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GENETIC DIVERGENCE, CORRELATION AND PATH ANALYSIS IN BLACK GRAM [*VIGNA MUNGO* (L.) HEPPER]

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Abstract

The nature and magnitude of genetic divergence in 35 black genotype for nine characters were assessed using Mahalanobis D^2 statistics. The mean for seed yield per plant was higher in the genotypes HG 157 (14.53g), LBG 623 (14.39) and VBG 5 (14.16g). The genotypes grouped into seven clusters. Cluster VI was the largest containing 13 genotypes followed by cluster V with six genotypes. Composition of clusters indicated non existence of correspondence between genetic diversity and geographical distribution. Seed yield per plant, number of clusters per plant and number of pods per plant were the major characters contributing towards genetic divergence. Cluster III (D= 32.74) is the most divergent followed by cluster V (D=29.62). This study was utilized for selection of divergent genotypes for further crop improvement programme. It is suggested that varietal improvement programme through the hybridization among the genotypes of divergent clusters should be done rather than depending on less divergent clusters. Seed yield per plant had significant positive relationship with number of pods per plant at phenotypic and genotypic levels. It evinced significant positive phenotypic and genotypic association with number of pods per cluster. It also showed positive significant association with number of clusters per plant at genotypic level. Path analysis revealed the importance of number of pods per plant and number of pods per cluster in the seed yield enhancement in black gram. Moreover, many characters exerted their positive direct effect towards seed yield per plant through number of pods per cluster. The magnitude of genotypic correlations was more than that of phenotypic correlation for all the traits.

Key words : D^2 analysis, correlation, path analysis, black gram.

Introduction

Genetic improvement mainly depends on the amount of genetic variability present in the population. In any crop, the germplasm serves as a valuable source of base population and provide scope for wide variability. Information on the nature and degree of divergence would help the plant breeder in choosing the right type of parents for future breeding programme to improve the both quantitative and qualitative characters. Importance of genetic diversity for selecting parents in combination breeding programme of different autogamous crop to recover transgressive segregates has been emphasized (Singh and Ramanujam, 1981; Cox and Murphy, 1990). Martin *et al*. (1981) observed that in the countries where okra culture is very old such as India, Iran and Turkey varietal groups showed a few or no distinguishing characters. Knowledge of correlation and causation among the yield and yield components is of paramount importance in any crop improvement programme through plant breeding. The present study also brings out the correlation among between nine yield and yield component characters and the causal basis of such relationship. However in this situation, correlation alone become insufficient to explain relationships among characters and thus, path analysis of economic yield components with yield is important. However, the information on such studies is meager to study the correlation and path analysis in black gram for high seed yield.

Materials and Methods

Thirty five black gram cultivars of diverse origin were

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Table 1 : Clustering pattern of 35 black gram genotypes on D^2 statistics.

Clusters	Number of genotypes	Name of the genotypes
I	3	COBG 662, ADT-5, RU 8703
II	5	LBG 623, VBG 5, T9, IC 10703, NIRMAL-7
III	4	IC 214843, IC 669, KKB 05016, ADT-3
IV	2	VBG 05-02, VBG 05-07
V	6	RU 8707, RU 8711, RU 8709, RU 8708, COBG 683, RU 8704
VI	13	RU 8706, RU 8701, TAU 1, VBG 4, VBN 3, LBG 752, COBG 653, TMV 1, RU 8702, VBG 05-008, COBG 647, KKB 20055
VII	2	HG 157, KKB 05001

Table 3 : Independent character contribution towards divergence in 9 characters of black gram genotypes.

Characters	Times ranked	Contribution (%)
Days to first flowering	0	0.01
Plant height (cm)	51	8.57
Number of branches per plant	0	0.01
Number of clusters per plant	71	11.93
Number of pods per cluster	14	2.34
Number of pods per plant	52	8.73
Number of seeds per pod	45	7.56
Hundred seed weight (g)	23	3.85
Seed yield per plant (g)	339	56.97
Total	595	100

Table 2 : Average intra and inter cluster D^2 and D values for 35 black gram genotypes.

Cluster	I	II	III	IV	V	VI	VII
I	**827.81(28.77)**	871.10 (29.51)	929.29 (30.48)	930.27 (30.50)	850.57 (29.165)	870.97 (29.51)	1286.60 (35.86)
II		**736.49(27.13)**	963.92 (31.04)	939.95 (30.65)	735.85 (27.12)	942.81 (30.70)	843.44 (29.04)
III			**1071.93(32.74)**	714.12 (26.72)	1172.24 (34.23)	835.43 (28.90)	1463.71 (38.25)
IV				**125.96(11.22)**	966.82 (31.09)	684.50 (26.16)	1811.18 (42.55)
V					**615.69(24.81)**	1104.83 (33.23)	1262.38 (35.53)
VI						**877.85(29.62)**	1515.89 (38.93)
VII							**803.69(28.35)**

Table 4 : Cluster mean for different characters of 35 black gram genotypes.

Clusters	Characters								
	Days to first flowering	Plant height (cm)	Number of branches per plant	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Number of seeds per pod	Hundred seed weight (g)	Seed yield per plant (g)
I	32.86	38.42	2.77	11.66	3.18	26.00	5.88	4.94	9.18
II	33.47	39.50	4.57	10.35	2.67	34.08	5.05	5.14	11.64
III	33.54.	38.94	2.34	9.64	3.10	25.12	4.70	4.89	9.95
IV	31.51	53.09	3.05	8.77	3.36	31.00	4.16	4.80	9.41
V	34.15	48.96	2.35	12.60	3.13	35.57	4.88	4.85	11.29
VI	33.46	39.42	2.54	10.00	2.82	27.25	4.77	4.92	9.50
VII	34.24	29.42	2.92	8.41	2.84	33.20	6.37	5.10	13.05

grown in randomized block design with three replications following a spacing of 30 × 30 cm at Plant Breeding Farm, Department of Agricultural Botany, Faculty of Agriculture, Annamalai University during 2009. Need based plant protection measures were given. Observations on days to first flowering, plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, hundred seed weight and seed yield per plant were recorded on five random plants of each genotype per replication. The data were subjected to Mahalanobis (1936) D^2 statistics to measure genetic divergence as suggested by Rao (1952). The phenotypic and genotypic correlation coefficients and path analysis were also computed by using procedure given by Deway and Lu (1959).

Table 5 : Phenotypic (P) and Genotypic (G) correlation coefficient among yield and its components in black gram.

S. no.	Characters	Type of corre-lation	Days to first flowering	Plant height (cm)	Number of branches per plant	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Number of seeds per pod	Hundred seed weight (g)	Seed yield per plant (g)
1	Days to first flowering	P	1.000	0.041	0.045	0.140	0.100	0.001	0.090	0.015	0.181
		G	1.000	0.052	-0.219	0.186	0.189	0.007	0.107	0.054	0.246
2	Plant height	P		1.000	-0.045	0.306	0.288	0.082	-0.181	-0.107	0.018
		G		1.000	-0.151	0.309	0.299	0.082	-0.184	-0.116	0.016
3	Number of branches per plant	P			1.000	0.111	0.044	0.019	-0.003	0.050	-0.057
		G			1.000	0.380*	0.267	-0.021	-0.057	-0.017	-0.231
4	Number of clusters per plant	P				1.000	0.170	0.235	-0.025	-0.028	0.125
		G				1.000	0.179	0.239	-0.023	-0.026	0.126
5	Number of pods per cluster	P					1.000	-0.128	0.128	-0.209	-0.252
		G					1.000	-0.135	0.141	-0.227	-0.261
6	Number of pods per plant	P						1.000	0.019	0.005	0.684**
		G						1.000	0.025	-0.001	0.689**
7	Number of seeds per pod	P							1.000	0.161	0.209
		G							1.000	0.168	0.215
8	Hundred seed weight	P								1.000	0.106
		G								1.000	0.123
9	Seed yield per plant	P									1.000
		G									1.000

Results and Discussion

The analysis of variance revealed significant differences among the genotype for all the characters except number of pods per cluster, number of seeds per pod and hundred seed weight indicating existence of variability among the characters studied. The mean for seed yield per plant was higher in the genotypes HG 157 (14.35 g) followed by VBG 623 (14.38 g) and VBG 5 (14.167 g). Fifteen genotypes recorded higher seed yield per plant than general mean (10.34 g). Based on the relative magnitude of D^2 values, 35 genotypes were grouped into seven clusters (table 1). The maximum number of genotypes (13) was included in cluster VI followed by cluster V with six genotypes. The genotype fell in one cluster indicating over all genetic similarity among them, similar findings were made by Lal *et al.* (2005). Cluster II contains five genotypes, cluster 3 contains four genotypes, cluster I contains three genotypes and cluster IV, VII contains two genotypes each. Composition of clusters indicated non existence of correspondence between genetic diversity and geographical distribution.

The estimates of intra and inter cluster D^2 and D values have presented in table 2. The intra cluster distance ranged from 11.22 for cluster IV to 32.74 for cluster III. The inter cluster distance was observed to be the highest between cluster IV and cluster VII (D=42.558), indicating that genotypes of these two clusters were genetically more diverse. The minimum diversity was observed between cluster IV and cluster VI (D=26.16). The greater the distance between two clusters wider is the genetic diversity among the parents, to be included in hybridization programme.

Among the different characters, the seed yield per plant (56.97%) contributed maximum towards genetic divergence followed by number of clusters per plant (11.93%) and number of pods per plant as shown in table 3. The other characters contributed comparatively lest towards genetic divergence. The cluster mean for various traits (table 4) revealed that genotypes included in cluster IV were early flowing types (31.51) followed by cluster VI (33.46) and clutter II (33.47). Cluster VII recorded lowest mean for plant height (29.43 cm), maximum number of seeds per plant (6.37) and seed yield per plant (13.05 g). Cluster II recorded (13.05g) highest number of branches per plant (4.57) and hundred seed weight (5.14 g). Cluster V recorded highest number of clusters per plant (12.60), number of pods per plant (35.57). Cluster IV recorded highest number of pods per cluster.

Cluster V comprises of six genotypes. Among six

Table 6 : Direct and indirect effects of various characters on pod yield per plant as partition by path analysis.

S. no.	Characters	Days to first flowering	Plant height	Number of branches per plant	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Number of seeds per pod	Hundred seed weight	Genotypic correlation with yield
1	Days to first flowering	0.246	0.002	0.016	-0.002	-0.044	0.004	0.022	0.001	0.246
2	Plant height	0.012	0.056	0.011	-0.004	-0.071	0.053	-0.038	-0.003	0.016
3	Number of branches per plant	-0.054	-0.008	-0.073	-0.005	-0.063	-0.013	-0.011	-0.000	-0.231
4	Number of clusters per plant	0.045	0.017	-0.027	-0.015	-0.042	0.154	-0.004	-0.000	0.126
5	Number of pods per cluster	0.046	0.016	-0.019	-0.002	-0.238	-0.087	0.029	-0.005	-0.261
6	Number of pods per plant	0.001	0.004	0.001	-0.003	0.032	0.647	0.005	-0.000	0.689
7	Number of seeds per pod	0.026	-0.010	0.004	0.001	-0.033	0.016	0.207	0.004	0.215
8	Hundred seed weight	0.013	-0.006	0.001	0.001	0.054	-0.000	0.034	0.026	0.123

Residual effect = 0.6056245

genotypes, five genotypes, *viz*., RU 8707 (12.32 g), RU 8711 (11.41 g), RU 8709 (12.03 g), COBG 683 (10.83 g) and RU 8704 (10.79 g) showed higher mean. Similarly Cluster VI comprises of 13 genotypes. Among 13, four genotypes viz., RU 8701 (12.01 g), VBG 4 (11.85 g), COBG 653 (11.08 g) and VBG 05.014 (12.84 g) which recorded higher seed yield per plant than general mean compared with CD value. The cluster II comprised of five genotypes. Among 5, two genotypes *viz*., LBG 623 (14.39 g) and VBG (14.16 g) and cluster III comprised of four genotypes, in which two genotypes namely IC 669 (11.38 g) and ADT-3 (11.439 g) recorded higher mean value. Similarly cluster VII contained of two genotypes *viz*., HG 157 (14.53 g) and KKB 05001 (11.57 g), which also recorded higher mean value than general man when compared with CD value (10.63 g). Above mentioned 15 genotypes fell in five difference clusters. The genotypes with higher mean value on different cluster can either straight away be used for adoption or can be used in hybridization programme for yield improvement. The hybrids developed from the selected genotypes of these cluster may produce desirable transgressive segregates that would be productive in black gram breeding programme. Similar studies also made by Elangaimannan (2008) and Konda *et al*. (2007).

The estimates of phenotypic and genotypic correlation coefficient (table 5) depicted that genotypic correlation were higher than phenotypic correlations for all the character combinations, establishing predominant role of heritable factors. The study revealed that the seed yield per plant had high significant positive association with number of pods per plant at phenotypic (0.689) and genotypic (0.684) levels (table 6). It was noted that number of branches per plant is positively correlated with number of clusters per plant at genotypic level. These results are in conformity with Manikannan (2000).

Path coefficient analysis (table 6) revealed that number of pods per plant (0.647) exerted it high positive direct effect towards seed yield per plant followed by days to first flowering (0.246) and number of seeds per pod (0.207). Similarly, number of clusters per plant (0.154) exhibit moderate positive indirect effect towards seed yield seed yield per plant through number of pods per plant. The characters like plant height (0.071), number of branches per plant (0.063) and hundred seed weight (0.054) exerted its negligible positive indirect effects towards seed yield per plant through number of pods per cluster. Similar reports were made carter by Konda *et al*. (2008). The study amply indicated that seed yield is influenced by number of pods per plant and number of pods per cluster. They may be declared as choice of characters for yield improvement programme in black gram through plant breeding.

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