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GENETIC VARIABILITY, CHARACTER CORRELATION AND PATH ANALYSIS OF YIELD COMPONENTS IN MUNGBEAN (*VIGNA RADIATA* (L.) WILCZEK)

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Abstract

Correlation and path analysis were carried out in 40 elite genotypes of *Vigna radiata* (L.) Wilczek. Highest genotypic and phenotypic correlations were observed between days to flowering and flower initiation (0.9976 and 0.8179), pod initiation and flower initiation (0.9945 and 0.7241), pod initiation and days to flowering (0.9930 and 0.8096), pods/plant and primary branches/plant (0.9859 and 0.5257) and pods/plant and clusters/plant (0.9986 and 0.7892). Path analysis revealed that pod initiation, plant height and biological yield had highest direct positive effect on grain yield/plant. The direct effects of flower initiation, days to maturity, clusters/plant, pod length and seeds/pod, on grain yield were high and negative.

Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) is an important pulse crop in South and South-East Asian countries but very little effort has been made for the improvement of this crop. Although genetic variability and relationship between yield and other charactres in pulses have been studied (Singh, 1968: Phadnis *et al.*, 1970; Bhardwaj & Singh, 1972; Dabholkar, 1973; Gowda & Panday, 1975; Rani & Rao, 1981; Malik *et al.*, 1983), yet there is not much information on the direct and indirect contribution of these characters towards yield of mungbean. Present study was conducted to understand the nature of the association and get additional information on path coefficient analysis to determine the components of yield. The information obtained will be used to arrive at specific physiological explanation for providing certain parameters that could be used as selection indices in breeding mungbean genotypes with high yield potential.

Materials and Methods

Forty genotypes were selected from a wide range of exotic and indigenous collections maintained at the National Agricultural Research Centre, Islamabad. The crop was grown in a randomized complete block design with 4 replications during summer 1984. Each plot had 4 m. long 4 rows, at a spacing of 40 cm. Plant to plant distance was 10 cm. Normal cultural practices were followed. At maturity, observations were recorded on

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10 randomly selected plants from 2 central rows of each plot on plant height (cm), number of primary branches per plant, clusters per plant, pods per plant, pod length (cm), seeds per pod, 100 seed weight (g), biological yield (g) and grain yield per plant (g). Besides, observations were also recorded on days to flower initiation, days to 50% flowering, days to pod initiation and days to 90% maturity.

The estimates of heritability and expected genetic advance were obtained according to the methods advanced by Singh & Chaudhary (1979). Genotypic, phenotypic and environmental correlation coefficient analysis and path coefficient analysis were performed according to the methods proposed by Dewey & Lu (1959).

Table 1. Estimates of some genetic parameters for different quantitative characters of mungbean.

Character	Genotypic variance	Phenotypic varience	Genotypic coefficient of variability	Phenotypic coefficient of variability	Heritability	G.A.	G.A. %
Flower initiation	3.7	6.8	0.418	6.5	0.54	2.14	5.35
Days of flowering	6.2	10.1	5.4	6.9	0.61	3.13	6.66
Pod initiation	3.3	5.8	3.6	4.8	0.57	2.13	4.18
Days to maturity	5.0	9.9	3.1	4.3	0.51	2.34	3.16
Plant height	96.6	108.2	11.8	12.4	0.89	18.01	28.0
Primary branches	0.09	0.56	14.9	36.1	0.17	0.11	4.40
Clusters per plant	1.7	5.9	15.2	28.3	0.29	0.78	9.75
Pods per plant	14.1	37.9	17.8	29.2	0.37	2.86	11.44
Pod length	0.24	0.51	6.8	9.9	0.47	0.22	6.71
Seeds per pod	0.46	1.2	6.8	11.0	0.38	0.53	5.30
100 seed weight	0.35	1.04	17.5	29.9	0.34	0.41	13.67
Biological yield	5165.9	8136.6	13.8	17.4	0.63	45.28	10.06
Grain yield per plant	0.73	2.40	16.36	29.65	0.30	0.53	13.25

G.A. : Genetic advance.

G.A. %: Genetic advance expressed as percentage of mean.

Results and Discussions

Wide range of variability exists in most of the characters under study (Table 1). The genotypic and phenotypic variances are fairly high for plant height (96.6 and 108.2) and biological yield (5165.9 and 8136.6) indicating a wide range of variation. Pande *et al.* (1975), Soundrapandian *et al.* (1976) and Malik *et al.* (1983) reported high values of genotypic and phenotypic variances for plant height and pods/plant. Broad sense heritability ranged from 0.17 (for primary branches/plant) to 0.89 (for plant height). The characters in order of high heritability were biological yield, days to flowering, pod initiation, flower initiation and days to maturity. Malik *et al.* (1983) reported high heritability values for plant height, 100 seed weight, pod length, pods/plant and branches/plant.

The heritability value alone provides no indication of the amount of genetic progress that would result in selecting the best individual, but heritability estimates alongwith the genetic advance is more useful (Johnson *et al.*, 1955). Genetic advance expressed as percentage of mean (using 5% selection intensity) revealed differences among the characters studied. High heritability associted with high genetic advance in case of plant height indicates that the additive gene effects are important in determining this character. Characters like biological yield, days to flowering, pod initiation, flower initiation and days to maturity showed that high heritability is coupled with low genetic advance, so non additive (dominant and epistasic) gene effefts are more important for these characters. These findings are in close agreement with Panse (1957) and Malik *et al.*, (1983).

Genotypic correlations were higher than phenotypic correlations for most of the comparisons (Table 2). All references in the text hereafter refer to genotypic correlations.

On reviewing the correlation between yield and its components, it was found that yield was strongly and positively associated with plant height, primary branches per plant, clusters per plant, pods per plant and biological yield. Luthra & Singh (1978) reported positive and highly significant association of yield with branches/plant and clusters/plant. Correlation coefficients of grain yield with days to maturity and pod length were found to be significant and negative. Correlation coefficients of remaining characters with yield were negligible.

The results of partitioning of correlations by the path coefficient technique with grain yield as resultant variable and remaining characters as causal variables are presented in Table 3.

The direct effect of flower initiation on yield was negative and high, while indirect effects of this trait via pod initiation and plant height were positive and high. The indirect effect via days to maturity was high and negative. Indirect effects via other characters

were negligible. The direct effect of days to flowering on yield was negative and moderate (– 0.4318). The indirect effects of this character via pod initiation, plant height, clusters/plant, seeds/pod, branches per plant and pods/plant were positive, while remaining traits showed negative effects bringing the total correlation to 0.0372. Similar results were reported by Chauhan & Sinha (1982) and Singh *et al.* (1977). Direct effect of pod initiation on grain yield was positive and high.

Maturity days had a high and negative direct effect on yield. It was strengthened by negative indirect effects via flower initiation, days to flowering, plant height, pod length, 100 seed weight and biological yield. Positive indirect effects via pod initiation, branches/plant, clusters/plant, pods/plant and seeds/pod tried to nullify the negative direct effect, but direct negative effect alongwith indirect negative effects with other traits resulted in significant negative correlation (– 0.3224). Dixit & Dubey (1984) also reported negative direct effect of days to maturity on yield, but Asawa *et al.*, (1981) reproted positive direct effect of maturity days on yield. Plant height seems to be a desired character for selection of mungbean genotypes. Its direct effect on yield was positve and high (2.2087) which was supported by pod initiation, biological yield, pod length, days to maturity and 100 seed weight. The negative forces of this character were branches/plant, seeds/

Table 2. Genotypic (rg) and Phenotypic (rph) correlation coefficients amongs 13 characters in mungbean.

Character	Coefficient	Days to flowering	Pod initiation	Days to maturity	plant height	Primary branches	Clusters per plant	Pods per plant
		**	**	**	*			
Flower	rg	0.9976	0.9945	0.7060	0.3982	0.0798	–0.1153	–0.0116
initiation	rph	0.8179	0.7241	0.4722	0.2554	–0.0109	–0.1313	0.0005
			**	**			*	
Days to	rg		0.9930	0.8200	0.2975	–0.2190	–0.3327	–0.2343
flowering	rph		0.8096	0.6090	0.1927	0.0383	–0.1625	–0.6580
				**				
Pod	rg			0.8785	0.2000	–0.3068	–0.2604	–0.2070
initiation	rph			0.6221	0.1364	–0.0264	–0.1090	–0.0542
						**	**	**
Days to	rg				–0.1403	–0.6144	–0.5231	–0.5039
maturity	rph				–0.0698	–0.2025	–0.2622	–0.2423
						**		**
Plant	rg					0.7157	0.2906	0.5241
height	rph					0.2684	0.2084	0.2886
							**	**
Primary	rg						0.8560	0.9859
branches	rph						0.6169	0.5257
								**
Clusters	rg							0.9986
per plant	rph							0.7892

Table 2 (contd)

Character	Coefficient	Pod length	Seeds per pod	100 seed weight	Biological yield	Grain yield
		*				
Flower	rg	0.3590	−0.0973	0.1321	−0.3080	0.1198
initiation	rph	0.1528	−0.0633	0.0791	−0.2343	0.0460
		**			**	
Days to	rg	0.5342	−0.1397	0.2913	−0.4991	−0.0372
flowering	rph	0.3002	−0.0146	0.1240	−0.3673	0.0149
		**		*	**	
Pod	rg	0.4831	−0.3111	0.3564	−0.5192	0.0772
initiation	rph	0.2425	−0.1537	0.1143	−0.3453	0.0248
		**	*	*	**	*
Days to	rg	0.5048	−0.3758	0.3549	0.8450	−0.3224
maturity	rph	0.2367	−0.1741	0.1460	0.5301	−0.1419
		*	**	**	**	**
Plant	rg	−0.3377	0.6846	−0.5051	0.4094	0.5539
height	rph	−0.3032	0.4363	−0.2678	0.3186	0.2935
		**		**	**	**
Primary	rg	−0.6633	0.2634	−0.7708	0.7470	0.6898
branches	rph	−0.2702	0.0978	−0.2590	0.2330	0.3716
		**		**	**	**
Clusters	rg	−0.7330	0.0288	−0.6005	0.6928	0.6960
per plant	rph	−0.3598	0.0095	−0.2334	−0.2661	0.5491
		**		**	**	**
Pods per	rg	−0.7271	0.0616	−0.6262	0.7821	0.7762
plant	rph	−0.3131	0.0608	−0.3281	0.3646	0.6106
			**	**	**	*
Pod	rg		−0.4131	0.8850	−0.5404	−0.3212
length	rph		0.1155	0.3957	−0.2579	0.0075
				**	**	
Seeds per	rg			−0.4903	−0.4639	0.2098
pod	rph			−0.1295	0.2040	0.1829
					**	
100 seed	rg				−0.5577	−0.1688
weight	rph				−0.2106	−0.1019
						**
Biological	rg					0.6666
yield	rph					0.3148

pod, cluster/plant, days to flowering and flower initiation. These findings were in close agreement with Soundarapandian *et al.*, (1976) but in contrast to Rani & Rao (1981). There was a strong negative direct effect of branches/plant on the resultant variable (– 1.2405). This effect was nullified by indirect positive effects via plant height, maturity days, pod length and biological yield resulting in a total correlation coefficent of 0.6898. Asawa *et al.* (1981) reported negative direct effect (– 0.923) of branches/plant on grain yield in contrast to Katiyar (1979) who reported very high positve direct effect of primary branches on yield. High negative direct effect of clusters/plant on yield was nullified

by high positive indirect effects via days to maturity, plant height, pods/plant and biological yield. Rani & Rao (1981) reported high positive direct effect of clusters/plant on yield.

The direct effect of pods/plant on grain yield was negative and moderate (– 0.3368) but it could not be reflected in total genetic correlation (0.7762) mainly due to high positive indirect effects via plant height, days to maturity, pod length and biological yield. There was a high negative direct effect of pod length on yield (– 0.9783) confirming the results of Rani & Rao (1981). Seeds/pod had positve and highly significant correlation with yield but this trait will be rather misleading for the production of high yield, as the direct effect of this character was negative and very high (– 1.9627). The indirect positive effects mainly via plant height, days to maturity, pod length and biological yield nullified the negative direct effect, bringing the total correlation to 0.2098. The direct effect of 100 seed weight on yield was negative (– 0.2911) confirming the findings of

Table 3. Direct (bold) and indirect effects of component characters on grain yield in mungbean.

Character	Flower initiation	Days to flowering	Pod initiation	Days to maturity	Plant height	Primary branches
Flower initiation	**–1.2668**	–0.4394	2.7946	–.3159	0.8794	–0.0990
Days to flowering	–1.3094	**–0.4318**	2.7906	–1.5285	0.6571	0.2716
Pod initiation	–1.2796	–0.4288	**2.8102**	–1.6376	0.4418	0.3806
Days to maturiry	–0.9084	–0.3541	2.4689	**–1.8640**	–0.3098	0.7621
Plant height	–0.5123	–0.1285	0.5621	0.2615	**2.2083**	–0.8878
Primary branches	–0.1027	0.0946	–0.8623	1.1452	1.5808	**–1.2405**
Clusters per plant	0.1484	0.1437	–0.7319	0.9750	0.8627	–1.0619
Pods per plant	0.0149	0.1012	–0.5817	0.9392	1.1575	–1.2230
Pod length	–0.4619	–0.2307	1.3577	–0.9409	–0.7460	0.8228
Seeds per pod	0.1252	0.0603	–0.8741	–0.7005	1.5121	–0.3268
100 seed weight	–0.1700	–0.1258	1.0015	–0.6616	–1.1154	0.9562
Biological yield	0.3963	0.2155	–1.4592	1.5751	0.9041	–0.9266

Table 3 (contd)

Character	Clusters per plant	Pods per plant	Pod length	Seeds per pod	100 seed weight	Biological yield	Genotypic correlation with grain yield/plant
Flower initiation	0.0958	0.0039	−0.3512	0.1909	−0.0358	−0.3141	0.1198
Days to flowering	0.2766	0.0789	−0.5226	0.2743	−0.0848	−0.5090	−0.0372
Pod initiation	0.2165	0.0697	−0.4727	0.6105	−0.1038	−0.5296	0.0772
Days to maturity	0.4347	0.1697	−0.4938	0.7376	−0.1033	−0.8619	−0.3224
Plant height	−0.3246	−0.1965	0.3304	−1.3437	0.1470	0.4175	0.5539
Primary branches	−0.7115	−0.2320	0.6490	−0.5170	0.2244	0.7619	0.6898
Clusters per plant	−0.8311	−0.3508	0.7172	0.0565	0.1748	0.7066	0.6960
Pods per plant	−0.8658	−0.3368	0.7114	−0.1208	0.1823	0.7978	0.7762
Pod length	0.6093	0.2449	−0.9783	0.8107	−0.2577	−0.5512	−0.3212
Seeds per pod	−0.0239	−0.0207	0.4041	−1.9627	0.1427	0.4732	0.2098
100 seed weight	0.4991	0.2109	−0.8658	0.9623	−0.2911	−0.5688	−0.1688
Biological yield	−0.5768	−0.2643	0.5287	−0.9105	0.1624	1.0200	0.6666

Chauhan & Sinha (1982) but in contrast to Rani & Rao (1981). Direct effect of biological yield on grain yield was positive and high (1.0200) which, even in the presence of high negative indirect effects via seeds/pod, clusters/plant, branches/plant and pod initiation, reflected a very high positive correlation (0.6666).

Path analysis showed that in spite of strong and positive correlation of pods per plant with yield, these were the flower initiation, days to flowering, days to maturity, plant height, pod length, 100 seed weight and biological yield that ultimately determined pod number per plant, since the direct effect of pods per plant on yield was negative. Similarly, branches per plant and clusters per plant had a negative direct effect on yield in spite of having a strong and positive correlation with it. Branches per plant contributed to yield indirectly through days to flowering, days to maturity, plant height, pod length, 100 seed weight, and biological yield, while contribution of clusters per plant to yield

came indirectly via flower initiaton, days to flowering, days to maturity, plant height, pod length, seeds per pod, 100 seed weight and biological yield. Out of twelve yield components studied, only three (pod initiation, plant height and biological yield) had a direct effect on yield if other components were kept constant. In mungbean, pod initiation, plant height and biological yield should therefore be given maximum weightage for grain yield improvement.

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