Pakistan J.Sci.Ind.Res., Vol. 27, No. 1, February, 1984

GENETIC VARIABILITY AND PATH COEFFICIENT ANALYSIS IN GREEN GRAM (*VIGNA RADIATA*)

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(Received February 18, 1982; Revised September 14, 1983)

Genetic variability and path coefficient study of exotic collections of green gram population was conducted at the Agronomy Section, Agricultural Research Institute, Tandojam, Pakistan. Estimates of variability, heritability and expected genetic advance were computed for plant height, branches per plant, pods per plant, pod length, seeds per pod, 100 grain weight and grain yield per plant. High heritability values recorded for all the traits accompanied with high genetic advance suggest that all these characters are controlled by an additive gene effect and suitable selection schemes will result in significant genetic improvement.

Further, the results of phenotypic correlation coefficient and path coefficient analysis indicate that maximum weightage should be given to branches, pods per plant, pod length and 100 grain weight in formulating selection indices for grain yield improvement in mungbean.

INTRODUCTION

Green gram commonly known as mungbean (*Vigna radiata* (L) Wilczek) is one of the staple grain legume crops of many countries of the world. The mungbean is an excellent source of high quality protein in Asian diets. This crop can contribute substantially in closing the protein gap for over 500 million undernourished people in the world.

In Pakistan, mungbean is the most important crop of the summer season pulses. Not much attention has been given to its improvement till the recent past, resulting in a steady fall in area and production. In order to rectify this dismal situation and to promote the crop in this region the mungbean germplasm was introduced from AVRDC, Taiwan, and from other mungbean growing centres of the world. This introduced plant material was evaluated and screened for desirable attributes.

For such type of evaluation and screening work, knowledge about the inter-relationships, direct and indirect influences of yield contributing attributes are pre-requisite for developing an effective basis of phenotypic selection in plant populations. Path coefficient analysis also helps to minimize the number of attributes for which simultaneous selection pressure must be exerted. A few reports on correlations and path analysis are available on this crop[1,2].

MATERIAL AND METHODS

Six exotic varieties collected from the PHILIPPINES, AVRDC, TAIWAN and INDIA and a local variety C-23 were selected for this investigation. The material was raised in a randomized complete block design with four replications during Kharif 1978. The plot size was 6 x 9 metres i.e., 20 rows of 6 m length. Seed was drilled at a row distance of 45 cm. Plant to plant distance was maintained at 7.5 cm by thinning the crop before first irrigation. Observations were recorded on five plants, taken at random from each replication for plant height (cm), number of branches/ plant, number of pods/plant, pod length (cm), seeds per pod, 100 grain weight (gm) and plant yield(gm).

Statistical analysis on mean values of 14 plants of each genotype was performed and genetic selection parameters were computed according to the procedures of Johnson *et al.*[3]. Path coefficient analysis for the assessment of direct and indirect effects of 6 different quantitative traits on yield was done after Dewey and Lu[4].

RESULTS AND DISCUSSION

Performance of yield contributing attributes are summarized in Table 1. As per results grain yield per plant is not significantly different from each other. However, yield potential of Philippine variety CES-55 and Taiwan variety CV-local was reasonably high.

The estimates of genetic parameters, genotypic variance ($\sigma^2 g$), phenotpic variance ($\sigma^2 ph$), heritability (h^2) and expected genetic advance (Gs) are presented in Table 2. A wide range of variability was observed in this study. All the characters had exhibited considerable range in their phenotypic variation (Table 2).

The phenotypic and genotypic variance was high for plant height (10.788 and 13.362) and pods/plant (13.827 and 20.139), moderate for 100 grain weight (3.608 and 3,744) whereas, low variability was observed for pod length, yield per plant, seeds per pod and branches per plant. In general for all the traits studied there was no great discrepancy between phenotypic nd genotypic variability, suggesting a small effect of environment on these characters. Hence selection for these traits will p

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Correlations. All the characters hae shown positive relationship with yield (Table 3). Correlation values were highly significant (P = .01) between yield and branches per plant, pods per plants and pod length. Similar findings have been reported by Singh *et al.*[6], Bahl and Jain[7] and Singh *et al.*[8] in chick pea. Singh and Malhotra also reported positive association of seed yield with pods per plant and 100 grain weight in mungbean. Giriraj and Vijayakumar[2] observed positive relationship between seed yield and plant height, pods per plant and seeds per pod. Significant correlation (P = .05) was observed between yield and seeds per pod. Estimates of correlation for plant height and 100 grain weight without grain yield reaching the significance level. 100 grain weight was found to exhibit significant and negative relationship with plant height. branches per plant, pods per plant and seeds per pod which shows that taller plants with more pods and pod bearing branches will produce smaller grains. Similar results were reported by Funnah and Mak[9]. Jatasra *et al.*[10], observed negative correlation between 100 grain weight and seeds per plant and seeds per pod in chick-pea. However, 100 grain weight showed highly significant positive correlation (P = .01) with pod length, which means longer pods will produce bold grains and confirmed the results of previous investigation by Sandhu *et al.*[11]; seeds per pod have positive but weaker correlation with branches per plant, pods per plant and pod length, whereas, significant positive correlation was found with plant height. This suggests that taller plants will produce more seeds per pod, but plants with more branches and pods would not necessarily increase grains per pod. Pod length showed a significantly negative association with plant height, branches and pods per plant. Highly significant and positive correlation of pods per plant and branches per plant with plant height indicate that taller plants will produce more branches bearing more pods per plant.

Path analysis. Path analysis (Table 4) revealed that plant height, branches per plant, pod length, seeds per pod and 100 grain weight had positive direct effect on seed yield per plant.

The direct effect of plant height on grain yield (0.0868) was of very low magnitude. However, when the positive and negative effects via other characters were observed, the high positive effect via pods per plant improved the total effect to some extent but could not reach the significance level. Other workers in chickpea[8], Singh *et al.*[6] in lentil and Giriraj and Vijayakumar[2] in mungbean, have also concluded that plant height has a positive direct effect on grain yield.

The direct effect of branches per plant on grain yield was positive but not well pronounced (0.1117). The high

Table-1. Performance of seven different green gram genotypes

Genotype	Plant height (cm)	Branches per plant	Pods per plant	Pod length (cm)	Seeds per pod	100 grain weight (gm)	Grain yield per plant plant (gm)
Eg-MG-60	39.86	1.00	16.14	9.89	9.86	8.10	7.35
MG-50-10 A (Green)	35.00	1.14	17.71	8.39	8.93	7.09	5.64
CES-55	39.93	1.43	21.57	9.00	10.29	7.36	9.19
CES-28	42.36	1.43	20.57	8.46	8.43	7.87	6.91
CV-local (Taiwan)	44.36	1.39	24.00	8.46	10.79	5.43	9.01
S-8	44.21	1.64	27.71	6.75	10.57	3.83	7.85
C-23	45.57	2.29	27.43	6.39	10.43	3.42	6.51
S.E.	1.6043	0.2234	2.5124	0.2468	0.4838	0.3681	0.8629
C.V.%	3.86	14.40	11.34	3.01	4.89	5.98	11.51
LSD_1	4.450	0.619	6.964	0.684	1.341	1.020	–
LSD_2	5.850	0.815	9.167	0.901	1.765	1.343	–

Table-2. Estimates of phenotypic and genotypic variance heritability and expected genetic advance.

Characters	Genotypic variance	Phenotypic variance	Heritability %	Genetic advance	Genetic advance % of means
Plant height	10.7883	13.3620	80.74	6.0798	14.61
Branches per plant	0.1486	0.1985	74.86	0.6871	44.29
Pods per plant	13.8268	20.1390	68.66	6.4398	29.06
Pod length	1.4475	1.5084	95.96	2.4279	29.64
Seeds per pod	0.5617	0.7957	70.59	1.2971	13.10
100 grain weight	3.6084	3.7438	96.38	3.8416	62.39
Grain yield per plant	0.9319	1.6765	55.69	1.4827	19 78

Table-3. Correlation coefficients among different characters in green gram

Characters	Plant height	Number of branches	No. of pods per plant	Pod length	Seeds/ pod	100 grain weight	Grain yield plant
1. Plant height	–	0.2052*	0.2711**	–0.2242*	0.2289*	–0.3986**	0.1694
2. Number of branches per plant	–	–	0.5614**	–0.2028*	0.1491	–0.2725**	0.4321**
3. Number of pods per plant	–	–	–	–0.2139*	0.1314	–0.2559*	0.7089**
4. Pod length	–	–	–	–	0.1096	0.7441**	0.2795**
5. Seeds per pod	–	–	–	–	–	–0.3201**	0.2152*
6. 100 grain weight	–	–	–	–	–	–	0.1771

*, ** Significant at 5% and 1% level respectively.

Table-4. Direct and indirect effects of seven quantitative characters on grain yield in green gram.

Characters	Plant height	Branches per plant	Pods per plant	Pod length	Sees per pod	100 grain weight	Correlation with yield
Plant height	(0.0868)	0.0229	0.1979	-0.0528	0.0352	-0.1207	0.1694
Branches per plant	0.0178	(0.1117)	0.4100	-0.0478	0.0229	-0.0825	0.4321**
Pods per plant	0.0235	0.0627	(0.7303)	-0.0504	0.0202	-0.0775	0.7089**
Pod length	-0.0195	-0.0226	-0.1562	(0.2355)	0.0169	0.2254	0.2795**
Seeds per pod	0.0199	0.0167	0.0959	0.0258	(0.1539–	-0.0970	0.2152*
100 grain weight	0.0346	-0.0305	-0.1868	0.1753	-0.0493	(0.3030)	0.1771

Figures in parenthesis indicate direct effect.

indirect effect via pods per plant made the total effect of branches per plant highly significant. These results confirm the findings of Jatasra *et al.* [10], Singh *et al.* [8] in chick-pea and Singh *et al.* [6] in lentil.

The very high direct effect of pods per plant on grain yield was somewhat masked due to negative indirect effect via pod length and 100 grain weight but still the total effect of pods per plant on grain yield remained highly significant. Based on these results the pods per plant can be used as a very reliable criterion in the selection of high yielding genotypes. Singh and Malhotra [1] have also reported larger magnitude of direct effect of pods per plant on seed yield which, thus, supports our results.

Highly significant positive total effect of pod length on seed yield was mainly due to its high direct and indirect effects via 100 grain weight. The rest of the characters mostly exerted negative indirect effect on grain yield. Giriraj and Vijayakumar [2] also observed a high direct effect of pod length on grain yield.

The direct effect of seeds per pod on grain yield was comparatively lower. The indirect effect via other characters under study except 100 grain weight, raised the total effect to significance level. Similar findings have been reported by Jatasra *et al.* [10]. Singh *et al.* [8], have reported negative direct effect of seeds per pod on grain yield in chick-pea. This contradiction could be due to the environment and material used.

The pronounced direct effect of 100 grain weight on yield (0.3030) was reduced to a non-significant level by the negative indirect effect via other characters. The pod length, however, had positive indirect effect on grain yield.

The residual effect (Fig. 1) was of moderate order (Px_1 = 0.5) which indicates the exclusion of some other factors which also contribute towards grain yield in mungbean.

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