

Short Research Article

Genetic Variability and Association Studies for Yield and Yield Attributing Traits in Blackgram (*Vigna mungo* L. Hepper)

ABSTRACT

Aims:The blackgram breeding program depends on estimating the variability in the plant population to increase productivity and production.

Place and Duration of Study:The field study was carried out during 2019-2020 in VOC Agricultural College and Research Institute, Killikulam, Tamil Nadu Agricultural University at Department of Genetics and Plant Breeding.

Study Design and Methodology:The present study was carried out on 60 F₄ progenies developed from the cross IC 436656 x KKB14045 in blackgram (*Vigna mungo* L. Hepper) for the assessment of *per se* performance, genetic variability, and association studies.

Results: Based on the production of a single plant, seventeen offspring were determined to be promising. The traits viz., number of clusters per plant, number of pods per plant, and single plant yield showed high PCV and GCV, which indicated that there was a high level of genetic variability in the population. The variables of plant height, number of clusters/plant, number of pods/plant, and single plant yield showed significant heritability and high genetic advancement, indicating additive gene action. Single plant yield was positively and significantly correlated with the traits viz., plant height, number of clusters/plant, number of pods/plant, and number of seeds/pod. Therefore, choosing these characteristics is crucial to creating high-yielding blackgram cultivars.

Key words:Blackgram, F₄ progenies, Per se performance, Genetic variability, Association studies

INTRODUCTION

An expensive pulse, blackgram (*Vigna mungo* L. Hepper) is high in iron, copper, calcium, magnesium, zinc, potassium, phosphorus, and vitamin B complex. Presently, India is the world's top producer of black gram, contributing over 70% of the total production. In India, blackgram is cultivated in an area of about 39.6 lakh ha (97.85 lakh acres) (Source: www.agricoop.nic.in) with a production of 2.23 million tonnes during 2020-21. Due to the plants' resilience to severe weather, blackgram cultivation is comparatively simple. Poor management techniques and several physical, biochemical, and crop genetic factors, however, contribute to the low yield of blackgram (agrifarming.in).

Estimating the variability in the plant population is crucial to the breeding program's effectiveness for blackgram. A population's level of genetic variety has a significant impact on how effective selection is. Although the genetic component alone is heritable, the observed variability is a result of both genotypic and epigenetic variables. Since more diversity expands the potential for selection,

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a high degree of phenotypic and genotypic variability is necessary for the selection of good genotypes. The likelihood that a genotype may be recognized by its phenotypic expression is indicated by the heritability magnitude. The term "genetic advance" describes how the mean genotypic value of the chosen families has improved over the population. Because the trait's additive gene action is so prevalent, high heritability suggests that changes in phenotypic performance could be achieved with simple selection.

Additionally, correlation aids in comprehending how different components affect yield (Kozak and Kang, 2006). When it comes to creating successful and sustainable breeding programs for seed yield, when direct selection is not very effective, the relationship between seed yield and plant characteristics is crucial (Mathivathana *et al.*, 2015). In order to identify ideal progenies and attributes for yield improvement, the current study concentrated on genetic variability and association studies in 60 F₄ blackgram progenies.

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MATERIALS AND METHODS

The experimental material consisted of 60 F₄ progenies derived from the cross IC 436656 × KKB 14045. The field experiment was conducted at Department of Genetics and Plant Breeding at VOC Agricultural college and Research Institute, Killikulam during 2019-2020. Biometrical traits *viz.*, plant height (cm), days to fifty percent flowering, number of primary branches / plant, number of clusters / plant, number of pods / plant, number of seeds / pod and single plant yield (g) were recorded.

All the 60 F₄ progenies were raised in 3 meter row with a spacing of 30 x 10 cm and proper agronomic practices were followed. The statistical methods suggested by Johnson *et al.*, (1955) for various genetic variability parameters *viz.*, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance as percentage of mean (GAM) were worked out. Genotypic correlation coefficient was worked out using the formulae given by Al-Jibouriet *al.*, (1958). TNAU STAT software was used for analysis of variability and correlation studies (Manivannan, 2014).

RESULTS AND DISCUSSION

The *per se* performance of F₄ progenies for the studied traits is given in Table 1.

Table 1. The *per se* performance of F₄ progenies in blackgram

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Sl No	F ₄ progenies	Days to 50% flowering	Plant height(cm)	Number of branches / plant	Number of clusters / plant	Number of pods / plant	Number of seeds / pod	Single plant yield(g)
1	1.11	32*	31.25	5.5	18.00	23.00	5.50	3.50
2	1.12	36*	28.40	7.5*	20.50	39.00	5.50	2.73
3	1.13	38	30.65	7.5*	24.00*	33.00	6.00	2.18
4	1.14	39	27.45	7.0	10.50	33.50	6.00	4.61
5	1.47	37*	35.05	7.5*	20.50	31.00	6.50	4.65

6	1.54	37*	31.50	6.0	10.00	24.75	5.50	4.38
7	1.55	34*	19.15	6.0	7.00	11.50	5.00	3.03
8	1.61	38	22.80	6.0	9.00	10.00	5.50	1.68
9	1.65	33*	26.45	4.0	7.00	15.00	5.50	2.50
10	1.67	37*	25.40	6.0	12.50	29.00	5.50	2.93
11	1.73	33*	27.70	6.5	12.50	27.50	6.00	3.49
12	1.75	32*	31.75	7.0	23.50*	30.00	6.00	4.84
13	2.1	45	26.60	6.0	8.00	14.00	5.50	4.02
14	2.12	41	32.50	5.0	20.00	39.50	5.50	12.36*
15	2.19	33*	27.25	6.5	11.50	23.00	6.00	6.90
16	2.2	40	34.25	8.0	26.50*	23.00	5.50	4.45
17	2.23	34*	29.25	7.0	15.50	21.00	5.00	2.43
18	2.25	43	22.10	3.5	10.00	18.50	4.50	4.84
19	2.29	46	22.65	6.0	24.00*	50.50*	5.00	12.54*
20	2.32	39	27.23	7.5*	27.00*	36.50	6.00	11.52*
21	2.33	40	27.90	4.0	14.00	26.00	5.00	4.72
22	4.1	38	30.10	4.5	14.50	33.50	6.00	13.68*
23	4.7	36*	25.90	4.0	11.00	24.00	5.50	4.92
24	4.8	38	27.25	5.5	11.50	29.50	5.50	11.91*
25	4.12	35*	28.50	4.5	10.00	24.50	5.00	3.13
26	4.17	37*	28.00	5.0	9.50	13.00	6.00	3.24
27	4.22	36*	31.15	6.0	13.50	19.50	5.00	6.49
28	4.23	46	22.70	3.0	2.50	7.50	5.00	2.72
29	5.11	35*	29.65	6.5	26.50*	62.00*	6.00	13.32*
30	5.13	39	26.60	6.0	13.50	27.00	5.50	7.30
31	5.14	40	28.75	5.0	23.50*	45.50*	6.00	15.10*
32	5.17	38	25.20	4.5	14.50	27.00	5.50	8.61
33	5.18	36*	31.75	5.0	24.00*	39.50	5.50	9.62
34	5.19	34*	37.25*	5.0	20.00	43.00*	5.50	12.01*
35	5.21	34*	26.43	5.0	16.50	27.00	5.00	8.95
36	5.22	36*	21.90	3.5	7.50	12.00	5.00	1.76
37	5.34	36*	23.00	5.0	15.50	35.50	5.00	10.19
38	5.36	39	27.35	5.0	16.50	28.50	6.00	9.91
39	5.37	39	27.15	4.5	11.50	12.00	5.00	4.65

40	5.41	37*	22.93	4.5	16.00	37.00	5.50	8.61
41	5.42	36*	30.43	6.5	13.50	24.00	6.00	5.47
42	5.45	37*	33.75	4.5	21.00	43.00*	6.00	13.63*
43	5.47	38	41.05*	4.5	30.00*	57.00*	6.00	13.57*
44	5.48	36*	39.70*	4.5	26.00*	42.00*	6.00	17.05*
45	5.51	37*	33.15	5.0	24.50*	36.00	5.50	4.30
46	5.53	34*	22.05	4.5	13.00	28.00	5.50	3.85
47	5.54	35*	22.78	5.0	15.50	25.50	6.00	4.39
48	5.55	34*	25.30	4.5	12.00	25.50	5.00	5.85
49	5.56	32*	30.90	4.5	19.00	44.00*	6.00	13.30*
50	5.57	35*	30.90	5.0	21.00	42.50*	5.50	6.84
51	5.58	34*	47.15*	5.0	37.50*	60.50*	6.00	13.88*
52	5.59	38	35.55	3.5	11.50	28.00	5.50	11.41*
53	5.61	36*	28.20	4.5	16.50	27.00	5.50	13.17*
54	5.66	36*	32.35	5.5	18.00	59.50*	5.50	12.52*
55	5.67	36*	41.55*	6.5	27.50*	59.00*	5.50	14.40*
56	6.7	36*	28.10	5.5	12.00	23.00	5.50	5.62
57	6.14	38	29.35	5.5	16.00	32.00	5.50	6.10
58	6.26	32*	27.80	4.0	14.00	24.00	5.50	6.18
59	6.27	38	22.88	5.0	14.25	22.50	5.50	7.20
60	6.28	39	21.25	5.5	13.00	17.00	5.50	3.93
MEAN		36	28.88	5.4	16.42	30.45	5.55	7.38
CD		1.83	7.37	1.92	6.87	10.82	1.05	3.06

The progenies viz., 2.12, 2.29, 2.32, 4.1, 4.8, 5.11, 5.14, 5.19, 5.45, 5.47, 5.48, 5.56, 5.58, 5.59, 5.61, 5.66 and 5.67 were identified as potential based on single plant yield. Thirty-seven progenies exhibited significantly superior performance for early maturity, five progenies for plant height, four progenies for number of branches/plants, thirteen progenies for number of clusters/plant, twelve progenies for number of pods/plant. The identified progenies may be forwarded to further generations in blackgram improvement programs.

Variability parameters in F₄ progenies of the cross IC 436656 × KKB 14-45 is given in **Table 2**. High PCV and GCV were observed for the traits viz., number of clusters/plant (43.51% and 38.16% respectively), number of pods/plant (44.61% and 40.93% respectively) and single plant yield (59.35% and 55.63% respectively) suggesting the presence of high genetic variability present in the population and selection is effective for these traits. Priya *et al.*, (2018) reported the similar results for the traits viz., single plant yield, number of clusters/plant, number of pods/plant; Pratap *et al.*, (2019) for the traits

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viz., number of pods/plant and grain yield /plant; Narayanan *et al.*,(2021) for the traits viz., number of pods per plant and single plant yield.

High heritability coupled with high genetic advance were observed in the traits viz., plant height (61.92% and 26.35% respectively), number of clusters / plant (76.93% and 68.94% respectively), number of pods / plant (84.16% and 77.34% respectively) and single plant yield (87.86% and 107.42% respectively). The trait number of branches per plant showed both strong genetic advancement and medium heritability (47.82% and 24.49%, respectively), indicating additive gene action for the genetic regulation of these traits. Sushmitharajet *et al.*, (2018) and Sathees *et al.*,(2019) reported similar findings for number of clusters / plant and single plant yield; Priya *et al.*, (2018) for the traits viz., plant height, number of primary branches / plant, number of clusters / plant, number of pods / plant and single plant yield. Vadivel *et al.*,(2019) for the traits viz., number of branches / plant, number of pods / plant and seed yield / plant; Gomathy *et al.*, (2020) for plant height, number of primary branches/plant, number of clusters/ plant, number of pods/plant and yield; Pratap *et al.*,(2019) for plant height; Narayanan *et al.*,(2021) for number of pods / plant and single plant yield.

Table 2 Variability parameters in F₄ progenies of the cross IC 436656 × KKB 14-45

Traits	GCV	PCV	Heritability (%)	GAM (%)
Days to 50% flowering	8.29	8.66	91.66	16.35
Plant height (cm)	16.26	20.66	61.92	26.35
Number of branches / plant	17.19	24.86	47.82	24.49
Number of clusters / plant	38.16	43.51	76.93	68.94
Number of pods /plant	40.93	44.61	84.16	77.34
Number of seeds / pods	2.64	9.79	7.27	1.47
Single plant yield (g)	55.63	59.35	87.86	107.42

The association between the yield and component traits is presented in **Table 3**. The trait single plant yield had significant and positive association with the traits viz., plant height (0.507), number of clusters/plant (0.588), number of pods/plant (0.749) and number of seeds/pod (0.295). Similar significant and positive association was reported in blackgram by Soheli *et al.*,(2016) for pods/plant; Sushmitharajet *et al.*, (2018) for plant height, number of clusters / plant and number of pods / plant in thirty two advanced black gram genotypes; Keerthiga *et al.*, (2018) for number of seeds / pod in 30 F₄ progenies of greengram; Priya *et al.*,(2018) for number of pods/plant and number of clusters/plant in one hundred and twenty black-gram genotypes; Blessy and Naik (2018) for number of pods/plant and number of clusters / plant in fourteen blackgram genotypes. Sathees *et al.*,(2019) for plant height, number of clusters/plant, number of pods/plant and number of seeds/pod in one hundred and sixty-two F₂ plants of the cross IC 436656 x KKB 14045; Pratap *et al.*, (2019) for number of pods/plant, number of seeds/pod and plant height; Gomathy *et al.*,(2020) for number of clusters/plant and number

of pods/plant in 140 F₃ progenies developed from the cross IC 436656 x KKB14045. Narayanan *et al.*,(2021) for number of clusters/plant, number of pods/plant and number of seeds/pod in F₄ black gram population.

From inter correlation studies, days to 50 % flowering was significant and negative association with number of seeds/pod (-0.223); plant height had significant and positive association with number of clusters/plant (0.700), number of pods/plant (0.617) and number of seeds/pod (0.433); number of branches/plant had significant and positive association with number of clusters/plant (0.322) and number of seeds/pod (0.361); number of clusters/plant had significant and positive association with number of pods/plant(0.809) and number of seeds/pod (0.428); number of pods/plant was in significant with number of seeds/pod (0.379). Blackgram breeding programs would benefit greatly from the selection of these traits, which might be used to increase blackgram yield.

Table 3. Correlation coefficients among yield components in F₄ progenies of the cross IC 436656 x KKB 14045

Traits	Days to 50% flowering	Plant height (cm)	Number of branches / Plant	Number of clusters / plant	Number of pods / plant	Number of seeds / pod	Single plant yield (g)
Days to 50% flowering	1	-0.208	-0.067	-0.11	-0.104	-0.223*	0.048
Plant height (cm)		1	0.143	0.700*	0.617*	0.433*	0.507*
Number of branches / Plant			1	0.322*	0.144	0.361*	-0.161
Number of clusters / Plant				1	0.809*	0.428*	0.588*
Number of pods / plant					1	0.379*	0.749*
Number of seeds / pod						1	0.295*
Single plant yield (g)							1

* Significant at 5% level

CONCLUSION

It is crucial to measure the variability in the plant population in order to ensure the effectiveness of the blackgram breeding program. On the basis of a single plant's yield, seventeen offspring were determined to be promising. A high degree of genetic variability in the population was suggested by the high PCV and GCV of the variables yield per single plant, number of clusters/plant, and number of pods/plant. Among the variables with high genetic progress and high heritability that demonstrated additive gene activity were plant height, number of clusters per plant, number of pods per plant, and single plant yield. The yield of a single plant was found to be positively and significantly correlated

with plant height, number of clusters per plant, number of pods per plant, and number of seeds per pod. Thus, selecting these traits is essential to producing high yielding blackgram cultivars.

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