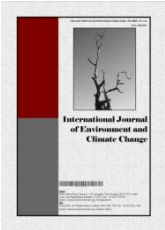

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Direct and Indirect Effects of Yield Contributing Characters on Seed Yield in Black Gram (*Vigna mungo* (L.) Hepper)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

India is the largest producer and consumer of pulses in the world. Pulses play a crucial role in the nutrition of mankind and can be cultivated all over the world, making them important both economically as well as nutritionally. The present investigation was carried out with objective of assessing genetic variability, genetic parameters like GCV, PCV, heritability, genetic advance, correlation and path analysis on 26 Blackgram genotypes with one check using randomized block design with three replication during *Kharif* 2021 in experimental Farm of the Department Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. Observations were recorded for 13 characters viz., days to 50% flowering, days to 50% pod setting, days to maturity, plant height (cm), number of primary branches, number of clusters per plant, number of pods per plant, number of seeds per pod, pod length (cm), biological yield per plant (g), harvest Index (%), seed index, seed yield per plant (g). based on mean performance MASH -338 found to be superior in seed yield per plant followed by IPU-99. Among the 13 quantitative characters, high estimates of GCV and PCV were recorded respectively for number of pods per plant followed by number of clusters per plant.

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Number of pods per plant showed high heritability and genetic advance. Positive and significant correlation with number of clusters per plant at genotypic and phenotypic level. At genotypic level, the highest positive direct effect on Seed yield per plant effect was found for number of clusters per plant and harvest index at genotypic level. It can be concluded that these traits can be used as selection criteria in blackgram for bringing improvement in seed yield.

Keywords: Correlation; genotypic correlation coefficient; heritability; path analysis; phenotypic correlation coefficient; variability.

1. INTRODUCTION

India is the largest producer and consumer of pulses in the world. Pulses play a crucial role in the nutrition of mankind and can be cultivated all over the world, making them important both economically as well as nutritionally. They are used as fodder, excellent green manure for soil reclamation and maintain soil fertility. Pulses provide proteins, carbohydrates, dietary fibres, vitamins, phytochemicals and minerals such as iron, zinc, folate and magnesium. "Legumes are the third largest family of higher plants with more than 20,000 species having major impact on agriculture, human and livestock nutrition and environment. These are second only to grasses in agricultural importance" [1].

"Blackgram (*Vigna mungo* (L.) Hepper), popularly known as urdbean or mash in India. It belongs to the family of Leguminoseae and sub-family Papilionaceae. it is a self-pollinating diploid (2n=2x=22) annual crop with a small genome size estimated to be 0.56pg/1C (574Mbp)" [2].

"India produces around 30 to 33 lakh tons of black gram annually from about 50.31 lakh hectares of area, and an average productivity of 650 to 750 kg per hectare". (Source: ICAR-Directorate of Pulses Development Annual Report, (2019-2020). "ICAR -Indian Institute of Pulses Research E- Pulse Data Book). Black gram output accounts for about 13.1% of India's total pulse production and 15.3% of India's total pulse growing area" (Pulses in India Retrospect & Prospects, 2020).

"Limited variability has been utilized in varietal development programmes in Blackgram. Pedigree analysis of the released cultivars indicated that small number of parents with high degree of relatedness was repeatedly used in crossing programmes. In blackgram, the variety T9 is the most frequently used ancestor appearing in 64% of the varieties. This indicated very narrow genetic base of the released varieties of blackgram" [3]. Research on this crop has lagged behind that of cereals and other legumes. Hence, development of this crop required through application of available genetic diversity which is essential in any hybridization programme.

The impact of selection in crop improvement is depends upon the differences present in the main target material and up to which extent it is heritable. Occasionally it is hard to justify whether the recorded variation for a specific traits is heritable or may be varying environment factors. Consequently estimation of heritability is important. Correlation coefficient estimates relationship between different characters with yield and between themselves. Path coefficient analysis selects the traits which are directly and indirectly responsible for yield and helps the breeder in formulating selection plan in breeding programme.

The present investigation is contemplated with the following objectives:

1. To study the nature and extent of genetic variability present in the Blackgram genotypes under study
2. To assess the magnitude of character association in seed yield and its attributing traits
3. To find the direct and indirect effects of different component traits on seed yield

2. MATERIALS AND METHODS

The genetic material for this study comprised of 26 genotypes of Blackgram were sown in the Randomized block design in 3 replications with row to row distance is 30cm and plant to plant 10cm for the "Direct and Indirect Effects of Yield Contributing Characters on Seed Yield in Blackgram (*Vigna mungo* (L.) Hepper)" was conducted at the Experimental Farm of the Department Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh during *Kharif,* 2021.

Table 1. List of experimental material used in the present investigation

S. No	Entry name	S. No	Entry Name
1	DH-85-2	14	NO-1314
2	BGP-21-28	15	PLU-85-6
3	PU-09-37	16	MASH-338
4	AKU-13-15	17	PKRU-03
5	AKU-14-02	18	KU-96-4
6	TU-99-2	19	PLU-708
7	PLU-570	20	L-6
8	PKGU-03	21	IPU-95-13
9	IPU-99	22	T-9
10	BG-8	23	KU-302
11	BG-369	24	PU-31
12	PDU-1	25	IPU-99-18
13	PLU-547	26	SHEKAR-2 (check)

Source: Dept. of Genetics and Plant Breeding, SHUATS

The observations for all the following traits were recorded on randomly selected five competitive plants per plot in each replication for following 13 quantitative characters. 1. Days to 50% flowering 2. Days to 50% pod setting 3. Days to maturity 4. Plant height (cm) 5. Number of primary branches 6. Number of clusters per plant 7. Number of pods per plant 8. Number of seeds per pod 9. Pod length (cm) 10. Biological yield per plant (g) 11. Harvest Index (%) 12. Seed index 13. Seed yield per plant (g).

Experimental materials used in the present investigation is collected from Department of

Genetics and Plant Breeding, Naini Agricultural Institute, SHUATS, Prayagraj, UP.

2.1 Statistical Analysis

- Analysis of variance [4]
- Genetic variability [5]
- Genotypic Coefficient of Variation (GCV)
- Phenotypic Coefficient of Variation (PCV)
- Estimation of Heritability (Broad sense) [6]
- Genetic advance [7]
- Correlation co-efficient analysis [8]
- Path coefficient analysis [9]

3. RESULTS AND DISCUSSION

The mean sum of squares values for 13 biometrical traits was presented in Table 2. The mean sum of squares due to the genotypes were significant for all the characters studied at both level of significance 1% and 5%, suggesting the existence of high genetic variability among the genotypes for all the traits. This indicates that there is sample for selection of genotypes from the present gene pool for yield and its component traits.

Table 2. Analysis of Variance (ANOVA) among 26 Blackgram genotypes for 13 quantitative traits

Sl. No.	Traits	Mean sum of squares		
		Replication	Treatment	Error
	Degrees of freedom	2	25	50
1	Days to fifty percent flowering	0.6280	19.882**	1.922
2	Days to fifty percent pod setting	1.7820	8.978**	1.675
3	Days to maturity	0.7310	18.213**	3.704
4	Plant height (cm)	31.3410	300.166**	22.668
5	Number of primary branches	0.0930	3.922**	0.18
6	Number of clusters per plant	0.0690	27.764**	0.548
7	Number of pods per plant	1.290	175.426**	3.447
8	Number of seeds per pod	0.2190	0.232**	0.099
9	Pod length (cm)	0.0840	0.096**	0.042
10	Seed yield per plant (g)	0.6360	0.692**	0.3
11	Biological yield per plant (g)	1.8710	16.537**	3.334
12	Harvest Index (%)	2.4550	45.587**	5.536
13	Seed Index (g)	0.0030	1.038**	0.101

** 5% Level of Significance, ** 1% Level of Significance*

Table 3. Genetic parameters for 13 quantitative traits of 26 Blackgram genotypes

Sl. No.	Parameters	Grand mean	Range		GCV	PCV	h² (Broad Sense)%	Genetic Advance 5%	Gen. Adv as% of Mean 5%
			Lowest	Highest					
1	Days to fifty percent flowering	45.25	40.00	49.33	5.408	6.216	75.702	4.385	9.693
2	Days to fifty percent pod setting	52.28	48.67	56.67	2.984	3.878	59.234	2.474	4.731
3	Days to maturity	64.00	60.00	69.33	3.436	4.566	56.629	3.409	5.327
4	Plant height (cm)	61.99	34.80	83.07	15.515	17.312	80.318	17.756	28.643
5	Number of primary branches	4.71	2.03	6.65	23.695	25.352	87.359	2.15	45.623
6	Number of clusters per plant	10.33	3.54	16.07	29.163	30.031	94.304	6.025	58.34
7	Number of pods per plant	21.59	8.02	41.93	35.072	36.111	94.328	15.148	70.17
8	Number of seeds per pod	6.07	5.60	6.60	3.463	6.239	30.812	0.24	3.96
9	Pod length (cm)	4.10	3.69	4.36	3.28	5.969	30.204	0.152	3.714
10	Seed yield per plant (g)	6.85	5.85	7.56	5.278	9.579	30.359	0.41	5.99
11	Biological yield per plant (g)	23.65	18.46	27.68	8.872	11.761	56.899	3.26	13.785
12	Harvest Index (%)	19.56	13.77	30.97	18.684	22.223	70.687	6.328	32.36
13	Seed Index (g)	4.56	3.50	6.10	12.316	14.17	75.552	1.001	22.053

GCV: Genotypic Coefficient of Variation, PCV: Phenotypic Coefficient of Variation h²bs: heritability (Broad sense), GA: Genetic Advance, GAM: Genetic Advance as Percent of Mean

Based on mean performance out of 26 Blackgram genotypes evaluated for various characters 13 genotypes were found superior for different characters. Among the lines, MASH-338 (7.44), PDU-1 (7.353), recorded the highest seed yield per plant followed by the genotypes PLU-570 (7.353), PKGU-03 (7.313), L-6 (7.047).

Among the 13 quantitative characters, high estimates of GCV and PCV were recorded respectively for number of pods per plant (35.072, 36.111), number of clusters per plant (29.163, 30.031), number of primary branches (23.695, 25.352).

Moderate estimates of GCV and PCV were recorded respectively for plant height (15.515, 17.312), seed index (12.316, 14.17) Low estimates of GCV and PCV were observed respectively for days to fifty percent flowering (5.408, 6.216), pod length (3.28, 5.969), days to maturity (3.436, 4.566)**,** days to fifty percent pod setting (2.984, 3.878).

3.1 Heritability Estimates and Genetic Advance

High heritability was reported for the character viz., number of pods per plant (94.328%), number of clusters per plant (94.304%), number of primary branches (87.359), plant height (80.318%), days to 50% flowering (75.702%), seed index (75.552%), harvest index (70.687%). Moderate heritability was reported for the character viz., days to 50% pod setting (59.234%), biological yield per plant (56.899%), days to maturity (56.629%), number of seeds per pod (30.812%), seed yield per plant (30.359%), pod length (30.204%).

Genetic advance was estimated for all the characters under study and are presented in (Table 3). Data on genetic advance exhibited the highest value of 17.756% genetic advance for plant height followed by number of pods per plant (15.148%), harvest index (6.328%), number of clusters per plant (6.025%), days to 50% flowering (4.385%), biological yield per plant (3.26%), days to maturity (3.409%), days to 50% pod setting (2.474%), number of primary branches (2.15%), seed index (1.001%), seed yield per plant (0.41%), pod length (0.152%), number of seeds per pod exhibited the least genetic advance (0.24%). Identical findings encountered for synchronous high heritability and high genetic advance by Meshram et al. [10], Usharani et al. [11], Priya et al. [12].

3.2 Correlation Coefficient

In Phenotypic correlation coefficient seed yield per plant shown positive and significant association with Plant height (0.267*), number of clusters per plant (0.408**), number of pods per plant (0.242*) number of seeds per pod (0.282*), Seed Index (0.302*). positive and non-significant with days to fifty percent pod setting (0.1060), number of primary branches (0.1528), biological yield per plant (0.0623), harvest index (0.1659). Negative and non significant with Days to fifty percent flowering (-0.0322), Days to maturity (-0.0399), Pod length (-0.0376) in (Table 4).

In Genotypic correlation coefficient seed yield per plant shown positive and significant association with number of clusters per plant (0.388**), number of pods per plant (0.252*) number of seeds per pod (0.312*), Seed Index (0.252*). positive and non-significant with Plant height (0.1329), days to fifty percent pod setting (0.0594), days to maturity (0.0159), number of primary branches (0.1036), Pod length (0.0726), biological yield per plant (0.1073), harvest index (0.1126). Negative and non significant with days to fifty percent flowering (-0.0609) in (Table 5). Similar findings were reported by Aher et al. [13], Konda et al. [14], Begum et al. [15].

3.3 Path Coefficient Analysis

In Phenotypic Path coefficient analysis positive direct effect on seed yield was shown by days to fifty percent pod setting (0.1720), days to maturity (0.0251), plant height (0.4407), number of clusters per plant (0.3092), number of pods per plant (0.0276), number of seeds per pod (0.2175), harvest Index (0.3148), seed Index (0.0841). Negative direct effect was showed by Days to fifty percent flowering (-0.0772), number of primary branches (-0.0477), pod length (-0.0182) in (Table 6).

Table 4. Estimation of phenotypic correlation coefficient between yield and yield attributing traits in 13 quantitative traits of 26 Blackgram genotypes

Traits	Days to fifty percent flowering	Days to fifty percent pod setting	Days to maturity	Plant height (cm)	Number of primary branches	Number of clusters per plant	Number of pods per plant	Number of seeds per pod	Pod length (cm)	Biological yield per plant (g)	Harvest Index (%)	Seed Index (g)	Seed yield per plant
Days to fifty percent flowering	1.0000	0.726**	0.1753	0.1969	0.1426	-0.0254	-0.0174	-0.226*	0.0009	0.288*	-0.278*	-0.1677	-0.0322
Days to fifty percent pod setting		1.0000	0.2161	0.0260	0.0041	-0.1351	-0.0700	-0.0130	0.0532	0.0859	0.0322	0.1367	0.1060
Days to maturity			1.0000	-0.0473	0.1185	-0.0209	0.0754	0.1986	0.1488	0.0777	-0.232*	-0.309*	-0.0399
Plant height (cm)				1.0000	0.255*	0.233*	-0.0465	-0.0021	-0.247*	0.729**	-0.596**	-0.233*	0.267*
Number of primary branches					1.0000	0.603**	0.524**	-0.0901	-0.0173	0.1879	-0.225*	-0.1413	0.1528
Number of clusters per plant						1.0000	0.616**	0.1320	-0.1401	0.1740	-0.0211	0.1176	0.408**
Number of pods per plant							1.0000	0.0872	0.1666	-0.1105	0.1468	0.1393	0.242*
Number of seeds per pod								1.0000	0.0237	-0.0526	0.0122	-0.0813	0.282*
Pod length (cm)									1.0000	-0.328*	0.257*	0.1022	-0.0376
Biological yield per plant (g)										1.0000	-0.770**	-0.297*	0.0623
Harvest Index (%)											1.0000	0.820**	0.1659
Seed Index (g)												1.0000	0.302*
Seed yield per plant													1.0000

Table 5. Estimation of Genotypic correlation coefficient between yield and yield attributing traits in 13 quantitative traits of 26 Blackgram genotype

Traits	Days to fifty percent flowering	Days to fifty percent pod setting	Days to maturity	Plant height (cm)	Number of primary branches	Number of clusters per plant	Number of pods per plant	Number of seeds per pod	Pod length (cm)	Biological yield per plant (g)	Harvest Index (%)	Seed Index (g)	Seed yield per plant
Days to fifty percent flowering	1.0000	0.613**	0.1086	0.244*	0.1154	-0.0315	0.0096	-0.284*	-0.0732	0.2054	-0.2170	-0.1448	-0.0609
Days to fifty percent pod setting		1.0000	0.2180	0.0724	0.0871	-0.0987	-0.0839	-0.0742	-0.0225	0.0361	0.0510	0.1191	0.0594
Days to maturity			1.0000	-0.0499	0.0791	-0.0953	0.0412	0.1345	0.1480	0.1652	-0.264*	-0.278*	0.0159
Plant height (cm)				1.0000	0.2074	0.0828	-0.1202	-0.1744	-0.328*	0.597**	-0.433**	-0.1002	0.1329
Number of primary branches					1.0000	0.589**	0.488**	-0.0469	-0.0232	0.1131	-0.1891	-0.1363	0.1036
Number of clusters per plant						1.0000	0.622**	0.244*	-0.0079	0.0905	-0.0128	0.0741	0.388**
Number of pods per plant							1.0000	0.1171	0.2040	-0.1070	0.0840	0.0455	0.252*
Number of seeds per pod								1.0000	0.1909	0.0229	-0.0635	-0.1008	0.312*
Pod length (cm)									1.0000	-0.2121	0.1756	0.0776	0.0726
Biological yield per plant (g)										1.0000	-0.738**	-0.235*	0.1073
Harvest Index (%)											1.0000	0.812**	0.1126
Seed Index (g)												1.0000	0.252*
Seed yield per plant													1.0000

Table 6. Phenotypic path between yield and yield attributing traits in 13 quantitative traits of 26 Blackgram genotypes

Traits	Days to fifty percent flowering	Days to fifty percent pod setting	Days to maturity	Plant height (cm)	Number of primary branches	Number of clusters per plant	Number of pods per plant	Number of seeds per pod	Pod length (cm)	Biological yield per plant (g)	Harvest Index (%)	Seed Index (g)	Seed yield per plant
Days to fifty percent flowering	-0.0772	-0.0560	-0.0135	-0.0152	-0.0110	0.0020	0.0013	0.0174	-0.0001	-0.0222	0.0215	0.0129	-0.0322
Days to fifty percent pod setting	0.1248	0.1720	0.0372	0.0045	0.0007	-0.0232	-0.0120	-0.0022	0.0092	0.0148	0.0055	0.0235	0.1060
Days to maturity	0.0044	0.0054	0.0251	-0.0012	0.0030	-0.0005	0.0019	0.0050	0.0037	0.0020	-0.0058	-0.0078	-0.0399
Plant height (cm)	0.0868	0.0115	-0.0208	0.4407	0.1123	0.1025	-0.0205	-0.0009	-0.1087	0.3213	-0.2628	-0.1029	0.267*
Number of primary branches	-0.0068	-0.0002	-0.0057	-0.0122	-0.0477	-0.0288	-0.0250	0.0043	0.0008	-0.0090	0.0107	0.0067	0.1528
Number of clusters per plant	-0.0079	-0.0418	-0.0065	0.0719	0.1866	0.3092	0.1905	0.0408	-0.0433	0.0538	-0.0065	0.0364	0.408**
Number of pods per plant	-0.0005	-0.0019	0.0021	-0.0013	0.0145	0.0170	0.0276	0.0024	0.0046	-0.0030	0.0040	0.0038	0.242*
Number of seeds per pod	-0.0491	-0.0028	0.0432	-0.0004	-0.0196	0.0287	0.0190	0.2175	0.0052	-0.0114	0.0027	-0.0177	0.282*
Pod length (cm)	0.0000	-0.0002	-0.0007	0.0011	0.0001	0.0006	-0.0007	-0.0001	-0.0044	0.0015	-0.0011	-0.0005	-0.0376
Biological yield per plant (g)	-0.0052	-0.0016	-0.0014	-0.0133	-0.0034	-0.0032	0.0020	0.0010	0.0060	-0.0182	0.0140	0.0054	0.0623
Harvest Index (%)	-0.0875	0.0101	-0.0729	-0.1877	-0.0707	-0.0067	0.0462	0.0039	0.0809	-0.2422	0.3148	0.2580	0.1659
Seed Index (g)	-0.0141	0.0115	-0.0260	-0.0196	-0.0119	0.0099	0.0117	-0.0068	0.0086	-0.0250	0.0689	0.0841	0.302*
Seed yield per plant	-0.0322	0.1060	-0.0399	0.267*	0.1528	0.408**	0.242*	0.282*	-0.0376	0.0623	0.1659	0.302*	1.0000

*Residual effect - 0.324, * 5% Level of Significance, ** 1% Level of Significance*

Table 7. Genotypic path between yield and yield attributing traits in 13 quantitative traits of 26 Blackgram genotypes

Traits	Days to fifty percent flowering	Days to fifty percent pod setting	Days to maturity	Plant height (cm)	Number of primary branches	Number of clusters per plant	Number of pods per plant	Number of seeds per pod	Pod length (cm)	Biological yield per plant (g)	Harvest Index (%)	Seed Index (g)	Seed yield per plant
Days to fifty percent flowering	-0.0616	-0.0378	-0.0067	-0.0151	-0.0071	0.0019	-0.0006	0.0175	0.0045	-0.0127	0.0134	0.0089	-0.0609
Days to fifty percent pod setting	0.0670	0.1094	0.0238	0.0079	0.0095	-0.0108	-0.0092	-0.0081	-0.0025	0.0040	0.0056	0.0130	0.0594
Days to maturity	0.0074	0.0149	0.0683	-0.0034	0.0054	-0.0065	0.0028	0.0092	0.0101	0.0113	-0.0180	-0.0190	0.0159
Plant height (cm)	0.0565	0.0167	-0.0115	0.2312	0.0480	0.0192	-0.0278	-0.0403	-0.0758	0.1380	-0.1001	-0.0232	0.1329
Number of primary branches	-0.0170	-0.0128	-0.0116	-0.0305	-0.1471	-0.0866	-0.0718	0.0069	0.0034	-0.0166	0.0278	0.0201	0.1036
Number of clusters per plant	-0.0101	-0.0316	-0.0305	0.0265	0.1886	0.3204	0.1992	0.0782	-0.0025	0.0290	-0.0041	0.0237	0.388**
Number of pods per plant	0.0011	-0.0095	0.0047	-0.0136	0.0551	0.0702	0.1129	0.0132	0.0230	-0.0121	0.0095	0.0051	0.252*
Number of seeds per pod	-0.0702	-0.0184	0.0333	-0.0432	-0.0116	0.0605	0.0290	0.2476	0.0473	0.0057	-0.0157	-0.0249	0.312*
Pod length (cm)	-0.0038	-0.0012	0.0077	-0.0170	-0.0012	-0.0004	0.0106	0.0099	0.0520	-0.0110	0.0091	0.0040	0.0726
Biological yield per plant (g)	0.0258	0.0045	0.0208	0.0751	0.0142	0.0114	-0.0135	0.0029	-0.0267	0.1258	-0.0928	-0.0296	0.1073
Harvest Index (%)	-0.0356	0.0084	-0.0432	-0.0710	-0.0310	-0.0021	0.0138	-0.0104	0.0288	-0.1210	0.1639	0.1331	0.1126
Seed Index (g)	-0.0203	0.0167	-0.0391	-0.0141	-0.0192	0.0104	0.0064	-0.0142	0.0109	-0.0330	0.1141	0.1405	0.252*
Seed yield per plant	-0.0609	0.0594	0.0159	0.1329	0.1036	0.388**	0.252*	0.312*	0.0726	0.1073	0.1126	0.252*	1.0000

*Residual effect: 0.282, * 5% Level of Significance, ** 1% Level of Significance*

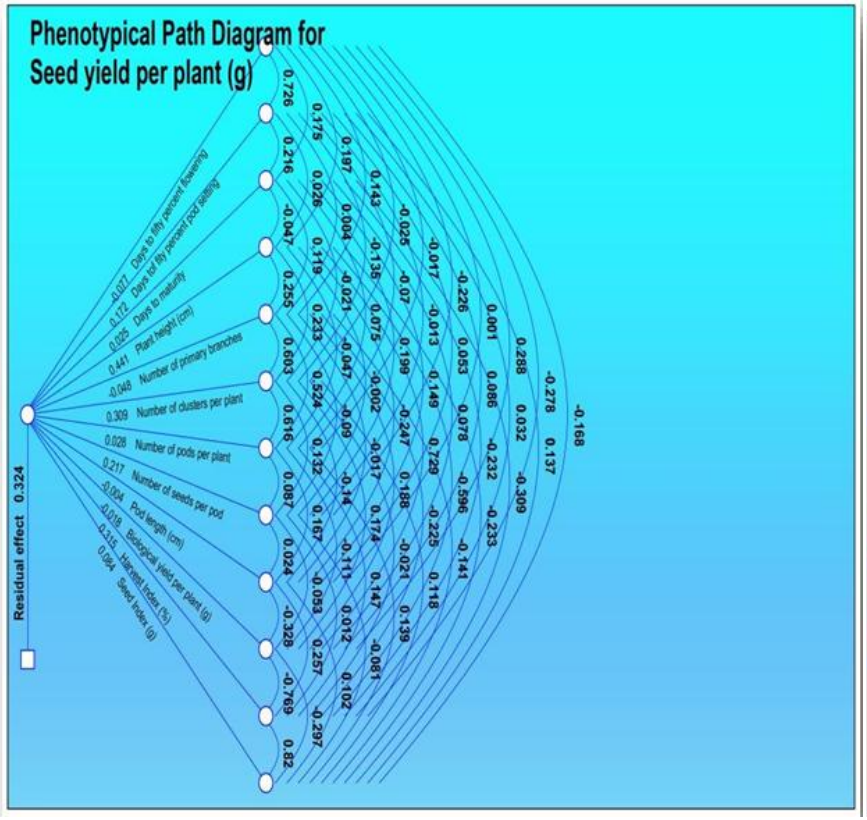

Fig. 1. Phenotypical path diagram

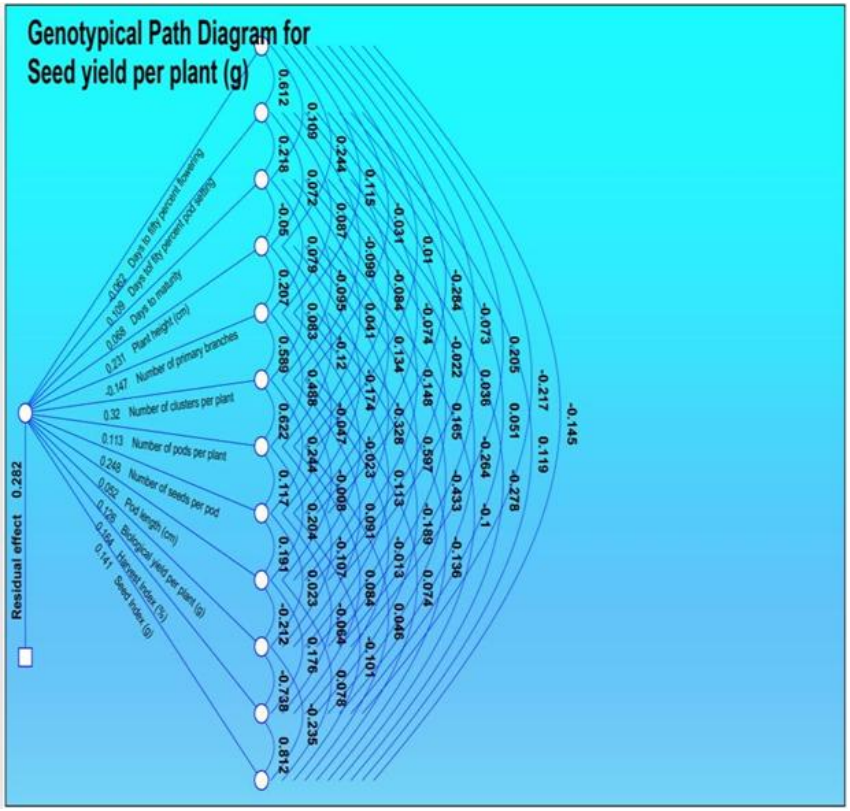

Fig. 2. Genotypical path diagram

In Genotypic Path coefficient analysis maximum direct positive effect on seed yield per plant was observed in number of clusters per plant (0.3204) followed by number of seeds per pod (0.2476), plant height (0.2312), harvest index (0.1639), seed index (0.1405), biological yield per plant (0.1258), number of pods per plant (0.1129) and days to 50% pod setting (0.1094). Maximum negative direct effect on seed yield per plant was observed from number of primary branches (-0.1471) followed by days to 50% flowering (-0.0616) in (Table 7). Such types of results have been reported by some researchers including Konda et al. [14], Begum et al. [15], Mehra et al. [16].

4. CONCLUSION

The present investigation concluded that among 26 genotypes of blackgram on basis of mean performance MASH – 338 was found to be superior in yield over the check (Shekar -2). As blackgram is mainly self pollinated crop different traits has different adoptions to different environmental conditions where those adaptions may have direct and indirect effect on yield contributing characters on seed yield. Positive and significant effect over a seed yield per plant was exhibited by number of pods per plant and number of clusters per plant at genotypic and phenotypic level. Positive and direct effect over a seed yield per plant is exhibited by number of pods per plant and number of clusters per plant. Hence these traits must primarily included in breeding procedure.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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