

Original Research Article

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Studies on Genetic Variability, Association and Path Coefficient Analysis in Black Gram (*Vigna mungo* L. Hepper)

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ABSTRACT

Keywords

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One hundred and sixty two F_2 plants of the cross IC 436656 x KKB 14045 was phenotyped for nine quantitative characters. High PCV and GCV were observed for number of primary branches, number of clusters per plant, number of pods per plant and single plant yield. High heritability coupled with high genetic advance was registered for the traits viz., days to 50% flowering, number of clusters per plant, hundred seed weight, pod length and single plant yield suggesting the additive gene action. The trait single plant yield was significantly and positively associated with plant height, number of primary branches, number of cluster per plant, number of pods per plant, number of seeds per pod, pod length and hundred seed weight. Path analysis revealed that number of pods per plant was main component for improving the single plant yield. Hence selection of these traits would improve yield in black gram breeding programs.

Introduction

Black gram (*Vigna mungo* L. Hepper, $2n=22$) is an important self-pollinated and short duration legume crop belonging to the family Leguminosae and sub-family *Papilionaceae*. India is the center of origin of black gram (Mehra *et al.*, 2016) and black gram is cultivated as a sole crop or succeeding crop using residual moisture of preceding crop, normally cultivated after harvest of rice. India produces 1.5 to 1.9 million tons of black gram annually from about 3.5 million hectares of area, and an average productivity of 500 kg per hectare (Sakila *et al.*, 2018). Black gram

seeds are rich in protein (25-26 %), carbohydrate (60%), fat (1.5%), minerals, amino acids and vitamins (Parveen *et al.*, 2011). Dried black gram seeds contain high protein and lysine content which is deficient in cereals.

Generally pulses are poor yielder due to the cultivation in marginally poor soils and rainfed conditions, narrow genetic diversity, photoperiod sensitivity, indeterminate growth habit, pod shattering and susceptible to pest and diseases (Fernandez and Shanmugasundaram, 1988; Sowmini and Jayamani, 2013). The achievement of high

yield mainly depends on the magnitude of yield contributing traits and nature of genetic variability (Johnson and Bernard, 1962). The magnitude of genetic variability is the base material for the development of new varieties (Venkatesan *et al.*, 2005).

The correlation coefficient gives a measure of the mutual relationship between various plant characters and determines component characters on which selection is practiced for the improvement of economic important character (Hemalatha *et al.*, 2017). The interrelationship between seed yield and plant characters are very important for making effective and viable breeding programmes for seed yield, for which direct selection is not much effective (Mathivathana *et al.*, 2015). Path coefficient analysis is an efficient statistical technique to assess the interrelationship of different components and direct and indirect effects on seed yield (Reni *et al.*, 2013). Hence, the present study focused on genetic variability, association and path coefficient analysis for efficient selection in black-gram breeding programs.

Materials and Methods

The experimental material consisted of 162 F₂ plants derived from the cross IC 436656 x KKB 14045. The field experiment was conducted at Department of Plant Breeding and Genetics at Agricultural college and Research Institute, Killikulam during 2018-2019. Biometrical traits *viz.*, plant height (cm), days to fifty percent flowering, number of primary branches per plant, number of clusters per plant, number of pods per plant, number of seeds per pod, pod length (cm), hundred seed weight (g) and single plant yield (g) were recorded. The pedigree details of the parents are given below.

All the 162 F₂ plants were raised along with parents in 3 meter row with spacing of 30 x

10 cm and proper agronomic practices were followed. The statistical methods suggested by Johnson *et al.*, (1955) for various genetic variability parameters *viz.*, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance as percentage of mean (GAM) were carried out. Genotypic correlation coefficient was worked out using the formulae given by Al-Jibouri *et al.*, (1958) and path coefficient analysis was calculated using the formulae given by Dewey and Lu (1959). TNAU STAT software was used for analysis of correlation and path coefficient analysis (Manivannan, 2014). The R software was used for preparing correlation chart (R Core Team, 2019). The direct and indirect effects were classified based on scale (Lenka and Mishra, 1973).

Results and Discussion

Studies on variability parameters

The genetic variability parameters for different plant characters were calculated and presented in Table 1. High PCV and GCV was observed for the traits *viz.*, number of primary branches per plant (33.26% and 21.87% respectively), number of clusters per plant (53.54 and 42.19% respectively), number of pods per plant (40.09 and 30.73% respectively) and single plant yield (62.10 and 53.30% respectively). These suggested the presence of high genetic variability present in the population and selection is effective for these traits. Soheli *et al.*, (2016) reported similar results of high PCV and GCV for number of primary branches per plant and Sushmitharaj *et al.*, (2018) for the traits *viz.*, number of clusters per plant, number of pods per plant and single plant yield.

The plant characters *viz.*, days to 50 % flowering, number of seeds per pod, hundred seed weight and pod length expressed

moderate level of PCV and GCV values. Similar results were reported by Kumar *et al.*, (2015) for days to 50 % flowering, Manjumder *et al.*, (2011) for number of seeds per pod and Panigrahi *et al.*, (2014) for hundred seed weight. The trait plant height showed high PCV but low GCV and similar finding was reported by Konda *et al.*, (2008) and it indicated that the variability present in plant height was highly influenced by environmental factors.

High heritability was recorded for the traits

viz., hundred seed weight (98.36%), days to 50% flowering (95.51%), pod length (89.60%), single plant yield (73.67%) and number of clusters per plant (62.11%). High GAM was recorded for traits single plant yield (94.24%), number of clusters per plant (68.50%), number of pods per plant (48.53%), hundred seed weight (37.55%), number of primary branches per plant (30.54%), pod length (23.35%) and days to 50% flowering (21.81%) on the basis of mean performance. Therefore for improving these traits simple selection would be more effective.

The pedigree details of the parents are given below

SI. No	Parents	Pedigree details	Source
1.	IC 436656	Land race	National Bureau of Plant Genetic Resources, New Delhi
2.	KKB 14045	PU-0620 x ADT-3	Agricultural College and Research Institute, Killikulam

Table.1 Variability parameters in F₂ derivatives of the cross IC 436656 x KKB 14045

Characters	PCV (%)	GCV (%)	(h ²) (%)	GAM (%)
Days to 50% flowering	11.09	10.84	95.51	21.81
Plant height	20.81	4.36	4.38	1.88
Number of primary branches/plant	32.26	21.87	45.95	30.54
Number of clusters /plant	53.54	42.19	62.11	68.50
Number of pods/plant	40.09	30.73	58.76	48.53
Number of seeds/pod	18.66	12.94	48.10	18.49
Hundred seed weight	18.53	18.38	98.36	37.55
Pod length	12.65	11.98	89.60	23.35
Single plant yield	62.10	53.30	73.67	94.24

Table.2 Correlation coefficients among yield components in F₂ derivatives of the cross IC 436656 x KKB 14045

Characters	Days to 50 % flowering	Plant height	Number of primary branches/plant	Number of clusters/plant	Number of pods/plant	Number of seeds/pod	Hundred seed weight	Pod length	Single Plant yield
Days to 50 % flowering	1.000								
Plant height	0.061	1.000							
Number of primary branches/plant	-0.131	0.439**	1.000						
Number of clusters/plant	-0.127	0.612**	0.671**	1.000					
Number of pods/plant	-0.135	0.658**	0.523**	0.868**	1.000				
Number of seeds/pod	-0.283**	0.274**	0.222*	0.338**	0.296**	1.000			
Hundred seed weight	0.001	0.333**	0.215*	0.181*	0.148	0.282**	1.000		
Pod length	-0.108	0.298**	0.232**	0.243**	0.203*	0.671**	0.465**	1.000	
Single Plant yield	-0.169*	0.649**	0.441**	0.779**	0.852**	0.524**	0.387**	0.410**	1.000

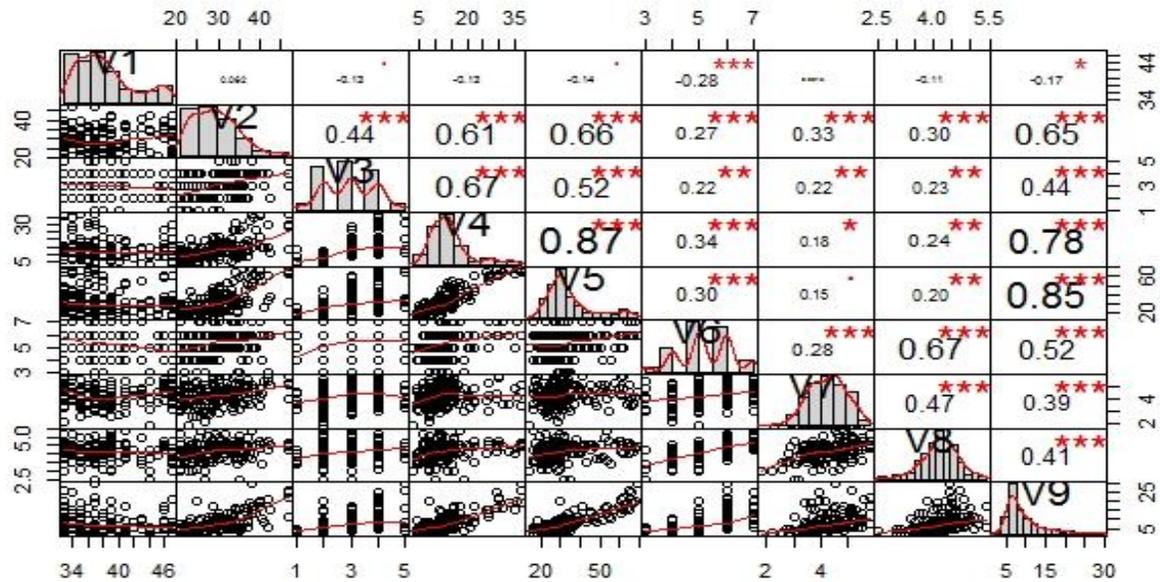
** Significant at 1% level; * Significant at 5% level

Table.3 Direct and indirect effects of different traits on yield in F₂ derivatives of the cross IC 436656 x KKB 14045

Characters	Days to 50 % flowering	Plant height (cm)	Number of primary branches/plant	Number of clusters/plant	Number of pods/plant	Number of seeds/pod	Hundred seed weight (g)	Pod length (cm)	Single plant yield (g)
Days to 50 % flowering	-0.0147	0.0031	0.0149	-0.0164	-0.0904	-0.0658	0.0003	-0.0001	-0.1690
Plant height (cm)	-0.0009	0.0507	-0.0498	0.0784	0.4379	0.0637	0.0689	0.0002	0.6491
Number of primary branches/plant	0.0019	0.0223	-0.1133	0.0859	0.3484	0.0517	0.0445	0.0002	0.4416
Number of cluster /plant	0.0019	0.0311	-0.0761	0.1279	0.5780	0.0786	0.0375	0.0002	0.7791
Number of pods / plant	0.0020	0.0334	-0.0593	0.1111	0.6654	0.0689	0.0308	0.0001	0.8523
Number of seeds /pod	0.0042	0.0139	-0.0252	0.0433	0.1971	0.2325	0.0583	0.0005	0.5245
Hundred seed weight (g)	-0.0000	0.0169	-0.0244	0.0232	0.0990	0.0656	0.2068	0.0003	0.3874
Pod length (cm)	0.0016	0.0151	-0.0263	0.0311	0.1353	0.1561	0.0963	0.0007	0.4100

Residual effect: 0.38

Fig.1 Chart of correlation matrix between different traits in F₂ derivatives of the cross IC 436656 X KKB 14045



(Note: V1-Days to 50% flowering, V2-Plant height, V3-Number of primary branches, V4-Number of cluster per plant, V5-Number of pods per plant, V6-Number of seeds per pod, V7-Hundred seed weight, V8-Pod length, V9-Single plant yield).

High heritability coupled with high GAM was registered for days to 50% flowering, number of clusters per plant, hundred seed weight, pod length and single plant yield suggesting additive gene action for the genetic control of these traits. Konda *et al.*, (2008) reported similar finding for days to 50 % flowering; Sushmitharaj *et al.*, (2018) for number of clusters per plant and single plant yield; Usharani and Kumar (2015) for hundred seed weight and Veeramani *et al.*, (2005) for pod length.

Studies on association between traits

The correlation between the traits is presented in Table 2 and Figure 1. The trait single plant yield had significant and positive association with plant height (0.649), number of primary branches per plant (0.441), number of clusters per plant (0.779), number of pods per plant (0.852), number of seeds per pod (0.524), pod length (0.387) and hundred seed weight (0.410) and also significant and negative

association with days to 50 % flowering. These traits could be targeted for improvement of single plant yield. Similar significant and positive association was reported by Sushmitharaj *et al.*, (2018) for plant height, number of clusters per plant and number of pods per plant; Keerthiga *et al.*, (2018) for number of primary branches per plant, number of seeds per pod and hundred seed weight and Rami Reddy *et al.*, (2011) for pod length.

From inter correlation studies, days to 50 % flowering was significant and negative association with number of seeds per pod and single plant yield. Plant height had significant and positive association with number of primary branches per plant, number of clusters per plant, number of pods per plant, number of seeds per pod, hundred seed weight, pod length and single plant yield. Number of primary branches showed positive and significant association with number of clusters per plant, number of pods per plant,

number of seeds per pod, hundred seed weight, pod length and single plant yield. Number of clusters per plant showed positive and significant association with number of pods per plant, number of seeds per pod, hundred seed weight, pod length and single plant yield. Number of pods per plant exhibited positive and significant association with number of seeds per pod, pod length and single plant yield. Number of seeds per pod showed positive and significant association with hundred seed weight, pod length and single plant yield. Hundred seed weight expressed positive and significant association with pod length and single plant yield. Pod length exhibited positive and significant association with and single plant yield. Hence selection of these traits would improve the plant yield in black gram.

Studies on path coefficient analysis

The results on path coefficient analysis are presented in Table 3. The trait number of pods per plant showed high, positive and direct effect on single plant yield. Sathya *et al.*, (2018) reported a similar result. Number of seeds per pod showed moderate, positive and direct effect on single plant yield. Plant height and pod length showed very low, positive and direct effect on single plant yield. Number of primary branches showed low, negative and direct effect on single plant yield. Days to 50 % flowering showed very low, negative and direct effect on single plant yield.

Similar results were carried out by Parveen *et al.*, (2011). Number of clusters per plant, plant height and number of primary branches showed high, positive and indirect effect on single plant yield through number of pods per plant. Number of seeds per pod and pod length showed low, positive and indirect effect on single plant yield through number of pods per plant.

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