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Genetic Parameters and Diversity Analysis in Blackgram (*Vigna mungo* L. Hepper) for Seed Yield Characters

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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

Pulses occupy a very unique position in Indian agriculture by virtue of the fact that they are highly nutritious and provide a protein-filled diet via food. As compared to the cereal production globally, pulses are being produced sporadically in low fertile lands having moisture stress condition which eventually conceal its true yield capacity to its poor management practices. The aim of the present study uses to estimate the genetic parameters of 13 yield attributing characters traits in 20 Black gram genotypes with the view to select for better yield contributed characters in Black gram. Analysis of variance showed significant differences for all the 13 characters. Seed yield per plant exhibited high estimates of PCV, GCV and heritability. Super—imposition of genotypes was observed in Metro glyph analysis because of close proximity two variables taken for plotting the genotypes. In this classification analysis made based on biological yield and harvest index for all the

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20 genotypes formed 4 complexes. Out of 20 genotypes 4 genotypes like KU-99-16, KU-96-8, KU-48 and KU-303 were recorded highest index score and fell into different complex, hence used as parents for getting good combinations for future hybridization programmers.

Keywords: RBD; Genetic variability; GCV; PCV; clusters; metro glyph; index score.

1. INTRODUCTION

Among pulses, black gram is an important short-duration grain legume crop grown throughout the country. It is domesticated from *V. mungo* var. *Silvestre's* [1]. Pulses are considered poor man's meat and nutritional powerhouse as one of the best complementary to animal protein. These are rich in protein (mainly globulins), high in fiber, and contain low concentrations of methionine and cysteine. But they are high in lysine than cereals.Black gram seeds can provide up to energy (346 Kcal), carbohydrate (63.4 g), protein (24 g), fat (1.6 g), and total dietary fiber (16.2 g) with respect to its 100-seed weight. Global pulse production has reached 83.46 MT including India's share of 21.75% in it. Total pulse production in India is estimated to 24.51MT whereas total production of Urad bean is recorded as 3.28 MT (DES, 2019-20). In India, black gram is cultivated in 5.031 m. ha with a total production of about 0.653 m. tonnes. One of the most important natural resources for supplying desired features for creating high-yielding, input-responsive cultivars that are resilient to diverse abiotic and biotic challenges is probably the evaluation of germplasm [2]. Therefore, selecting donors with the quality traits needed to be improved in future breeding programmes requires carefully evaluating germplasms in the context of the current environment. Therefore, it is essential to take advantage of the genetic diversity that already exists by calculating various genetic parameters such as genotypic, phenotypic, and environmental variances, as well as their coefficients of variability, genetic progress, and heritability. It mainly helps to study the inheritance of various developmental-cum-productive traits. Metro glyph and Index score analysis is the technique was developed by [3] to investigate the pattern of morphological variation in chickpea genotypes.

2. MATERIALS AND METHODS

The present investigation was carried out in the Field Experimentation Centre of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, U.P during *Kharif*-2021. A randomized block design was adopted with three replications and row to row spacing is 30cm and plant to plant spacing is 10cm with plot size of 1mx1m.To examine the impact of various traits for heritability and genetic divergence on Seed yield over time, 20 genotypes were grown during Kharif 2021 [2] and [4].

On the basis of five competitive plants selected at random from each replication, replication-specific data were collected for the following thirteen (13) quantitative traits: Days to 50% flowering (45 to 60 days).

Days to maturity Plant height No. of per branches plant No. of clusters per plant No. of pods per plant No. of pods per cluster No. of seeds per pod Pod length (cm) Seed index.

Biological yield per plant Harvest index Seed yield per plant [5].

All of the recorded data for the characters under consideration were analyzed for variance using the [6] formula. Additionally, the genetic parameters genotypic coefficient of variance (GCV), phenotypic coefficient of variance (PCV), heritability in the broadest sense, genetic advance as percent of mean, and correlation analysis were carried out by using the appropriate statistical procedure. These additional components of variance included phenotypic, genotypic, and environmental variance [7].

3. RESULTS AND DISCUSSION

The abundant scope for improving these characters including seed yield provided the material is subjected to judicious selection programme. Due to diverse source of material taken as well as environmental influence affecting the phenotypes the presence of variability might be large.

The mean values, coefficient of variation (C.V.), standard error of the mean (Sem+), critical difference (C.D.) at 5% and 1%, and range of 20 genotypes are shown in which demonstrated a large range of variance for all characteristics tested [8].

On the basic of mean performance, the highest seed yield per plant was observed for blackgram genotypes Ku-96-8 (10.17g), Type-9 (9.93g), Ku-99-16 (9.70g) and Azad-1 (9.60g) were found to be superior in seed yield [9].

3.1 Variability

The present investigation, the Phenotypic coefficient of variation was higher than the corresponding Genotypic coefficient of variation for all the traits indicating that there was an influence of the environment. Among the 13 quantitative characters, high estimates of GCV and PCV were recorded for harvest index (28.89, 29.95), seed yield per plant (20.96, 21.86), no. of pods per plant (18.86, 20.39) and no. of clusters per plant (25.95, 26.52).The high estimates of PCV and GCV for these traits suggested the possibility of yield improvement through selection of these traits. Similar fining were reported by [10] and [11].

3.2 Heritability

The present investigation, high heritability values were recorded for no. of clusters per plant (95.80%), harvest index (93.05%), seed yield per plant (92.01%), no. of pods per plant (85.54), days to 50% flowering (81.41%), biological yield (78.88%), plant height (68.85%) and seed index (52.83%) [12] and [13]. The high heritability values of the considered traits in the present study indicated that those were less influenced by the environment and thus help in effective selection of the traits based on the phenotypic expression by adopting simple selection method and suggested the scope of genetic improvement. Similar finding are reported by [14] and [15].

3.3 Genetic Advance as a Percentage Mean

The estimation of genetic advance as percent mean is classified as low (<10%), moderate (10 to 20%) and high (>20%) proposed by [16] and [17].

In the present study, high estimates of heritability coupled with high genetic advance as percent of mean was observed for harvest index (57.41, 93.05%), no. of clusters per plant (52.34, 95.80), seed yield per plant (41.43, 92.01%), no. of pods per plant (35.94, 85.54%), biological yield (28.82, 78.88%) and days to 50% flowering (24.60, 81.41%).Similar findings are reported by [18] and [19].

3.4 Metroglyph Analysis

The scatter diagram revealed that four complexes could be distinguished on the basis of morphological variation. Complex-II was represented by 7 genotypes with High biological yield per plant with moderate harvest index [20].

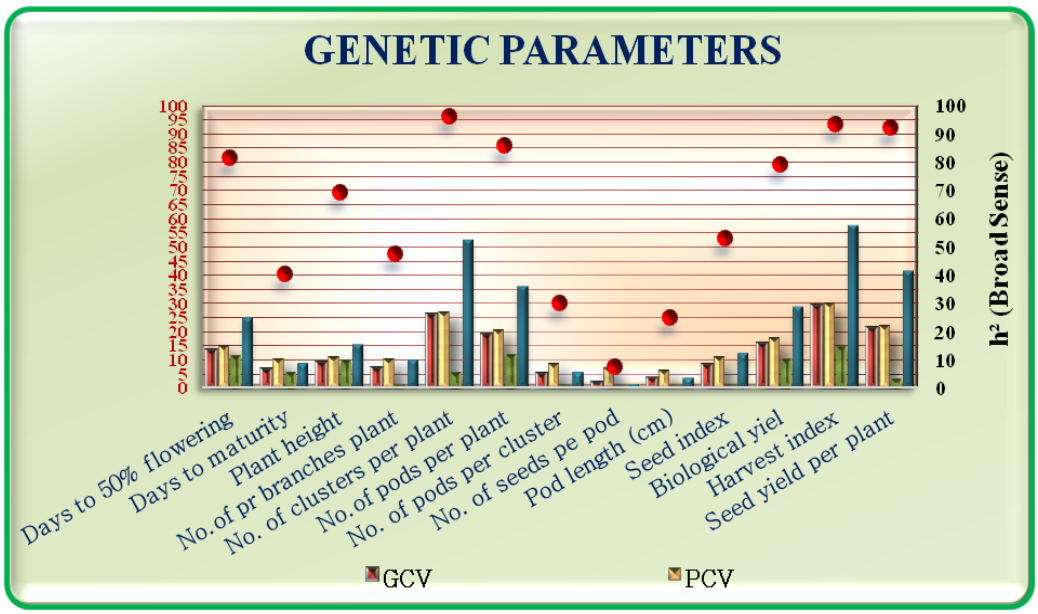

Fig. 1. Histogram depicting GCV, PCV, Genetic Advance and Heritability for 13 quantitative characters of Blackgram Genotypes

Table 1. Analysis of Variance for 13 quantitative characters of Blackgram genotypes

		Mean Sum of Squares		
	Source	**Replication**	**Treatment**	**Error**
S. No.	**Degrees of freedom**	**2**	**19**	**38**
1	Days to 50% flowering(45 to 60 days)	4.688	114.975**	8.131
2	Days to maturity	1.371	72.421**	24.176
3	Plant height	2.029	109.993**	14.413
4	No. of per branches plant	0.13	1.76**	0.479
5	No. of clusters per plant	0.294	20.662**	0.297
6	No. of pods per plant	10.854	117.895**	6.285
7	No. of pods per cluster	0.033	0.068*	0.03
8	No. of seeds per pod	0.056	0.261	0.212
9	Pod length (cm)	0.033	0.082*	0.041
10	Seed index	0.056	0.239**	0.055
11	Biological yield per plant	3.198	96.105**	7.873
12	Harvest index	4.461	164.211**	3.987
13	Seed yield per plant	0.017	7.567**	0.213

Table 2. Genetic parameters for 13 quantitative characters in Blackgram genotypes

S. No.	**Genetic Parameters**	**GCV**	**PCV**	**h2 (Broad Sense)**	**GAM%**
1	Days to 50% flowering(45 to 60 days)	13.237	14.671	81.413	24.604
2	Days to maturity	6.43	10.174	39.947	8.372
3	Plant height	8.924	10.755	68.852	15.254
4	No. of per branches plant	6.864	10.002	47.099	9.704
5	No. of clusters per plant	25.959	26.521	95.805	52.342
6	No.of pods per plant	18.866	20.398	85.548	35.947
7	No. of pods per cluster	4.686	8.563	29.945	5.282
8	No. of seeds per pod	1.877	7.005	7.184	1.037
9	Pod length (cm)	3.104	6.258	24.604	3.172
10	Seed index	7.981	10.98	52.834	11.95
11	Biological yield per plant	15.753	17.736	78.884	28.822
12	Harvest index	28.895	29.954	93.053	57.419
13	Seed yield per plant	20.969	21.86	92.012	41.435

Table 3. Index scores and signs used for characters for metro glyph analysis of 20 genotypes of Blackgram

S. No.	Character	Range of Mean	Score 1	Sign	Score 2	Sign	Score 3	Sign
			Value <		Value from - to		Value >	
1	Days to 50% flowering	38.33-58.67	38.89		38.89-51.27		51.27	
2	Days to maturity	55.33-73	57.45		57.45-67.28		67.28	
3	Plant height	50.97-75.9	57.19		57.19-69.31		69.31	
4	No.of per branches plant	8.27-10.87	8.75		8.75-10.28	O	10.28	O
5	No. of clusters per plant	5.13-15.67	7.41		7.41-12.66		12.66	
6	No.of pods per plant	20.13-40.8	26.06		26.06-38.6		38.60	
7	No. of pods per cluster	2.13-2.6	2.26		2.26-2.56		2.56	
8	No. of seeds per pod	6.27-7.2	6.53		6.53-7.12		7.12	
9	Pod length (cm)	3.43-4.13	3.57		3.57-3.9		3.90	
10	Seed index	2.63-3.93	2.82		2.82-3.39		3.39	
11	Biological yield per plant	20.53-45.37	28.77		28.77-40.09		40.09	
12	Harvest index	13.77-48.93	17.89		17.89-32.69	O	32.69	O
13	Seed yield per plant	5.3-10.17	5.88		5.88-9.05		9.05	

Table 4. Distribution of genotypes in different complex in metro glyph analysis

Complex	Name of complex	No. of Genotypes	Name of lines	Range and average score
I	Moderate biological yield with moderate harvest index	10	Ku-48, Ku-88-31-2, Azad-2, Ku-96-7, Ku-303, Azad-1, Shekhar-3, Azad-3, Ku-321, 05-Ku-96-1	24-33 (27.42)
II	High biological yield with moderate harvest index	7	Ku-42, Ku-96-8, Ku-302, Pusa Urad, Ku-96-4, ku-88-9-1, Ku-99-16	19-30 (25.80)
III	Lower biological yield with lower harvest index	2	Ku-16-4, BARABANKI	26-27 (26.50)
IV	Lower biological yield with higher harvest index	1	Type-9	23

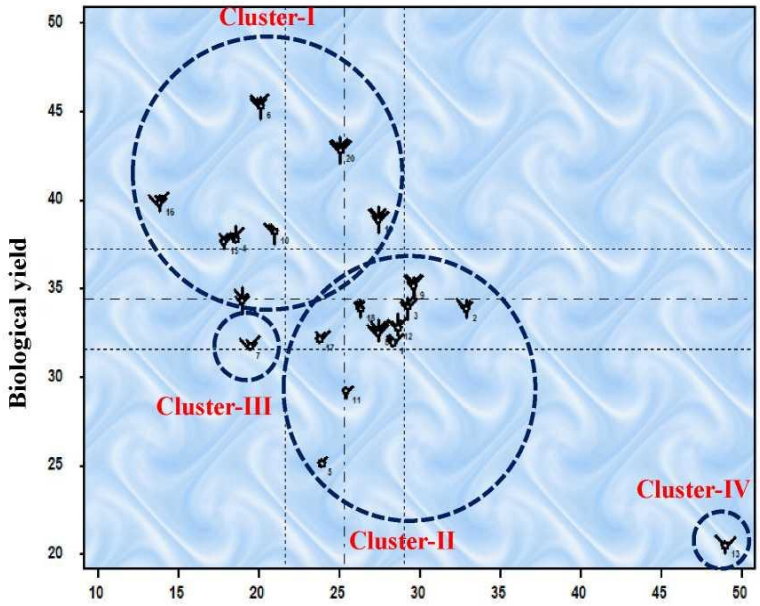

Fig. 2. Scattered diagram of Metro glyph analysis showing 20 genotypes of Blackgram

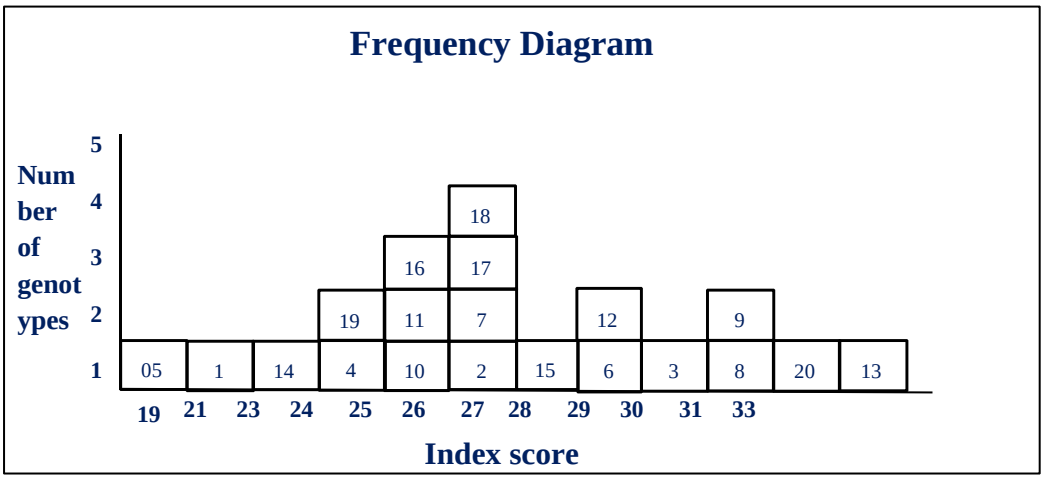

Fig. 3. Metro glyph frequency diagram showing 20 genotypes of Black gram

Complex –I was represented by ten genotypes and characterized by Moderate biological yield with moderate harvest index.

Complex-II was represented by seven genotypes and characterized by High biological yield with moderate harvest index.

Complex-III was represented by two genotypes and characterized by lower biological yield with lower harvest index.

Complex-IV was represented by one genotype and characterized by Lower biological yield with higher harvest index.

The range of variability for characters, their values for index score and signs with rays are. The plant height (50.97-75.90) followed by days to maturity (55.33-73.00), days to 50% flowering (38.33-58.67), harvest index (13.77-48.93), biological yield (20.53-45.37) and no. of pods per plant (20.13-40.80). These traits thus were most variable for classificatory analysis in black gram [21] and [22].

The mean performance and total index score of 20 genotypes are presented. The total index score was varied from 19 (KU– 96– 1) to 33 (BARABANKI).

The frequency diagram revealed that the index scores ranged from 19-33. Maximum frequency of genotypes 10 occurred for index score of 26 followed by minimum frequency of genotypes 1 occurred for index score of 19, 21, 23, 27, 29, 31 and 33. Highest index score of 33 recorded by only one line (BARABANKI) followed by index score of 31, 30 and 29 by 1, 2, and 1 lines. [23] and [24].

4. CONCLUSION

From the present investigation it is concluded that among 20 Black gram genotypes based on the mean performance KU-96-8 (10.17g) was found to be superior in seed yield per plant. Harvest index had recorded with high estimates of GCV and PCV and high heritability values were recorded for no. of clusters per plant. High estimates of heritability coupled with high genetic advance as percent of mean was observed for harvest index. KU-99-16, KU-96-8, KU-48 and KU-303 recorded highest index score and fell into different complex, hence used as parents for getting good combinations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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