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STUDIES ON GENETIC VARIABILITY, CORRELATION AND PATH ANALYSIS IN BLACK GRAM (*VIGNA MUNGO* L. HEPPER)

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Abstract

An experiment was carried out with 21 black gram genotypes grown in *Kharif* season 2018-19 following randomized block design with three replication at Barani Jaivik Krishi Anusandhan Prachetra, Narayanbag, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.). The observations recorded on 14 quantitative characters *viz,* days to 50% germination, days to 50% flowering, days to 50% maturity, plant height (cm), number of primary branches, number clusters per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, pod length (cm), seed yield per plant (g), 100 seed weight (g), biological yield per plant (g) and harvest index (%). The data recorded on these characters were utilized for simple correlation coefficient and path coefficient. A very strong positive association of seed yield per plant observed with number of pods per plant, biological yield per plant and harvest index.

The characters showed highly significant positive correlation among yield and its components suggested that selection would be highly effective and efficient in improving these traits while number of primary branches and days to 50% maturity showed negative correlation with seed yield. The path analysis identified harvest index, number of cluster per plant followed by number of pod per plant as the direct positive contributors towards seed yield. The results of path coefficient analysis of yield and its components revealed that biological yield per plant, harvest index, plant height, days to 50% maturity, number of primary branches per plant, number of cluster per plant, number of pods per cluster, number of seeds per pod, days to 50% flowering, days to 50% germination and pod length were the most important characters of black gram contributing towards seed yield per plant.

Key words: *yield, length, cluster, branches etc.*

Introduction

Black gram generally known as urd bean , is an important self-pollinated crop and belong to the family Fabaceae and sub family Papilionaceae. Black gram is extensively used as a nutritious pulse. India is the largest producer of pulses in the world, accounting for about 25% global share. Black gram is the fourth important pulse crop in India which holds about 12 % of the total pulse area and contributing about 10% to the total pulse production. Its cultivation is spread over three different seasons namely the rainy seasons (kharif), dry (rabi), and summer (zaid). Black gram is one of the most important pulse crops of rainfed areas, grown throughout the country. Urd bean production in the country is largely concentrated in five states *viz,* Uttar Pradesh (UP), Andhra Pradesh, Maharashtra, Madhya Pradesh and Tamil Nadu. These five states together contribute for about 65% of total urd production in the country. U.P. and Andhra Pradesh occupy the first two positions, contributing over 40%. Maharashtra contributes about 14% respectively of total production in the country. Black gram is a highly priced pulse, rich in protein (24%), carbohydrates (56%), fat (2%), minerals (4%), Vitamins (0.4%) and phosphoric acid.

Correlation coefficient studies provide an opportunity to study the magnitude and direction of association of yield with its components and also among various components (Bharti, *et al.,* 2013 and Divya Vyas, *et al.,* 2018). Path coefficient analysis is an efficient statistical technique specially designed to quantify the interrelationship of different components and their direct and indirect effects on seed yield (Sushmitharaj, *et al.,* 2018). Lack of stable varieties giving higher yield, because of technological stagnations is the major bottleneck for growing of this crop to serve as a commercial crop. The plant type should be determinate, photo insensitive, early maturing with high harvest index and should have

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reasonable seed yield. The present study was undertaken to estimate association between yield contributing characters along with path analysis for developing suitable selection criterion for black gram improvement. Knowledge of inter-relationships existing among yield components is essential when selection for improvement is to be effective. Path analysis identifies the yield components which directly and indirectly influence the yield. Hence, the present research work was carried out to study the correlation coefficients and path coefficients in order to formulate selection criteria for evolving high yielding genotypes of black gram.

Materials and Methods

The experimental materials consisted of 21 black gram genotypes obtained from NBPGR, New Delhi, raised in Randomized Block Design with three replications at the Barani Jaivik Krishi Anusandhan Prachetra, Narayanbag, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.), during *Kharif* season 2018-19. The genotypes were raised following spacing of 20 X 10 cm and other recommended cultural practices. Observations were recorded on five randomly selected plants from each replication for fourteen quantitative traits *viz.,* days to 50% germination, days to 50% flowering, days to 50% maturity, plant height (cm), number of primary branches, number clusters per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, pod length (cm), seed yield per plant (g), 100 seed weight (g), biological yield per plant (g) and harvest index (%).The genetic association among the traits was estimated according to the formulae described by Johnson *et al*., (1955). The path coefficient analysis was done according to (Miller *et al.,* 1958 and Dewey and Lu, 1959) for assessing the direct and indirect effects of each trait on grain yield.

Results and Discussion

The estimates of genotypic and phenotypic correlation coefficients among yield and yield attributing traits are presented in table 1 and 2. The results showed that the value of genotypic correlation coefficient were higher than that of phenotypic correlation coefficient. The interrelationships were, therefore, strongly inherent and low phenotypic expression were due to environmental factors. Genotypic and phenotypic correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant correlation with pods per plant (0.609), harvest index (0.535), biological yield per plant (0.524), number of pod per cluster (0.421) and clusters per plant (0.398). Similar kind of positively significant association of all five characters are reported earlier by

Table 1: Estimates of genotypic correlation coefficient among yield and its contributing characters in black gram.

Characters	Days to 50% germination	Days to 50% flowering	Days to 50% maturity	Plant height cm	No. of primary branch	No. of cluster /plant	No. of pod/ cluster	No. of pod/ plant	Pod length cm	Biological yield (g)	No. of seed/ plant	100 seed weight	Harvest index	seed yield /plant
Days to 50% germination	1.000	0.115	0.089	0.132	0.49	0.292	-0.389	-0.024	0.739	0.289	-0.062	0.454	-0.558	-0.324
Days to 50% flowering		1.000	0.857	0.625	-0.148	0.066	-0.386	-0.269	0.114	0.067	-0.484	-0.007	0.185	-0.050
Days to 50% maturity			1.000	0.562	-0.086	0.009	-0.444	-0.373	0.070	0.009	-0.538	-0.216	-0.092	-0.340
Plant height (cm)				1.000	0.000	0.434	-0.297	0.214	0.669	0.569	0.174	0.052	-0.265	0.247
No. of primary branches					1.000	0.020	-0.256	-0.074	0.631	-0.063	0.041	0.202	-0.274	-0.390
No. of cluster/plant						1.000	-0.545	0.766	0.298	0.496	-0.053	0.441	-0.002	0.398
No. of pod/cluster							1.000	0.155	-0.294	0.168	-0.261	-0.271	0.143	0.421
No. of pod/plant								1.000	0.128	0.623	-0.265	0.278	0.004	0.609
Pod length (cm)									1.000	0.308	0.129	0.698	-0.724	-0.369
Biological yield (g)										1.000	0.120	0.108	-0.330	0.524
No. of seed per plant											1.000	0.165	-0.317	0.154
100 seed weight												1.000	0.065	0.164
Harvest index													1.000	0.535
Seed yield/plant (g)														1.000

Table 2: Estimates of phenotypic correlation coefficient among yield and its contributing characters in black gram.

Characters	Days to 50% germination	Days to 50% flowering	Days to 50% maturity	Plant height (cm)	No. of primary branch	No. of cluster /plant	No. of pod/ cluster	No. of pod/ plant	Pod length (cm)	Biological yield (g)	No. of seed/ plant	100 seed weight (g)	Harvest index	seed yield /plant (g)
Days to 50% germination	1.000	0.114	0.036	0.053	0.217	0.155	-0.227	-0.064	0.341	0.261	-0.037	0.247	-0.450	-0.231
Days to 50% flowering		1.000	0.771	0.466	-0.053	0.108	-0.272	-0.199	-0.001	0.065	-0.250	-0.078	0.113	-0.055
Days to 50% maturity			1.000	0.382	-0.091	0.063	-0.351	-0.272	0.023	0.050	-0.264	-0.114	-0.109	-0.254
Plant height (cm)				1.000	-0.053	0.318	-0.225	0.210	0.255	0.519	0.110	0.044	-0.201	0.222
No. of primary branch					1.000	0.100	-0.172	0.008	0.198	-0.049	-0.116	0.143	-0.198	-0.342
No. of cluster/plant						1.000	-0.369	0.674	0.102	0.424	-0.012	0.242	-0.093	0.251
No. of pod/cluster							1.000	0.118	-0.144	0.139	-0.053	-0.215	0.133	0.280
No. of pod/plant								1.000	0.018	0.551	-0.069	0.133	0.014	0.499
Pod length (cm)									1.000	0.138	0.277	0.183	-0.367	-0.190
Biological yield (g)										1.000	0.037	0.050	-0.338	0.445
No. of seed per plant											1.000	0.085	-0.057	0.077
100 seed weight (g)												1.000	0.132	0.140
Harvest index													1.000	0.504
Seed yield/plant (g)														1.000

Table 3: Direct and indirect effect components traits on seed yield genotypes of blackgram in genotypic level.

Characters	Days to 50% germination	Days to 50% flowering	Days to 50% maturity	Plant height (cm)	No. of primary branch	No. of cluster /plant	No. of pod/ cluster	No. of pod/ plant	Pod length (cm)	Biological yield (g)	No. of seed/ plant	100 seed weight (g)	Harvest index
Days to 50% germination	0.278	-0.093	-0.013	0.082	-0.201	0.195	-0.173	0.016	0.284	0.140	0.005	-0.144	-0.699
Days to 50% flowering	0.032	-0.814	-0.123	0.387	0.061	0.044	-0.172	0.186	0.044	0.033	0.039	0.002	0.232
Days to 50% maturity	0.025	-0.698	-0.144	0.348	0.035	0.006	-0.198	0.257	0.027	0.004	0.043	0.069	-0.116
Plant height (cm)	0.037	-0.509	-0.081	0.620	0.000	0.289	-0.132	-0.147	0.257	0.276	-0.014	-0.017	-0.332
No. of primary branch	0.136	0.120	0.012	0.000	-0.411	0.013	-0.114	0.051	0.243	-0.030	-0.003	-0.064	-0.344
No. of cluster/plant	0.081	-0.054	-0.001	0.269	-0.008	0.666	-0.243	-0.528	0.115	0.241	0.004	-0.140	-0.003
No. of pod/cluster	-0.108	0.314	0.064	-0.184	0.105	-0.363	0.446	-0.107	-0.113	0.081	0.021	0.086	0.179
No. of pod/plant	-0.007	0.219	0.054	0.132	0.030	0.510	0.069	-0.690	0.049	0.302	0.021	-0.088	0.005
Pod length (cm)	0.205	-0.093	-0.010	0.414	-0.259	0.198	-0.131	-0.088	0.385	0.149	-0.010	-0.222	-0.908
Biological yield (g)	0.080	-0.055	-0.001	0.353	0.026	0.331	0.075	-0.430	0.118	0.485	-0.010	-0.034	-0.413
No. of seed per plant	-0.017	0.394	0.077	0.108	-0.017	-0.035	-0.116	0.183	0.050	0.058	-0.080	-0.052	-0.398
100 seed weight (g)	0.126	0.005	0.031	0.033	-0.083	0.294	-0.121	-0.192	0.269	0.053	-0.013	-0.318	0.081
Harvest index	-0.155	-0.150	0.013	-0.164	0.113	-0.002	0.064	-0.003	-0.279	0.160	0.025	-0.021	1.254

Residual Value = -0.0646

Table 4: Direct and indirect effect components traits on seed yield genotypes of black gram in phenotypic level.

Characters	Days to 50 % germi-nation	Days to 50% flow-ering	Days to 50% mat-urity	Plant height (cm)	No. of primary branch	No. of cluster /plant	No. of pod/ cluster	No. of pod/ plant	Pod length (cm)	Biolo-gical yield (g)	No. of seed/ plant	100 seed weight (g)	Harvest index
Days to 50% germination	-0.035	-0.007	-0.008	0.009	-0.043	0.010	-0.009	-0.002	-0.006	0.142	0.001	0.005	-0.287
Days to 50% flowering	-0.004	-0.064	-0.173	0.076	0.011	0.007	-0.011	-0.006	0.000	0.035	0.004	-0.002	0.072
Days to 50% maturity	-0.001	-0.049	-0.225	0.062	0.018	0.004	-0.014	-0.008	0.000	0.027	0.004	-0.002	-0.069
Plant height (cm)	-0.002	-0.030	-0.086	0.163	0.010	0.021	-0.009	0.006	-0.004	0.281	-0.002	0.001	-0.128
No. of primary branch	-0.008	0.003	0.020	-0.009	-0.198	0.007	-0.007	-0.000	-0.003	-0.027	0.002	0.003	-0.126.
No. of cluster/plant	-0.005	-0.007	-0.014	0.052	-0.020	0.065	-0.015	0.021	-0.002	0.230	0.000	0.005	-0.059
No. of pod/cluster	0.008	0.017	0.079	-0.037	0.034	-0.024	0.040	0.004	0.002	0.075	0.001	-0.005	0.085
No. of pod/plant	0.002	0.013	0.061	0.034	-0.002	0.044	0.005	0.031	0.000	0.299	0.0011	0.003	0.009
Pod length (cm)	-0.012	0.000	-0.005	0.042	-0.039	0.007	-0.006	0.001	-0.017	-0.075	-0.004	0.0044	-0.234
Biological yield (g)	-0.009	-0.004	-0.011	0.085	0.010	0.028	0.006	0.017	-0.002	0.542	-0.001	0.001	-0.215
No. of seed per plant	0.001	0.016	0.059	0.018	0.023	-0.001	-0.002	-0.002	-0.005	0.020	-0.016	0.002	-0.037
100 seed weight (g)	-0.009	0.005	0.026	0.007	-0.028	0.016	-0.009	0.004	-0.003	0.027	-0.001	0.022	0.084
Harvest index	0.016	-0.007	0.024	-0.033	0.39	-0.006	0.005	0.000	0.006	-0.183	0.001	0.003	0.638

Residual Value = 0.216

Mahesha and Lal (2017); Priyanka, *et al.,* (2016) for clusters per plant, pods per plant and harvest index. Negative significant correlation exhibited by number of primary branch (-0.390). Similar kind of negative and significant association of components with seed yield as observed for characters in present study was also reported earlier by Jyothsna, *et al.*, (2016). Positive non-significant correlation shown by plant height (0.247), 100 seed weight (0.164) and number of seed per plant (0.154). Reni, *et al.,* (2013) and Patidar, *et al.,* (2018) also reported the same for primary branches per plant and finally, negative non-significant correlation exhibited by pod length (-0.369), days to 50 % maturity (-0.340), days to 50% germination (-0.324) and days to 50% flowering (-0.050). Vidya, *et al.,* (2018) also reported negative non significant correlation for pod length.

Path analysis furnishes the cause and effect of different yield components which would provide better index for selection rather than mere correlation coefficients. Correlation gives only the relation between two variables whereas path coefficient analysis allows separation of the direct effect and their indirect effects through other attributes by partitioning the correlation (Wright , 1921). Path coefficient analysis table 3 and 4 results showed that positive direct effect on grain yield was exhibited by number of cluster per plant (0.666), plant height (0.620), biological yield per plant (0.485), number of pods per cluster (0.446), pod length (0.385) and days to 50 % germination (0.278). Hence, selection based on these traits would be effective in increasing the seed yield. Conversely, the other characters *viz.,* days to 50% flowering (-0.814), number of pod per plant (-0.690), number of primary branches (-0.411), 100 seed weight (-0.318), days to 50 % maturity (-0.144) and number of seeds per plant (-0.080) revealed negative direct effect of given magnitudes towards seed yield per plant. The characters harvest index (1.254) recorded the maximum and positive magnitude of direct effect on seed yield per plant and their association with seed yield was also highly significant and positive followed by number of cluster per plant (0.666) and days to 50 % germination (0.278). However, the days to 50% flowering (-0.814) had negative direct effect but positive and significant association with seed yield per plant whereas number of seeds per plant (-0.080) also recorded positive direct effect but significantly negative correlation association with seed yield per plant. Similar findings were reported by Sardana, *et al.,* (2007). The observations showed the extent of reliability of these traits as a good selection index for grain yield. So, direct selection for these traits can help to improve black gram

seed yield per unit area. Correlation coefficient and path coefficient analysis showed direct effect and significant positive association with pods per plant, biological yield per plant, harvest index which indicates that these characters can be used as selection parameters for black gram improvement.

Conclusion

The estimates of mean sum of square due to genotypes were highly significant for all the characters indicating the presence of genetic variability in the existing material. The mean performance of the genotypes revealed a wide range of variability for all the characters. The variation was highest for plant height, followed by biological yield per plant, number of pods per cluster, harvest index. The association study implies that the advantages of upgrading black gram (Urd bean) genotypes through simultaneous selection for biological yield per plant, harvest index, plant height, pod length and number of pods per cluster.

Path coefficient analysis showed that biological yield per plant, harvest index, number of seed per pod, number of primary branches per plant, 100 seed weight, days to 50% maturity, number of seed per pod, pod length, and days to 50% flowering were the most important characters contributing towards seed yield per plant and hence purposeful and balanced selection based on these characters would be more effective for improvement in black gram (Urd bean).

References

Bharti, B., R. Kumar, H.N. Bind, A. Kumar and V. Sharma (2013). Correlation and path analysis for yield and its components in blackgram (*Vigna mungo* L. hepper). *Progressive Research*, **8:** 617-620.

Sushmitharaj, D.V., D. Shoba and M. Arumugam Pillai (2018). Genetic variability and correlation studies in black Gram (*Vigna mungo* L. hepper). *International J. Curr, Microbiol. App. Sci.,* **6:** 2849-2856.

Divya Vyas, Arunabh Joshi, Ganesh Rajamani and Devendra Jain (2018). Assessment of genetic diversity in blackgram (*Vigna mungo* L. Hepper) genotype based on ISSR. *Legume research an International Journal*, **41(2):** 175-181.

Dewey, D.R. and K.H. Lu (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.,* **51:** 515-518.

Mahesha, H.S. and Gabriel M. Lal (2017). Studies on genetic diversity in black gram (*Vigna mungo* L. Hepper) Germplasm. *IJABR,* **7(3):** 426- 434.

Johnson, H.W., H.F. Robinson and R.E. Comstock (1955). Estimates of genetics and environment variability in soybean. *Agronomy Journal,* **47(1):** 314-318.

Jyothsna, S., T.S.S.K. Patro, S. Ashok, Y. Sandhya Rani and B. Neeraja (2016). Character association and path analysis of seed yield and its yield components in black gram (*Vigna mungo* L. Hepper). *Int. J. Theo. Appli. Sci.,* **8(1):** 12-16.

Manish Patidar, Hemlata Sharma and Santra Haritwal (2018). Genetic variability studies in Blackgram (*Vigna mungo* L. Hepper) *International Journal of Chemical Studies*, **6(2):** 1501-1503.

Miller, D.A., J.C. Williams, H.F. Robinson and K.B. Comstock (1958). Estimates of genotypic and environmental variances and covariance's in upland cotton and their implication in selection. *Agronomy Journal,* **50:** 126- 131.

Gowsalya, P., D. Kumaresan, D. Packiaraj and J.R. Kannan Bapu (2017). Genetic divergence in black gram (*Vigna mungo* L. Hepper). *Indian J. Agric, Res.*, **51(2):** 184-187.

Priyanka, S., S. Rangaiah and B.M. Showkath Babu (2016). Genetic quantitative and qualitative traits in black gram. *Int J. Agric*., **8(40):** 1821-1824.

Reni, Y.P., R.Y. Koteswara, Y. Satish and J.B. Sateesh (2013). Estimates of genetic parameters and path analysis in black gram (*Vigna mungo* L. Hepper). *Int. J. of Plant Animal Environ. Sci.,* **3(4):** 231 234.

Vidya, S., T. Sabesan and K. Saravanan (2018). Genetic Divergence studies in blackgram (*Vigna mungo* L. hepper) for yield and quantitative traits. *Journal of Phytology*, **10:** 24-26.

Sardana, S., R.K. Mahajan, N.K. Gautam and B. Ram (2007). Genetic variability in pea (*Pisum sativum* L.) germplasm for utilization SABRAD. *Journal of Breeding and Genetics,* **39(1):** 31-41.

Wright, S. (1921). Correlation and causation. *J. agric. Res.,* **20:** 557- 587.