

RESEARCH ARTICLE

Studies on genetic variability and morphological characterization in blackgram [*Vigna mungo* (L.) Hepper]

■ Devaraboina Shruthi and Gaibriyal M. Lal

SUMMARY

21 blackgram genotypes were grown at the field experimental centre to study the amount of genetic variability, heritability, direct and indirect effects of yield contributing components and morphological characterization in blackgram genotypes. In the present study an attempt was made to characterize and identify 21 blackgram genotypes based on 13 quantitative traits and on morphological characters like anthocyanin colour on hypocotyl, plant growth habit, time of flowering, stem colour, stem pubescence, leaf terminal shape, foliage colour, leaf vein colour, leaf pubescence, twinning habit, petiole colour, pod pubescence, peduncle length, pod length, colour of mature pod, seed colour and seed shape. Correlation coefficient analysis revealed that seed yield per plant exhibited positive and significant association with plant height, number of primary branches, number of clusters, number of pods per plant, pod length, harvest index, biological yield. Path analysis revealed that 50% pod setting, number of pods per plant, number of seeds per pod, biological yield and harvest index showed positive direct effect on seed yield at both genotypic and phenotypic level.

Key Words : Blackgram, Morphological characters, Genetic variability, Correlation, Path analysis

How to cite this article : Shruthi, Devaraboina and Lal, Gaibriyal M. (2022). Studies on genetic variability and morphological characterization in blackgram [*Vigna mungo* (L.) Hepper]. *Internat. J. Plant Sci.*, 17 (1): 18-24, DOI: 10.15740/HAS/IJPS/17.1/18-24, Copyright@ 2022:Hind Agri-Horticultural Society.

Article chronicle : Received : 20.08.2021; Revised : 05.10.2021; Accepted : 03.11.2021

Blackgram (*Vigna mungo* L.) is one of the major pulse crop grown throughout the country. It is an annual leguminous crop belonging to the family

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Fabaceae and sub family Papilionaceae having chromosome number $2n=22$. It is originated from South Asia. It is an important *Kharif* legume, short duration crop which can be grown under adverse climatic conditions. Morphological characterization is the important procedure to identify desirable traits of progenitors to be included in breeding programs. A set of morphological descriptors can be used to describe a phenotype. In India blackgram was grown in 35.62 lakh hectares contributing production of 24.86 lakh tones with productivity of 697.92 kg/hectares. In U.P it was grown under area of 6.30 lakh hectares contributing production

of 3.46 lakh tones with productivity of 549.20 kg/ hectares.

Selection is an important procedure in any breeding programme but without genetic variability it is not possible, hence it is very necessary to make improvement in production of this crop by evaluation of different germplasm lines of blackgram. The knowledge of the inheritance of different quantitative and qualitative traits through estimation of genetic parameters like phenotypic and genotypic co-efficient of variability, heritability, and genetic advance is prerequisite in conducting an effective breeding programme.

Variability is one of the important considerations in any crop improvement. Variability is a measure of estimation of mean, genotypic and phenotypic co-efficient of variation, heritability, for different quantitative traits. Environment plays an important role in the expression of genotypic and phenotypic traits which are inferred, from phenotypic observations. Hence, variability can be observed through biometric parameters like genotypic coefficient of variation, heritability (broad sense). This would be of great help to breeder in evolving a selection programme for genetic improvement of crop plants.

Path analysis developed by Wright (1923) is a standardized partial regression analysis which permits the partitioning of the correlation co-efficient into components of direct and indirect effect.

MATERIAL AND METHODS

The present investigation comprised of 21 blackgram genotypes including one check (SHEKAR-2). Experiment was conducted at Department of Genetics and Plant Breeding Research farm of Sam Higginbottom University of Agriculture Technology and Sciences, Naini, Prayagraj (U.P) during Zaid 2021. These genotypes were sown in Randomized Block Design (RBD) with three replicates. Row to Row and Plant to Plant distance was kept at 30 cm and 10 cm, respectively.

Data was recorded on 13 quantitative characters viz., days to 50% flowering, days to 50% pod setting, days to maturity, number of primary branches, number of clusters, number of pods per plant, pod length, number of seeds per pod, 100 seed weight, biological yield, harvest index and seed yield. In each replication and in each plot five randomly selected plants were taken and tagged excluding border plants to minimize border effects. The observations like days to 50% flowering, days to 50% pod setting and days to maturity were recorded on

whole plant basis.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Distinguishable morphological characters were recorded which were shown in the Table 1. The mean performance of 21 blackgram genotypes including 1 check are presented in the Table 2. A perusal of variability parameters revealed that wide range of genotypic variability was observed. Highest genetic variance (GCV) was recorded for seed yield (21.469) followed by number of pod per plant (19.723), biological yield (19.144) whereas low estimates of genetic variability was observed for number of clusters (16.374), hundred seed weight (15.924), harvest index (14.734), number of primary branches (11.57), plant height (7.689), number of seeds per pod (3.11), 50% pod maturity (3.052), date of 50% flowering (2.964), pod length (2.919) this indicates the influence of environment for the expression of most of the characters in present investigation.

Phenotypic variance (PCV) was also high for seed yield (22.159) followed by biological yield (20.858), Number of pods per plant (20.802) indicating the interaction of the characters with environment whereas low estimates of phenotypic variance was observed for number of clusters (18.015), hundred seed weight (17.313), harvest index (16.729), plant height (13.743), number of primary branches (13.172), number of seeds per pod (6.302), date of 50% flowering (5.381), 50% pod maturing 4.956, pod length 4.611, 50% pod setting 4.214. In the present study, a perusal of genetic advance showed that it was moderately high for harvest index (14.2), number of pods per plant (3.956) followed by 50% pod maturity (3.004), date of 50% flowering (1.844), biological yield (1.744), 50% pod setting (1.698), number of clusters (1.445), hundred seed weight (1.158), plant height (1.231), seed yield (1.032), Number of seeds per pod (0.176), pod length (0.148), Number of primary branch (0.559). The knowledge about genetic advance as percent of mean coupled with heritability is most useful. In the present study high heritability coupled with genetic advance as per cent of mean recorded for grain yield (93.868,42.848), No. of pods per plant (89.903, 38.524), 100 seed wgt (84.597,30.171), biological yield

Table 1a : Distinguishable morphological characters observed in blackgram

Sr. No.	Variety	Anthocyanin pigmentation	Time of flowering	Plant growth habit	Plant habit	Stem colour	Stem pubescence
1.	AJEET-33	Present	Late	Semi erect	Determinate	Purple	Present
2.	MASH-338	Present	Late	Semi erect	Determinate	Purple with green splashes	Absent
3.	IPU-99-18	Present	Late	Semi erect	Determinate	Green with purple splashes	Present
4.	k-16-4	Present	Medium	Errect	Determinate	Purple with green splashes	Present
5.	H-1	Present	Medium	Semi erect	Determinate	Green with purples plashes	Present
6.	DH-85-5	Present	Medium	Errect	Determinate	Purple	Present
7.	T-9	Present	Medium	Semi erect	Indeterminate	Purple	Present
8.	KU-302	Present	Late	Semi erect	Determinate	Purple with green splashes	Present
9.	KU-48	Present	Late	Semi erect	Determinate	Green with purple splashes	Present
10.	IPU-95-13	Present	Medium	Semi erect	Determinate	Purple	Present
11.	AZAD-1	Present	Late	Semi erect	Indeterminate	Purple with green splashes	Present
12.	PLU-19	Present	Late	Semi erect	Determinate	Green with purple splashes	Present
13.	IC-240-183	Present	Medium	Errect	Determinate	Purple with green splashes	Present
14.	PDV-103	Present	Late	Semi erect	Determinate	Green with purple splashes	Present
15.	PLU-708	Present	Medium	Semi erect	Determinate	Purple	Absent
16.	PU-31	Present	Late	Semi erect	Determinate	Green with purple splashes	Present
17.	KU-96-4	Present	Medium	Semi erect	Determinate	Purple with green splashes	Present
18.	NO-7368-15	Present	Late	Semi erect	Indeterminate	Purple with green splashes	Absent
19.	VBN-5	Present	Medium	Semi erect	Determinate	Purple with green splashes	Present
20.	LBG-623	Present	Late	Errect	Indeterminate	Purple	Present
21.	Shekar-2	Present	Late	Semi erect	Determinate	Purple	Present

Table 1b : Distinguishable morphological characters observed in blackgram

Sr. No.	Variety	Pod pubescence	Peduncle length	Pod length	Colour of mature pod	Seed colour	Seed shape
1.	AJEET-33	Present	Short	Long	Brown	Greenish brown	Drum
2.	MASH-338	Absent	Short	Long	Black	Greenish brown	Globose
3.	IPU-99-18	Present	Short	Long	Black	Greenish brown	Globose
4.	K-16-4	Absent	Short	Long	Black	Mottled	Globose
5.	H-1	Present	Short	Long	Black	Mottled	Drum
6.	DH-85-5	Absent	Short	Medium	Brown	Greenish brown	Oval
7.	T-9	Present	Short	Long	Black	Mottled	Globose
8.	KU-302	Absent	Short	Long	Black	Greenish brown	Drum
9.	KU-48	Present	Short	Long	Brown	Greenish brown	Oval
10.	IPU-95-13	Absent	Medium	Long	Black	Mottled	Globose
11.	AZAD-1	Absent	Short	Long	Black	Green	Globose
12.	PLU-19	Present	Short	Long	Brown	Black	Drum
13.	IC-240-183	Absent	Medium	Long	Black	Greenish brown	Oval
14.	PDV-103	Present	Short	Long	Black	Black	Globose
15.	PLU-708	Present	Short	Long	Brown	Black	Drum
16.	PU-31	Absent	Short	Medium	Black	Mottled	Oval
17.	KU-96-4	Present	Short	Long	Black	Black	Oval
18.	NO-7368-15	Present	Medium	Long	Black	Green	Oval
19.	VBN-5	Absent	Short	Long	Black	Greenish brown	Oval
20.	LBG-623	Present	Short	Long	Black	Black	Oval
21.	Shekar-2	Absent	Short	Long	Black	Greenish brown	Drum

(84.242, 36.197), number of cluster (82.608,30.656), harvest index (77.587, 26.735), number of primary branches (77.155, 20.935), low heritability coupled with genetic advance as per cent of mean was recorded for pod length (40.066, 3.806), 50% pod maturity (37.921, 3.871), plant height (31.307, 8.863), 50% pod setting (31.074, 2.697), number of seeds per pod (24.357,3.162).

In the present study heritability was high for seed yield (93.868) followed by number of pods per plant (89.903), hundred seed weight (84.597), biological yield

(84.242), number of clusters (82.608), harvest index (77.587), number of primary branches (77.155), pod length (40.066), 50% pod maturity (37.921), plant height (31.307), 50% pod setting (31.074), data of 50% flowering (30.343), number of seeds per plant (24.357). Correlation co-efficient analysis revealed that grain yield per plant showed highly significant positive association with plant height (0.694**), no. of primary branches (0.426**), number of clusters (0.603***), number. of pods per plant (0.752**), pod length (0.346**), number.

Table 2 : Mean performance of 21 blackgram genotypes for 13 quantitative traits

Sr. No.	Genotype	Date of 50% flowering	50 % pod setting	50%pod maturity	Plant height	No. of primary branches	No. of clusters	No. of pods per plnat	Pod lenght	No. of seeds per pod	100 seeds per pod	Biological yield	Seed yield	Harvest index
1.	PLU-708	56.00	65.00	77.67	13.51	2.46	4.47	9.47	3.76	5.58	3.33	5.07	2.33	46.97
2.	KU-96-4	55.00	62.33	80.00	14.23	3.53	5.20	11.47	3.90	5.54	3.33	4.87	2.27	52.58
3.	NO- 7368-15	56.67	64.67	80.00	13.95	2.67	4.20	8.27	4.01	5.74	5.00	4.40	1.87	43.11
4.	VBN-5	53.67	62.67	75.67	13.35	2.53	4.60	9.33	3.86	5.71	3.33	4.40	2.07	49.58
5.	LBG-623	57.00	64.67	79.67	11.47	2.47	4.26	8.80	3.69	5.64	4.00	4.00	2.27	58.25
6.	AZAD-1	55.33	63.00	73.00	13.76	2.53	4.40	11.20	3.75	5.36	4.33	4.80	3.07	73.08
7.	PLU-19	56.00	63.67	77.33	13.23	2.53	4.33	9.47	3.74	5.08	3.67	3.27	1.80	60.53
8.	IC-240-183	55.00	63.33	74.33	12.03	2.53	4.27	9.07	3.72	5.83	3.33	4.53	2.60	60.58
9.	PDV-103	57.33	64.67	77.00	12.28	2.80	4.14	8.60	3.84	5.45	3.67	5.00	2.07	43.37
10.	PU-31	54.00	62.67	77.33	16.14	3.20	7.33	17.13	4.13	5.90	3.00	5.67	3.33	59.28
11.	DH-85-5	55.33	63.33	80.00	14.69	2.40	5.07	10.66	4.05	5.87	4.67	6.13	3.40	59.24
12.	T-9	51.67	61.00	74.33	14.82	2.47	4.07	9.20	4.03	5.51	4.00	4.27	1.93	48.94
13.	KU-302	55.00	62.33	81.00	15.27	2.93	4.47	10.20	3.99	5.43	3.67	4.66	2.40	52.05
14.	KU-48	55.00	63.33	76.33	15.61	2.20	5.93	12.80	3.93	5.51	3.67	5.80	2.80	48.32
15.	IPU-95-13	51.67	61.33	77.33	13.90	2.33	4.53	9.47	3.85	5.62	3.67	4.47	1.74	42.57
16.	AJEET-33	55.33	64.00	77.67	14.98		5.53	12.47	3.93	6.02	4.33	5.40	3.00	54.73
17.	MASH-338	57.67	64.67	79.33	12.03	3.00	4.60	9.27	3.69	5.25	3.33	4.00	2.34	61.50
18.	IPU-99-18	55.00	61.33	78.67	12.29	2.40	4.06	7.87	4.00	5.36	4.67	3.47	1.67	54.53
19.	K-16-4	56.33	65.00	82.33	14.03	2.80	5.27	11.20	3.80	5.52	2.67	4.80	2.60	58.86
20.	H-1	54.00	62.67	80.33	13.42	2.53	4.40	8.87	3.79	5.12	4.00	4.60	2.06	48.49
21.	Shekar-2 (Check)	48.33	56.33	70.00	16.67	3.07	3.87	10.87	4.12	5.71	4.90	7.60	2.97	38.84
	Mean	54.83	62.95	77.59	13.89	2.67	4.71	10.27	3.89	5.56	3.84	4.82	2.41	53.11
	CV	4.49	3.50	3090	11.39	6.30	7.51	6.61	3.57	5.48	6.79	8.28	5.49	7.92
	S.E. ±	1.42	1.27	1.75	0.91	0.10	0.20	0.39	0.08	0.18	0.15	0.23	0.08	2.43
	C.D. (P=0.05)	4.06	3.63	5.00	2061	0.28	0.58	1.12	0.23	0.50	0.43	0.66	0.22	6.94
	C.D. (P=0.01)	5.44	4.86	6.69	3.49	0.37	0.78	1.50	0.31	0.67	0.58	0.88	0.29	9.29
	Minimum	48.33	56.33	70.00	11.47	2.20	3.87	7.87	3.69	5.08	2.67	3.27	1.67	38.84
	Maximum	57.67	65.00	82.33	16.67	3.53	7.33	17.13	4.13	6.02	5.00	7.60	3.40	73.08

Table 3 : Analysis of variance of 13 quantitative characters in 21 black gram genotypes

Sr. No.	Characters	Mean sum of squares		
		Replication (d.f=2)	Treatments (d.f=20)	Error (d.f= 40)
1.	Days to 50% flowering	2.397	13.987	6.063
2.	Days to 50% pod setting	12.333	11.410	4.850
3.	Days to maturity	3.111	25.997	9.178
4.	Plant height	4.998	5.924	2.502
5.	No. of primary branches per plant	0.006	0.314	0.028
6.	No. of clusters per plant	0.227	1.913	0.125
7.	No. of pods per plant	1.333	12.76	0.461
8.	No. of seeds per plant	0.031	0.183	0.093
9.	Pod length	0.022	0.058	0.019
10.	Seed index	0.208	1.188	0.068
11.	Biological yield (g)	0.320	2.713	0.159
12.	Harvest index %	16.653	201.4	17.69
13.	Seed yield per plant	0.053	0.820	0.017

*and *8 indicate significance of values at P=0.05 and 0.01, respectively

Table 4 : Genotypical correlation co-efficient for yield contributing traits of black gram

	Days o to 50% flowering	Days to 50% pod setting	Pod maturity	Plant height	No.of primary branches	No.of clusters	No.of pods per plant	Pod length	No.of seeds per pod	100 seeds weight	Biological yield	Harvest index	Seed yield
Date of 50% flowering	1	0.945**	0.792**	- 0.993**	0.0186	0.1716	-0.2052	-1.020**	-0.419**	-0.403**	-0.660**	0.715**	-0.0915
50% pod setting		1	0.752**	- 0.797**	-0.2286	0.259*	-0.1272	-0.960**	-0.1373	-0.560**	-0.592**	0.524**	-0.0883
50% pod maturity			1	-0.302*	0.1179	0.291*	-0.0743	-0.2182	-0.308*	-0.345**	-0.514**	0.1544	-0.2389
Plant height				1	0.390**	0.654**	0.919**	0.985**	0.653**	0.1355	0.959**	-0.401**	0.694**
No.of primary branches					1	0.303*	0.345**	0.275*	0.1123	-0.0659	0.472**	0.0748	0.426**
No.of clusters						1	0.958**	0.363**	0.559**	-0.454**	0.334**	0.2459	0.603**
No.of pods per plant							1	0.538**	0.606**	-0.310*	0.563**	0.255*	0.752**
Pod length								1	0.846**	0.459**	0.690**	-0.517**	0.346**
No.of seeds per pod									1	0.1929	0.748**	-0.1730	0.720**
100 seeds weight										1	0.2300	-0.2243	0.0137
Biological yield											1	-0.312*	0.762**
Harvest index												1	0.389**
Seed yield													1

Table 5: Phenotypical correlation co-efficient for yield contributing traits of black gram

	Days to 50% flowering	Days to 50% pod setting	Pod maturity	Plant height	No. of primary branches	No. of clusters	No. of pods per plant	Pod length	No. of seeds per pod	100 seeds weight	Biological yield	Harvest index	Seed yield
Date of 50% flowering	1	0.8265 ***	0.4392 ***	-0.3426 **	0.0707	0.0692	-0.0563	-0.1579	-0.0408	-0.1096	-0.3441 **	0.2527 *	-0.0340
50% pod setting		1	0.4768 ***	-0.3504 **	-0.0271	0.1506	-0.0383	-0.2915 *	-0.0148	-0.2344	-0.3527 **	0.2414	-0.0438
50% pod maturity			1	-0.1770	0.0867	0.1638	-0.0695	-0.0833	-0.0883	-0.1822	-0.2386	0.0471	-0.1591
Plant height				1	0.2181	0.3343 **	0.4800 ***	0.4600 ***	0.1902	0.1560	0.5351 ***	-0.1566	0.395**
No. of primary branches					1	0.2995 *	0.3160 *	0.1654	-0.0140	-0.0403	0.3711 **	0.1015	0.370**
No. of Clusters						1	0.8341 ***	0.2282	0.2860 *	-0.3871 **	0.2719 *	0.2256	0.547**
No. of pods per plant							1	0.2611 *	0.2821 *	-0.2803 *	0.4569 ***	0.2116	0.709**
Pod length								1	0.1898	0.3661 **	0.3855 **	-0.2675 *	0.2159
No. of seeds per pod									1	0.0427	0.3575 **	-0.0842	0.396**
100 seeds weight										1	0.1821	-0.1959	0.0062
Biological yield											1	-0.2964 *	0.686**
Harvest index												1	0.373**
Seed yield													1

Table 6 : Direct and indirect effect on yield components on seed yield at genotypic level

	Date of 50% flowering	50% pod setting	Pod maturity	Plant height	No. of primary branches	No. of clusters	No. of pods per plant	Pod length	No. of seeds per pod	100 seeds weight	Biological yield	Harvest index	Seed yield
Date of 50% Flowering	-0.1217	-0.1268	-0.0964	0.1208	-0.0023	-0.0209	0.025	0.1241	0.051	0.049	0.0804	-0.087	-0.0915
50% pod setting	0.2027	0.1947	0.1464	-0.155	-0.0445	0.0503	-0.0248	-0.1869	-0.0267	-0.1091	-0.1153	0.1021	-0.0883
50% pod maturity	0.3988	0.3786	0.5035	-0.1521	0.0594	0.1464	-0.0374	-0.1099	-0.1548	-0.1736	-0.2585	0.0777	-0.2389
Plant height	-0.0955	-0.0766	-0.029	0.0962	0.0375	0.0628	0.0884	0.1145	0.0628	0.013	0.0922	-0.0386	0.694**
No. of primary branches	-0.0048	0.0593	-0.0306	-0.1011	-0.2594	-0.0785	-0.0895	-0.0714	-0.0291	0.0171	-0.1225	-0.0194	0.426**
No. of clusters	-0.1034	-0.1559	-0.1754	-0.394	-0.1825	-0.6029	-0.5778	-0.219	-0.3368	0.2738	-0.2012	-0.1483	0.603**
No. of pods per plant	-0.0339	-0.021	-0.0123	0.1519	0.0571	0.1585	0.1654	0.089	0.1002	-0.0512	0.0931	0.0422	0.752**
Pod length	-0.1373	-0.1293	-0.0294	0.1602	0.0371	0.0489	0.0725	0.1346	0.1139	0.0618	0.0929	-0.0696	0.346**
No. of seeds per pod	-0.0617	-0.0202	-0.0453	0.0962	0.0165	0.0823	0.0893	0.1246	0.1473	0.0284	0.1101	-0.0255	0.720**
100 seeds weight	0.0775	0.1078	0.0664	-0.0261	0.0127	0.0874	0.0596	-0.0883	-0.0371	-0.1925	-0.0443	0.0432	0.0137
Biological yield	-0.8736	-0.7838	-0.6796	1.2685	0.6248	0.4417	0.7451	0.9132	0.9892	0.3044	1.3233	-0.4129	0.762**
Harvest index	0.6615	0.485	0.1428	-0.3712	0.0692	0.2275	0.236	-0.4785	-0.1601	-0.2075	-0.2886	0.9251	0.389**
Seed yield	Seed yield	-0.0915	-0.0883	-0.2389	0.694**	0.426**	0.603**	0.752**	0.346**	0.720**	0.0137	0.762**	0.389**

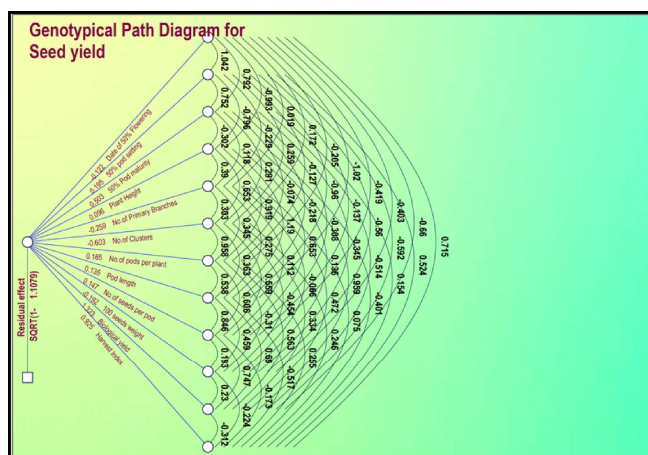


Fig. 1: Genotypic path for yield contributing traits in blackgram

Of seeds per pod (0.720**) biological yield (0.762**), harvest index (0.389**), It also showed positive but non-significant association with 100 seed weight (0.0137). Negative non-significant association was recorded for date of 50% flowering (-0.0340), 50% pod setting (-0.0438), 50% pod maturity (-0.1591).

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