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Unlocking the Characters Association and Path analysis to Frame out the Idiotype for a Breeding Program in Black Gram (*Vigna mungo* L. Hepper)

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ABSTRACT: Black gram is one of the important crops in the family Leguminosae. It has been used widely for its protein contents and other nutrients. To design and improve the breeding program the characteristics of the crop are foremost important. For which the analysis of correlation and path coefficient pays way to select the desirable characters for the improvement of black gram. In this study, twelve genotypes were evaluated for ten biometric traits *viz.*, days to fifty percent flowering, plant height, number of branches per plant, number of clusters per plant, number of pods per plant, number of seeds per pod, pod length, 100-seed weight, seed yield per plant, days to maturity which revealed that number of clusters per plant and number of pods per plant had a significantly positive correlation with yield. From the path analysis, number of branches, days to fifty percent flowering, number of seeds per pod, and plant height were recorded with a very high direct effect on single plant yield. Thus, the traits *viz.*, hundred seed weight, number of branches per plant, and number of pods per plant could be selected for improving seed yield in black gram.

Keywords: Black gram, Correlation, Path analysis, Yield components.

INTRODUCTION

Black gram is a self-fertilized, widely cultivated legume crop (Naga *et al.*, 2006). Cultivated black gram belongs to the family Leguminosae and subfamily Papilionaceae. Generally, this crop is grown as a mixed crop, sequential crop, and cash crop besides growing as a sole crop under the residual moisture content after the rice harvest (Parveen *et al.*, 2011). The crop is resistant to different adverse climatic conditions and enhances soil fertility by fixing atmospheric nitrogen. This crop is originated in South and South East Asia but widely grown in Indonesia, China, Thailand, Philippines, Myanmar, Bangladesh, Pakistan, and India (Poehlman, 1991). Black gram is one of the important grain legumes and is consumed worldwide for its nutritional quality. India is considered the center of diversity for black gram (Zeven *et al.*, 1982). Majorly black gram is utilized as dhal, sweets, soup, and curries. Seed contains higher carbohydrates (62 % – 65 %), protein (25 % – 28 %), oil (3.5 % – 4.5 %), and fiber (4.5 % – 5.5 %) on dry weight basis. Alternatively, it can be used as green fodder for cattle. Also, it enhances soil fertility and improves the soil structure (Parashar, 2006). It can be grown in varying agroecological conditions and various cropping systems. Hence it requires an appropriate plant type for each growing situation. For which, the desirable traits are to be identified and combined for developing the appropriate plant type which could adapt to various environments. Seed yield is a complex character that depends on various genetic factors interacting with the environment. Hence it is needy to find the interrelation of the yield component with the highly heritable characters. Furthermore, selecting the plants by applying heavy selection pressure for these characters would result in indirect selection. Thus it is essential to study the correlation between different characters for the selection of desirable traits. The path coefficient reflects a good index for selection than the mere correlation coefficient where it separates the correlation coefficient of traits into direct and indirect effects. Therefore the present investigation was undergone to study the character association and path coefficient in black gram. The selected desirable traits could help in designing the best breeding strategy for the genetic improvement of black gram.

MATERIAL AND METHODS

The current study was conducted at Adhiparasakthi Agricultural College, G.B. Nagar, Kalavai during summer in the year 2022. Seed materials consist of twelve genotypes which were collected from National Pulses Research Centre, Vamban. Details of the genotypes were presented in Table 1. The genotypes were raised using the plat bed method in a randomized block design with three replications and a spacing of 30 × 10 cm. Five randomly chosen plants from each replication were used for data collection. Ten quantitative parameters viz., days to fifty percent flowering, plant height, number of branches per plant, number of clusters per plant, number of pods per plant, number of seeds per pod, pod length, 100-seed weight, seed yield per plant, and days to maturity.

Table 1: Details of the genotypes of black gram used for this study.

Sr. No.	Genotypes	Parentage	Source
1.	VBN 2	Spontaneous mutant	NPRC, Vamban, TN
2.	VBN 3	LBG 402 × LBG 17	NPRC, Vamban, TN
3.	VBN 5	VBN 1 × LBG 20	NPRC, Vamban, TN
4.	VBN 6	VBN1 × *Vigna mungo var. silvestris*	NPRC, Vamban, TN
5.	VBN 7	VBN 3 × *Vigna mungo var. silvestris*	NPRC, Vamban, TN
6.	VBN 8	VBN 3 × VBG 04-008	NPRC, Vamban, TN
7.	VBN 9	Mash114 × VBN 3	NPRC, Vamban, TN
8.	VBN 10	VBN 1 × UH04-04	NPRC, Vamban, TN
9.	VBN 11	PU31 × CO 6	NPRC, Vamban, TN
10.	ADT 5	Selection from Kanpur Variety	NPRC, Vamban, TN
11.	ADT 6	Vamban 1 × VBG 04-2006	NPRC, Vamban, TN
12.	CO 6	DU 2 × VB 20	NPRC, Vamban, TN

According to a formula provided by Johnson *et al* (1955a) the genotypic correlation coefficient values (r) were obtained. The phenotypic and genotypic correlation coefficient was subdivided using path coefficient analysis into direct, indirect, and residual effects. According to Dewey and Lu (1959), the analysis was conducted

RESULTS AND DISCUSSION

Selection based on the detailed knowledge of the magnitude and direction of association between yield and its attributes is very important to identify the key characters, which can be exploited in crop improvement through a suitable breeding program.

Correlation analysis. The relative magnitude of genotypic correlation prevalence among different characters relating to yield and interrelationship between different yield attributes were furnished in Table 2. Among the ten yield attributes, single plant yield was positive and significantly associated with all the traits except days to 50% flowering, days to maturity, and plant height. The single plant yield exhibited a high positive and significant correlation with hundred seed weight (0.829) followed by the number of branches per plant 0.780) and the number of pods per plant 0.625 respectively. Hence selection can be done on these characters for crop improvement. Likewise negative correlation with days to 50% flowering (-0.392), days to maturity (-0.481) plant height (-0.164). Number of branches per plant showed positive and significant inter-correlation with yield through number of pods per plant (0.722), number of clusters per plant (0.716) and hundred seed weight (0.605) respectively. Likewise, numbers of pods per plant exhibited a positive significant inter-correlation with yield through hundred seed weight (0.679). Selecting the genotypes concerning the interrelation of the characters leads to improvement in crop breeding of black gram.

Hence based on their association with seed yield per plant emphasis had to be given to these traits in the selection of genotypes for higher yield in black gram. Similar results were furnished by Baisakh *et al*. (2016) in green gram; Parveen *et al*. (2011); Pushpa Reni *et al.* (2013); Sushmitharaj *et al.* (2018).

Path analysis. Simple correlation does not accurately reflect the contribution of the characteristics to yield, thus route coefficient analysis was used to further divide the overall phenotypic and genotypic correlation coefficients into direct and indirect impacts. Biological yield per plant followed by seeds per plant, which looked to be the genuine link, were found to have the largest positive direct effects at both the phenotypic and genotypic levels, according to path analysis; thus, direct selection through these traits will be successful.

Table 2: Genotypic correlation coefficients among yield and yield contributing traits in blackgram.

Characters	DFF	PH	NBP	NCP	NPP	PL	NSP	DM	HSW	SPY
DFF	1.000	0.831*	- 0.234	-0.514	-0.266	0.137	-0.299	0.862*	-0.165	-0.392*
PH		1.000	- 0.247	-1.002	-0.475	0.311	-0.004	0.943*	0.266	-0.164*
NBP			1.000	0.716*	0.722*	0.363	0.115	0.020	0.605*	0.780*
NCP				1.000	0.863*	- 0.045	0.499*	-0.188	0.283	0.334
NPP					1.000	-0.120	0.109	-0.030	0.679*	0.625*
PL						1.000	0.684*	0.151	0.204	-0.033
NSP							1.000	-0.321	0.172	0.046
DM								1.000	0.111	-0.481*
HSW									1.000	0.829*
SPY										1.000

Note: * Significant at 5% level, DFF - Days to 50% flowering, PH - Plant height, NBP - Number of branches per plant, NCP - Number of clusters per plant, NPP - Number of pods per plant, PL - Pod length, NSP - Number of seeds per pod, DM - Days to maturity, HSW - Hundred seed weight, and SPY - Single plant yield.

Results obtained from path analysis revealed that the number of branches, days to fifty percent flowering, number of seeds per pod, and plant height were registered with very high direct effects on single plant yield (Table 3). The higher direct effect of plant height and days to fifty percent flowering revealed the maturity duration directly depends on plant height. Likewise, the association was established between the numbers of branches, seed number. Hence a higher magnitude of positive direct effect is observed between single plant yield and number of branches pods per plant, hundred seed weight, and days to 50 % flowering. Whereas days to maturity, pod length, and number of pods per plant showed a negative direct effect on single-plant yield. This suggested a true relationship between these traits with seed yield per plant and direct selection for these traits would be rewarding for yield improvement. Finding similar results reported by Gupta *et al.*, (2003); Konda *et al.*, (2008); Lad *et al.* (2011); Punia *et al.* (2014) in urd bean, Bharti *et al*. (2014); Gowsalya *et al.* (2016); Rajasekhar *et al* (2017); Usharani *et al*. (2015); Kumar *et al*., (2015).

Table 3: Direct and indirect effects of yield components on seed yield in 12 Blackgram genotypes.

Characters	DFF	PH	NBP	NCP	NPP	PL	NSP	DM	HSW	SPY
DFF	**0.789**	0.153	-1.020	0.135	0.546	-0.538	-0.703	-0.672	-0.081	-0.392
PH	0.317	**0.387**	-1.080	0.263	0.975	-0.224	-0.010	-0.923	0.130	-0.164
NBP	-0.651	-0.343	**0.368**	-0.188	-0.483	-0.426	0.270	-0.061	0.296	0.780
NCP	-0.434	-0.391	0.125	**-0.263**	-0.773	0.177	0.173	0.582	0.138	0.334
NPP	-0.741	-0.658	0.153	-0.227	**-0.055**	0.472	0.256	0.092	0.332	0.625
PL	0.382	0.432	0.584	0.012	0.247	**-0.932**	0.610	-0.467	0.100	-0.033
NSP	-0.834	-0.006	0.502	-0.131	-0.224	-0.691	**0.352**	0.994	0.084	0.046
DM	0.405	0.309	0.087	0.049	0.061	-0.593	-0.754	**-0.098**	0.054	-0.481
HSW	-0.460	0.369	0.643	-0.074	-0.396	-0.802	0.404	-0.343	**0.489**	**0.829**

Residual Effect = 0.2033, DFF - Days to 50% flowering, PH - Plant height, NBP - Number of branches per plant, NCP - Number of clusters per plant, NPP - Number of pods per plant, PL - Pod length, NSP - Number of seeds per pod, DM - Days to maturity, HSW - Hundred seed weight, and SPY - Single plant yield.

CONCLUSION

In conclusion, the correlation analysis indicated Single plant yield was positive and significantly associated with hundred seed weight, number of branches per plant, and number of pods per plant. Results obtained from path analysis revealed that number of branches, days to fifty percent flowering, number of seeds per pod, and plant height were registered with very high direct effect on single plant yield. Hence characters *viz*., hundred seed weight, number of branches per plant, and number of pods per plant could be utilized as selection criteria for improving seed yield in black gram.

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Conflict of Interest. The results furnished in this paper were from my own research and there were no any conflicts from other research scholars or scientists.

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