GENETIC PARAMETERS AND PATH CO-EFFICIENT ANALYSIS IN MUTATED GENERATION OF MUNGBEAN, *VIGNA RADIATA* L. WILCZEK

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ABSTRACT

These studies were conducted at Nuclear Institute for Agriculture and Biology, Faisalabad during 2004. M_4 generation of three AVRDC mungbean accession was evaluated to exploit maximum yield components and formulate selection criteria in mutated population. Genetic parameters (genotypic and phenotypic variance, heritability, genetic advance), genotypic and phenotypic correlation and path co-efficient were computed. The results revealed high heritability coupled with moderate to high genetic advance for primary branches (33.80, 68.95), pods per plant (79.40, 60.59), 100 seed weight (50.10, 68.52) and seed yield (73.90, 87.60). It means that additive genes mainly control such characters. Clusters per plant (0.99), pods per plant (0.89) and pod length (0.96) had positive and highly significant correlation with seed yield. Plant height (69.69), primary branches (20.97) and clusters per plant (62.18) showed strong positive direct effect on seed yield.

KEYWORDS: *Vigna radiata;* mutation; performance; agronomic characters; Pakistan.

INTRODUCTION

Green gram, commonly known as mungbean, *Vigna radiata* (L.) Wilczek, belongs to family leguminosae and genus *Vigna.* It is one of the important short duration pulse crops of Pakistan. It is an excellent source of high quality protein in Asian diets. This crop can contribute substantially in bridging the protein gap for over 500 million under-nourished people in the world. Mungbean has been under cultivation in India since 2200 B.C. (4). It is native to India and Central Asia. Mungbean is grown in 23 countries of the world and is the most important grain legume in Thailand which is its main exporter.

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In Pakistan, mungbean is grown in summer season. It is cultivated on an area of 258 thousand hectares with an annual production of 138 thousand tonnes with average seed yield of 537 kg per hectare. This low yield cannot meet the demand of ever rising population. Little attention has been given to its improvement till the recent past, resulting in a steadily fall in area and production. To rectify this dismal situation and promote the crop in this region, mungbean germplasm was introduced from AVRDC, Thailand and attempts were made to increase its seed yield per hectare.

Inability to visually recognize small differences in quantitative traits among single plants have led to frequent attempts to find associated traits more amenable to visual selection. The correlation co-efficient gives the measure of relationships between traits and provides the degree to which various characters of a crops are associated with productivity. It is the result of direct and indirect effects of a number of plant characters and selection based on these characters would be more effective rather than seed yield. Path co-efficient is used in assessing the real contribution of various component traits towards seed yield, so that direction for desired improvement may be developed. Selection based on yield components is advantageous if different yield related traits have been well documented (11).

Positive correlation of number of clusters per plant with seed yield has been reported by Tamilselvam and Das (14). Gill *et al*. (3) observed that in general, genotypic co-efficient of variability was higher than corresponding phenotypic co-efficient of variability. Kar *et al*. (6) reported positive direct effect of plant height on seed yield. Positive direct effect of primary branches on seed yield per plant has been reported by Kalpande *et al*. (5). Positive correlation of seed yield with primary branches has been reported by Mahto and Mahto (7). Ram and Singh (8) reported high heritability for pod length and seed yield in cowpea. Wahid and Ahmad (16) reported positive correlation of plant height with seed yield in mungbean. High heritability for seed yield has been reported by Venkateswarlu (15). Sarwar *et al*. (10) observed positive and significant correlation of plant height with primary branches. Abbas *et al*. (1) reported positive and significant correlation of seed yield with clusters per plant, pods per plant, pod length and seeds per pod. Positive correlation of seed yield with plant height, primary branches, number of pods, pod length and 100-seed weight has been reported by Sadiq *et al.* (9).

In the present study efforts were made to exploit yield components and formulate selection criteria in mutated population of mungbean.

MATERIALS AND METHODS

This study was conducted at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad during the year 2004 in summer season. The experimental material comprised M_4 generation of three AVRDC accessions i.e. VC1560D, VC2307A and VC2565 which were radiated at 300 Gy at NIAB during 2001. M_1 generation was raised during summer 2001 and mutants with desirable traits were isolated. Single plant rows of M_2 selected plants were grown during summer 2002. True breeding progenies from the selected M_2 plants were grown during summer 2003 and desirable progenies were further evaluated. Ten progenies as M_4 from each accession were sown in three replications in RCBD keeping row length of 4 meter, spaced at 30 cm and plant to plant distance of 10 cm.

Ten equidistance plants from each progeny in each replication were taken at maturity and data on plant height, number of primary branches per plant, number of clusters per plant, number of pods per plant, pod length, 100 seed weight and seed yield per plant were recorded. Mean values were taken and averages were used for statistical analysis. Analysis of variance was carried out following Steel and Torrie (13). Genetic parameters like genotypic, phenotypic variances, heritability, genetic advance and genotypic phenotypic correlation and path co-efficient analysis were computed according to Singh and Chaudhary (12).

RESULTS AND DISCUSSION

Significant differences among the progenies of VC1560D were observed for primary branches, clusters per plant and seed yield (Table 1). Progenies of VC2307A differed significantly for pods per plant, 100-seed weight and seed yield. Also the population of VC2565 differed significantly for primary branches, pods per plant and seed yield. From the results it is concluded that M_4 populations of all accessions are amendable to visual selection for improving seed yield.

In general, phenotypic co-efficient of variability was high than corresponding genotypic coefficient of variability for all the characters in all the populations. This shows the influence of environment upon the characters. The results agree to those of Gill *et al*. (3). In M_4 generation of VC 1560D, higher heritability (68.40%) was estimated for seed yield and higher genetic advance (69.53) for primary branches (Table 2).

Table 1. Statistical significant of different morphological traits

in M4 generation of mungbean.

Characters	VC1560D	VC2307A	VC2565
Plant height (cm)	1.35NS	1.32**	0.46NS
Primary branches/plant	0.46*	0.31NS	0.46*
Clusters/plant	0.98*	0.17NS	0.77NS
Pods/plant	1.13NS	5.86**	22.99**
Pod length	0.30NS	0.15NS	0.09NS
100-seed weight (g)	0.38NS	0.87**	0.10NS
Seed yield (g)	5.22	0.59*	9.51**

NS=Non-significant, *Significant. **Highly significant.

Table 2. Genetic parameters for various quantitative traits in mungbean.

Character		PV	PCV	GV	GCV	Hb(5)	G.A.
Plant height	1	1.07	1.89	0.14	0.68	13.10	29.91
	2	0.80	1.67	0.26	0.94	31.70	58.70
	3	0.10	0.98	0.03	0.25	6.40	8.41
Primary branches	1	0.27	21.22	0.09	12.34	33.80	69.53
	2	0.27	21.22	0.02	5.52	0.07	14.00
	3	0.27	20.67	0.09	12.01	33.80	36.15
Clusters/plant	1	0.59	9.40	0.20	5.42	33.30	68.65
	2	0.27	6.11	0.05	2.68	19.20	39.51
	3	0.59	6.04	0.09	2.40	15.70	24.87
Pods/plant	1	0.99	6.42	0.07	1.72	7.10	14.42
	2	2.26	6.21	1.80	5.53	79.40	60.59
	3	8.17	10.07	7.42	9.60	90.80	48.42
Pod length	1	0.27	6.17	0.02	1.44	5.50	5.88
	2	0.24	5.84	0.04	2.53	18.70	18.91
	3	0.14	4.65	0.03	1.97	18.00	56.90
100-seed weight (g)	1	0.27	7.72	0.06	3.50	20.60	22.02
	2	0.44	8.17	0.22	5.78	50.10	68.52
	3	0.17	5.92	0.03	2.62	19.60	16.63
Seed yield (g)	1	2.21	13.84	1.51	11.4	68.40	19.47
	2	0.33	6.60	0.13	4.17	39.90	47.21
	3	3.67	16.30	2.71	14.01	73.90	87.60

1:Genetic parameters in VC1560D, 2=Genetic parameters in VC2307A, 3=Genetic parameters in VC2565. PV=Phenotypic variance, GV=Genotypic variance, Hb=Heritability Broad Sense, PCV=Phenotypic coefficient of variability, GCV=Genotypic Coefficient of variability, GA=Genetic Advance.

The results are in accordance with findings of Venkateswarlu (15) who reported high heritability for seed yield. Highest heritability value (79.40%) was observed for pods per plant; while moderate heritability values were observed for 100-seed weight (50.1%) and seed yield (39.90) in population of VC2307A. The highest genetic advance (68.5) coupled with moderate heritability was observed for 100-seed weight. Hundred seed weight was controlled mainly by additive genes. High heritability (73.90%) coupled with highest genetic advance (87.60) was also observed for seed yield in VC2565. It means that seed yield was mainly controlled by additive type of gene action. The results confirm the findings of Ram and Singh (8) who reported high heritability for pod length and seed yield in cowpea.

Correlation among traits may result from physiological association among the characters. From breeder's point of view, type of association of seed yield with agronomic characters is of paramount importance. In M_4 population of VC1560D and VC2307A seed yield was negatively correlated with plant height at the genotypic level. Plant height has positive and highly significant correlation (0.99) with seed yield in the population of VC2565 (Table 3). Similar results have earlier been reported (16). The difference in association of seed yield with plant height was due to different genetic material. Seed yield per plant had positive but non-significant correlation with number of primary branches in the population of all accessions. Mahto and Mahto (7) report similar findings. Clusters per plant were positively correlated with seed yield per plant at the genotypic level in population of VC1560D and VC2307A.

In M_4 generation of VC2565, seed yield had positive and significant correlation (0.70) with number of clusters per plant. The results agree to the findings of Tamilselvam and Das (14).

Pods per plant had negative correlation with seed yield in M_4 generation of VC2307A, but positive correlation with seed yield in VC 1560D (0.89) and VC 2565 (0.25). Seed yield per plant was positively and significantly correlated with pod length at the genotypic level in VC 1560D (0.36), VC 2307A (0.38) and VC265 (0.39) . Venkateswarlu (15) also reported positive and significant association of pod length with seed yield.

Hundred seed weight was positively and highly significantly correlated (0.33) with seed yield in VC1560D while negative correlation between such two attributes was observed in other two accessions. The difference in correlation pattern was due to varied genetic material.

The direct effect of plant height on seed yield per plant was positive in M_4 populations of VC2307A and VC2565. Negative direct effect of plant height was observed in case of VC1560D. Negative indirect effect of plant height was observed in all the traits except primary branches, and 100-seed weight in case of VC1560D. (Table4). In VC2307A, indirect effect was also negative for all the traits except primary branches and pod length. Plant height affected positively and indirectly all the traits except clusters per plant, but had no indirect effect on pod length.

Primary branches had positive direct effect on seed yield in M_4 generation of VC1560D and VC2307A. The results are in accordance with the earlier

Table 3. Genotypic correlation co-efficient in M4 generation of different AVRDC accessions.

Characters		Plant height	Primary branches	Clusters/ plant	Pods/ plant	Pod length	100-seed weight
Plant height (cm)	1						
	2						
	3						
Primary branches	1	0.60					
	2	0.51					
	3	-0.91**					
Clusters/plant	1	0.14	-0.22				
	2	-0.96**	0.06**				
	3	-0.68*	0.44*				
Pods/plant	1	-0.99**	-0.80**	0.99**			
	2	0.66*	0.30*	-0.25*			
	3	0.69*	-0.46*	-0.30*			
Pod length (cm)	1	-0.69*	0.90**	0.55**	0.89**		
	2	0.07	-0.77**	0.46**	0.42**		
	3	0.00	-0.90**	-0.60**	0.57**		
100-Seed weight (g)	1	-0.098**	0.39**	0.49**	-0.40**	0.96**	
	2	0.16	0.94**	0.16**	0.43**	0.31	
	3	-0.23	0.06	0.07	0.62	-0.01	
Seed yield (g)	1	-0.07	0.54	0.10	0.89**	0.36**	0.33**
	2	-0.94**	-0.74*	-0.02*	-0.44*	0.16	0.11
	3	0.99**	0.69*	0.49*	0.25*	-0.06	-0.06*

1:Genotypic correlation co-efficient in VC 1560D, 2:Genotypic correlation co-efficient in VC2307A, 3:Genotypic correlation co-efficient in VC 2565.

findings (5). Negative direct effect was observed in case of VC2565 (Table 4). In population of VC1560D, indirect effects of primary branches were negative through all the traits except clusters per plant and pod length. In case of VC2307A indirect effects were also negative for all the traits except plant height and clusters per plant. Positive indirect effects of primary branches on seed yield were observed through all the traits except plant height and pods per plant.

Table 4. Direct and indirect effects of different traits in mungbean.

Characters		Plant height	Primary branches	Clusters/ plant	Pods/ plant	Pod length	100-seed weight
Plant height	1	-0.22	0.04	-0.09	-0.55	-0.63	1.38
	2	69.69	10.72	-60.00	-15.57	0.59	-6.38
	3	0.19	0.21	-0.60	0.96	0.00	0.23
Primary branches	1	-0.13	0.07	0.15	-0.45	1.27	-0.36
	2	35.64	20.97	3.72	-7.17	-6.58	-47.30
	3	-0.17	-0.23	-0.39	-0.65	0.79	0.21
Clusters/plant	1	-0.03	-0.02	-0.67	0.77	0.50	-0.46
	2	-67.25	1.25	62.18	6.07	3.93	-6.14
	3	-0.13	-0.10	*-0.89*	-0.42	0.53	-0.07
Pods/plant	1	0.22	-0.06	-0.92	0.56	1.72	0.37
	2	46.07	6.39	-15.85	-23.55	3.56	-17.06
	3	0.13	-0.11	-0.27	1.40	-0.50	-0.61
Pod length	1	0.15	0.10	-0.36	1.05	0.91	-1.49
	2	4.87	-16.24	28.78	-9.88	8.49	-15.64
	3	0.00	-0.21	-0.54	0.80	-0.88	0.01
100-Seed weight	1	0.33	0.03	-0.33	-0.22	1.45	-0.93
	2	11.29	25.19	9.70	-10.20	3.37	-39.38
	3	-0.04	-0.05	-0.06	0.86	9.10	-1.00

1:Genotypic correlation co-efficient in VC1560D, 2:Genotypic correlation co-efficient in VC2307A, 3:Genotypic correlation co-efficient in VC 2565.

Clusters per plant had positive direct effects on seed yield per plant in the populations of VC2307A and VC2565 but it was negative in case of VC1560D. Clusters per plant affected seed yield positively and indirectly through pods per plant and pod length in VC1560D. In case of VC2307A clusters per plant affected positively through all the traits except plant height and 100-seed weight (Table 4). Positive indirect effect was observed only through pod length in M_4 generation of VC2565. Pods per plant had positive direct effects on seed yield per plant in all the populations. Indirect effects were positive through plant height, pod length and 100-seed weight and were negative through primary branches and number of clusters per plant in VC1560D. In VC2307A positive indirect effects of pods per plant were observed through plant height, primary branches and pod length and were negative via clusters per plant and 100-seed weight. Indirect effects of pods per plant were negative through all the traits except plant height and primary branches in case of VC2565.

Pod length had positive direct effect in accessions VC1560D and VC2307A. The results are in accordance with the earlier findings (6). Positive indirect effect of pod length was observed through all the traits except number of clusters and 100-seed weight in VC1560D. In the population of VC2307A pod length affected negatively through all the traits except plant height and clusters per plant. Pod length affected positively and indirect through all the traits except clusters per plant.

Hundred seed weight had negative direct effect on seed yield in all the populations. Indirect effects were positive through all the traits except clusters and pods per plant in case of VC1560D. in M_4 generation of VC2307A 100-seed weight had positive indirect effect through all the traits except pods per plant. Positive indirect effects of 100-seed weight were also observed through all the traits except plant height in case of VC2565.

It is concluded that plant height, pods per plant and pod length can also be used as selection indices to improve seed yield in mungbean for evolving high yielding genotypes.

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