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Genotypic and Phenotypic Correlations and Path Analysis in Blackgram, *Vigna mungo* (L.)

By

G. SOUNDARAPANDIAN[1], R. NAGARAJAN[2], K. MAHUDESWARAN[3] and P. V. MARAPPAN[4]

ABSTRACT

Sixteen cultivars of blackgram were studied for assessing the association between yield and its component characters. A significant positive association existed between seed yield and all the yield components studied. The co-heritability estimates between the various pairs of characters indicated that the strength of association of all other characters with height of plant is high as against the association of them with branch number. The path analysis showed that two characters namely the height of plant and cluster number have a direct effect as well as indirect effect *via.* other characters on seed yield, while branch number, pod number, pod length and seed number per pod have either very low positive or high negative, direct or indirect effects on seed yield. As such the height of plant and cluster number are important yield components to be considered.

INTRODUCTION

Correlation studies on association of yield components and path analysis for partitioning the correlation co-efficients into direct and indirect effects are efficient techniques for accelerating selection in breeding programmes. Limited information is available on such studies in blackgram (*Vigna mungo* (L.) Hepper). Significant and positive genotypic and phenotypic correlations between seed yield and branch number, pod number, pod length, number of fruiting nodes and seed size have been established (Singh 1969., Singh *et al.* 1972). However, these estimates do not precisely weigh the relative influence of the different yield components on seed yield with direct and indirect effects, and only path analysis can bring out such results. Such an analysis done by Singh *et al.* (1972) has taken into account six yield component characters other than plant height and number of seeds per pod with the result the pod number per plant is shown to have a direct effect on seed yield. Further evidences are wanting to support the existing information and hence the present investigation.

MATERIALS AND METHODS

Sixteen cultivars of blackgram were used in this investigation: Co. 1, Co. 2, PLS. 364 and Killikulam, from Tamil Nadu, T. 9, T. 21, H. 10, H. 21 and UPU. 2 from Uttar Pradesh, Mash-43, Mash-64, L. 35-5 and UL. 2 from Punjab, 338/3 from Bihar, Krishna from Rajasthan and No. 55 from Maharashtra. Seeds were sown during 1973 monsoon season at the Tamil Nadu Agricultural University, Coimbatore with a spacing of 30 X 10 cm in plots of 3.0 X 2.4 m size adopting

1-4 Department of Agricultural Botany, Tamil Nadu Agricultural University, Coimbatore-641003.

randomized block design replicated four times. Measurements were taken on five random plants per plot. Genotypic and phenotypic correlations and co-heritability were estimated based on the method adopted by Miller *et al.* (1958). Path analysis was carried out following the principles of Wright (1921).

RESULTS

The genotypic and phenotypic correlations showed significant positive correlations between seed yield and all the six component characters studied (Table I) except for branch number where the phenotypic correlation though positive (0.427) was not significant. In general, the genotypic correlation co-efficients were higher than phenotypic correlation co-efficients for all the six characters. The genotypic correlations between branch number and the three characters viz. plant height, pod length and number of seeds per pod, though positive were not significant, while in the phenotypic correlations, the associations between branch number and all the six characters studied were not significant. The genotypic correlations between height of plant and all the other characters except branch number were positive and significant and in the case of phenotypic correlations, all except branch number and number of seeds per pod were positive and significant with plant height.

The genotypic and phenotypic co-efficients of variation for height of plant, pod number per plant, cluster number and seed yield were high as compared to the other characters where the values were less than one. The genotypic and phenotypic co-variances were higher between seed yield and height of plant, pod number and cluster number and also between height of plant and seed yield, cluster number and pod number as compared to the co-variances between branch number and all other characters.

When the co-heritability values for height of plant and branch number were compared, it was observed that the co-heritability was the highest (more than 73 per cent) between height of plant and all other characters except branch number as compared to the co-heritability between branch number and all other characters.

The results of path analysis presented in Table II, showed that the height of plant and cluster number per plant have a high positive and direct effect on seed yield, while branch number, pod number, pod length and seeds per pod have negative or low direct effect on seed yield, while branch number, pod number, pod length and seeds per pod have negative or low direct effect on seed yield. Estimates of the direct and indirect effects of all the six characters on seed yield are presented in Table III. In all the correlations except plant height and cluster number, all the characters have exerted a negative or opposite influence either by direct or indirect effect via. one or other characters. In the case of yield vs. pod number, though the total genotypic correlation co-efficient was high (0.925), the direct effect was low and negative (--0.044) whereas the indirect effects

TABLE I. Path, Genotypic and Phenotypic correlation Co-efficients among selected traits

Trait	Co-efficient	Seed yield per plant	Pod number per plant	No. of seeds per pod	No. of clusters per plant	No. of branches per plant	Pod length	Height of plant
Seed yield per plant	P		— 0.044	— 1.984	1.072	— 0.193	0.009	2.014
	rg		0.925**	0.998**	0.860**	0.583**	0.919**	0.879**
	rph		0.806**	0.624**	0.818**	0.427	0.676**	0.649**
Pod number per plant	P							
	rg			0.814**	0.893**	0.721**	0.914**	0.873**
	rph			0.472	0.943**	0.487	0.614*	0.685**
No. of seeds per pod	P							
	rg				0.829**	0.227	1.113**	1.061**
	rph				0.454**	0.123	0.605*	0.471
No. of clusters per plant	P							
	rg					0.680**	0.949**	0.844**
	rph					0.419	0.666**	0.761**
No. of branches per plant	P							
	rg						0.343	0.361
	rph						0.204	0.267
Pod length	P							
	rg							1.014**
	rph							0.791**
Height of plant	P							...
	rg							...
	rph							...

P = Path co-efficient
rg = Genotypic correlation Co-efficients
rph = Phenotypic correlation Co-efficients
* = Significant at 5% leve
** = Significant at 1% leve

through height of plant (1.758) and cluster number (0.957) were high. In the case of yield vs. number of seeds per pod, though the genotypic correlation value was high (0.996), there was very high direct negative effect (–1.964) which was compensated by the very high indirect effects of plant height and cluster number. In the case of yield vs. branch number,

TABLE II. Genotypic, Phenotypic variances, Co-variances and Co-heritability

Genetic		Seed yield per plant	Pod number per plant	No. of seeds per pod	No. of clusters per plant	No. of branches per plant	Pod length	Height of plant
Genotypic variance		1.05	15.58	0.09	1.89	0.07	0.149	25.26
Phenotypic variance		1.73	32.52	0.31	3.16	0.23	0.184	34.65
Traits :								
Seed yield per plant	GC	3.73	0.307	1.211	0.158	0.363	4.530	
	PC	6.02	0.462	1.912	0.269	0.381	5.030	
	COH %	61.96	66.45	63.34	58.74	95.27	90.05	
Pod number per plant	GC		0.96	4.84	0.75	1.39	17.31	
	PC		1.52	9.55	1.33	1.50	22.98	
	COH %		63.16	50.68	56.39	92.60	75.33	
No. of seeds per pod	GC			0.34	0.018	0.128	1.60	
	PC			0.45	0.033	0.145	1.57	
	COH %			75.56	54.54	88.89	103.80	
No. of clusters per plant	GC				0.247	0.503	5.83	
	PC				0.357	0.508	7.97	
	COH %				69.19	99.02	73.15	
No. of branches per plant	GC					0.035	0.481	
	PC					0.042	0.750	
	COH %					83.33	64.13	
Pod length	GC						1.968	
	PC						1.993	
	COH %						98.74	
Height of plant	GC						...	
	PC						...	
	COH %						...	

GC = Genotypic Co-variance PC = Phenotypic Co-variance COH % = Co-heritability percentage

though the genotypic correlation co-efficient was 0.583, the direct effect was low and negative (-0.193) which was compensated through the indirect positive effect of 0.729 by cluster number, and plant height has no

TABLE III. Path Co-efficient analysis of components upon yield
Nature of association of yield components and their path co-efficients

Influence on yield through	Pod No. / plant	Seed No. / pod	Cluster No. / plant	Branch No. / plant	Pod length	Plant height
Pod No. / plant	—0.044	—0.039	—0.039	—0.032	—0.040	—0.038
Seed No. / pod	—1.615	—1.984	—1.645	0.000	—2.208	—2.105
Cluster No. / plant	0.957	0.880	1.072	0.729	1.017	0.904
Branch No. / plant	—0.139	0.000	—0.131	—0.193	0.000	0.000
Pod length	0.008	0.010	0.009	0.000	0.009	0.009
Plant height	1.758	2.130	1.699	0.000	2.010	2.014
Total Correlation	0.925	0.998	0.860	0.583	0.919	0.879

Yield vs. other residual factors: Path co-efficient = 1.054

influence on yield through branch number. In the case of yield vs. pod length, though the genotypic correlation co-efficient was high (0.919), the direct effect of pod length and seed yield was negligible (0.009) which again was compensated by the high direct effects of plant height (2.010) and cluster number (1.017). In the case of yield vs. cluster number and yield vs. plant height, the correlation values as well as direct effects were high and positive.

DISCUSSION

Simple correlation studies of different component characters with yield of blackgram made by Singh (1969), Singh *et al.* (1972) and Verma and Dubey (1970) have established that there are positive and significant genotypic and phenotypic correlations between seed yield and branch number, pod number, pod length, number of seeds per pod and seed size. The results obtained from the present study have confirmed the above findings. Two other characters namely plant height and cluster number per plant which have not been considered by the other workers, have also shown a high and positive correlations with seed yield. These results indicate that there is good amount of environmental influence on all the characters studied and therefore the genotypic correlation co-efficients are more reliable estimates of the associating traits.

The estimates of co-efficients of variation of yield components in blackgram have offered promise for improvement in seed yield. The extent of variability in height of plant, cluster number and pod number is fairly wide indicating a scope for improvement in seed yield through selection for

these characters in particular. The co-variances between height of plant and seed yield, cluster number and pod number are greater as compared to those between branch number and the rest of the seven characters studied. This shows the strength of genetic association between different characters and that the height of plant, cluster number and pod number per plant are important yield attributes as against the number of branches per plant. This is further confirmed by the high estimates of co-heritability of all other characters with plant height and not with branch number.

The pre-eminence of path analysis has enhanced the methodology for critical evaluation of the association between seed yield and its component characters. Eventhough there is significant and positive genotypic correlations between seed yield and all the six characters studied, path analysis has shown that the height of plant and cluster number are the only two characters having direct and positive influence on seed yield, while branch number, pod number, pod length and number of seeds per pod have only negative direct effect on seed yield. In the path analysis reported by Singh *et al.* (1972) in blackgram, it is evident that the number of pods per plant has a direct influence on seed yield, and in greengram (*Phaseolus aureus* Roxb.) Singh (1969) has reported that pod number, seeds per pod and seed size directly influence seed yield. From the multiple regression analysis in blackgram, Singh (1969) has reported that pod number, pod length and seed size are important yield contributing characters. But the path analysis results presented in the study have shown that pod number has only indirect negative effect *via.* other characters on seed yield in all the correlations and even the direct effect is very negligible and negative (-0.044). The high direct correlation value (0.925) between pod number and seed yield is due to the very high indirect effect of height of plant (1.758) though has been nullified by the negative indirect effect of number of seeds per pod, has been improved by the considerable positive direct effect of number of clusters per plant. Similarly in the case of pod length, path analysis has revealed that this character has a very poor direct effect as well as indirect effect on seed yield *via* all other characters. Though there is a very high total correlation (0.919) between pod length and seed yield, it is primarily due to the high indirect effects through height of plant and number of clusters per plant in spite of heavy pull in the opposite direction by number of seeds per pod. Selection directed towards an increase in branch number, pod number, pod length and number of seeds per pod alone may not be effective in increasing the seed yield. Therefore for realising maximum yield in blackgram, a compromise should be made in selecting for height of plant and number of clusters per plant and also the number of branches per plant, pod number, length of pod and number of seeds per pod.

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