clusters per plant. The relationship between days to maturity and reproductive period, was significantly positive. Plant height showed significant positive association with number of branches per plant, pods per plant, clusters per plant, seeds per pod and pod length. The important yield related traits like branches per plant, pods per plant and clusters per plant exhibited significant positive association among themselves. Pods per plant recorded very high significant positive association with seed yield per plant followed by branches per plant and clusters per plant. The cluster per plant showed significant positive association with pod length and 100-seed weight. Seeds per pod showed significant positive association with pod length and significant negative association with 100-seed weight. Hundred seed weight exhibited positive association with seed yield per plant. Similar positive and significant association of seed yield with different quantitative traits were also reported in blackgram by Konda *et al.* (2008), Kumar *et al*., (2015), Mohanlal *et al*., (2018).

The phenotypic correlation coefficients of different quantitative traits with seed yield were subjected to path coefficient analysis for estimating direct and indirect effects of component traits on seed yield, which was considered as dependent variable for analysis. The direct and indirect effects of various traits on seed yield per plant pooled over seasons are given in Table-3. Path coefficient analysis pooled over six environments revealed that, plant height, number of branches and number of pods had higher magnitude of direct effect on seed yield. The association of days to 50 per cent flowering and seed yield per plant was positive and non-significant but direct effect of this trait was also found to be positive and low in magnitude (0.1451) and indirect effects via days to maturity was also positive. The days to maturity showed non-significant negative correlation with seed yield per plant and its direct effect on seed yield per plant was also negative (-0.2518). The reproductive period displayed non-significant negative correlation with seed yield per plant (-0.104) but it had positive direct effect on seed yield per plant (0.1616) and its indirect effects via days to maturity (0.1437) were positive. The plant height showed significant positive correlation with seed yield per plant and its direct and indirect effects on seed yield per plant were of positive with higher magnitude. The number of branches showed significant positive correlation with seed yield per plant and its direct effect was positive (0.6270) and high and its indirect effects via other traits were also found positive and high. The number of pods had significant positive correlation with seed yield per plant coupled with high positive direct effect (1.9639). The indirect effects of this trait via plant height, number of branches and number of clusters was also found to be positive and high. The number of clusters had significant positive correlation with seed yield per plant but showed negative direct effect with high magnitude (-1.0646). The number of seeds per pod exhibited non-significant positive correlation with seed yield per plant but its direct effect was negative (-

0.3521). Hundred seed weight had significant positive correlation with seed yield per plant but showed negative direct effect of -0.5228 on seed yield per plant. High positive direct effects for some of these characters branches per plant, pods per plant, cluster per plant and plant height were reported by earlier workers (Konda *et al*., 2008; Parveen *et al*., 2011).

The characters which showed high positive correlation with yield like branches per plant, clusters per plant, pods per plant showed high positive direct effects on yield. These results implied the association of these characters with yield was more valuable. Moreover, the indirect effects of these characters through each other are also positive and high indicating the inter-dependent interactions of these characters to form yield. Therefore, due emphasis should be given to these traits in the selection programme to evolve high yielding blackgram genotypes suitable for different seasons.

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