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Research Article

ESTIMATION AND EVALUATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN F_1 GENERATION OF BLACK GRAM (*Vigna mungo* L. Hepper)

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Abstract: Black gram (*Vigna mungo*) is one of the most ancient and important legume crop of India and contributes 10 % of India's total Pulse Production. The research was conducted during kharif 2017 in the Field experiment Centre at Department of Genetics and Plant Breeding involving 36 genotypes along with 2 checks to examine genetic variability, Heritability and Genetic advance in black gram. The experiment was laid out in Randomized Block Design with three replications. Analysis of variance showed that highly significant differences among 36 genotypes of black gram for 13 characters studied. The estimates of PCV values were higher than GCV for all the characters. High estimates of GCV were observed for pods per plant, Branches per plant, cluster per plant but, for Harvest Index, Seed yield per plant, Biological Yield showed higher differences between PCV and GCV which indicates that the influence of Environment is high when compared to the other characters. High Heritability coupled with high genetic advance were observed for the character Plant Height (cm), pods per plant, 100 seed weight, seed yield per plant and Biological Yield indicating under the control of additive genes effects, and the selection should be fruitful for this trait.

Keywords: *Vigna mungo, Variability, Heritability, Genetic advance, Selection*

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Introduction

Black gram (*Vigna mungo*) is one of the most ancient and important legume crop of India and contributes 10 % of India's total Pulse Production. The research was conducted during kharif 2017 in the Field experiment Centre at Department of Genetics and Plant Breeding involving 36 genotypes along with 2 checks to examine genetic variability, Heritability and Genetic advance in black gram. The experiment was laid out in Randomized Block Design with three replications. Analysis of variance showed that highly significant differences among 36 genotypes of black gram for 13 characters studied [1]. The estimates of PCV values were higher than GCV for all the characters. High estimates of GCV were observed for pods per plant, Branches per plant, cluster per plant but, for Harvest Index, Seed yield per plant, Biological Yield showed higher differences between PCV and GCV which indicates that the influence of Environment is high when compared to the other characters. High Heritability coupled with high genetic advance were observed for the character Plant Height (cm), pods per plant, 100 seed weight, seed yield per plant and Biological Yield indicating under the control of additive genes effects, and the selection should be fruitful for this traits[3].

Materials and Methods

Methods 1

Black gram (*Vigna mungo*) is one of the most ancient and important legume crop of India and contributes 10 % of India's total Pulse Production. The research was conducted during kharif 2017 in the Field experiment Centre at Department of Genetics and Plant Breeding involving 36 genotypes along with 2 checks to examine genetic variability, Heritability and Genetic advance in black gram [3]. The experiment was laid out in Randomized Block Design with three replications. Analysis of variance showed that highly significant differences among 36 genotypes of black gram for 13 characters studied.

The estimates of PCV values were higher than GCV for all the characters. High estimates of GCV were observed for pods per plant, Branches per plant, cluster per plant but, for Harvest Index, Seed yield per plant, Biological Yield showed higher differences between PCV and GCV which indicates that the influence of Environment is high when compared to the other characters. High Heritability coupled with high genetic advance were observed for the character Plant Height (cm), pods per plant, 100 seed weight, seed yield per plant and Biological Yield indicating under the control of additive genes effects, and the selection should be fruitful for this traits.

Statistics 1

Mean: Mean value of each character was worked out by dividing the totals by the corresponding number of observations.

Mean $(\bar{X}) = \frac{\sum x}{N}$

Where,

Σx = Sum of all observations for each character in each replication

N = Corresponding number of observation.

Range:

It was taken as the difference between the highest and lowest mean value for each character.

Range = Xn- X1

Where,

Xn = Highest Mean value of the character

X1 = Lowest Mean Value of the character

Components of Variance

This was calculated by the formula suggested by Burton (1952)

1. Genotypic Variance(σ^2g)

The genotypic variance (VG or σ2g) is the variance due to the genotypes present in the population. The formula used for calculation of genotypic variance was,

$$\{\sigma 2g\} = \frac{Vt - EMS}{Number\ of\ Replications(r)}$$

Where,

Vt = Mean sum of squares due to treatment

EMS = Error mean sum of square.

2. Phenotypic Variance: (σ^2p)

Phenotypic variance (Vp or σ^2p) denotes the total variance present in a population for particular character and is calculated by following formula

$$\{\sigma^2p\} = \sigma^2g + \sigma^2e$$

Where,

σ^2g = Genotypic Variance

σ^2e = Error Variance

3. Environmental Variance (σ^2e)

The environmental variance (VE or σ^2e) is the variance due to environmental deviation.

VE = EMS

a. Coefficient of variation

It is the measure of variability evolved. Coefficient of variation is the ratio of standard deviation of a sample to its mean and expressed in percentage.

$$CV(\%) = \frac{Standard\ deviation}{Mean} \times 100$$

In the present investigation three types of coefficient of variations where estimated, *viz*., phenotypic coefficient of variation (GCV) and error/environmental coefficient of variation (ECV). The formula used to calculate PCV, GCV and ECV were given by Burton (1952),

$$PCV\ (\%) = \frac{Phenotypic\ standard\ deviation}{Grand\ Mean} \times 100$$

$$GCV\ (\%) = \frac{Genotypic\ standard\ deviation}{Grand\ Mean} \times 100$$

$$ECV(\%) = \frac{Error\ Standard\ deviation}{Grand\ Mean} \times 100$$

Where,

VP = Phenotypic Variance

VE = Environmental Variance

VG = Genotypic Variance

$\bar{X}$ = Mean of the Character

b) Heritability: (broad sense)

Heritability (h^2) in broad sense is the ratio of genotypic variance to the phenotypic or total variance. It is that portion of total variability or phenotypic variability which is heritable and due to the genotype. It was calculated by the formula suggested by Lush (1949) and Burton and Devane, (1953)

$$h^2 = \frac{VG}{VP} \times 100$$

Where,

VG = Genotypic Variance

VP = Phenotypic Variance

Searle, *et al*., (1955) suggested heritability values as follows:

Low = Less than 30%

Moderate = 30-60%

Higher = More than 60%

Genetic Advance

Genetic advance is the improvement in mean genotypic value of selected plant over the parental population. The estimates of genetic advance were obtained by the formula suggested by Lush, (1949) and Johnson, *et al*. (1955).

$$GA = K.\sigma p.h^2$$

Where,

K = Constant selection differential at 5% level intensity (=2.06)

σp = Phenotypic standard deviation

h^2 = Heritability in broad sense

Genetic Advance as percent as mean (GA% M)

$$GA\ (\%)\ M = \frac{GA}{\bar{X}} \times 100$$

The range of genetic advance is classified as suggested by Johnson, *et al*.(1955)

Low : Less than 10%

Moderate : 10-20%

Higher : More than 20%

Results 1

Table-1 Analysis of Variance for13Characters of Black gram Genotypes.

SN	Characters	Mean Sum Of Squares		
		Replication df = 2	Treatments df = 37**	Error df = 74
1	Days to 50% Flowering	4.195	36.450**	2.24
2	Days to 50% Pod Setting	0.802	54.734**	2.17
3	Days to Maturity	5.535	44.080**	2.98
4	Plant Height(cm)	1.726	232.66**	2.30
5	No.of Branches per plant	0.027	1.233**	0.05
6	No. of Cluster per plant	3.92	10.23**	1.48
7	Number of Pods per Plant	0.002	91.495**	1.97
8	Number of Seeds per pod	0.798	1.647**	0.50
9	Pod length(cm)	0.062	0.228**	0.04
10	100 Seed weight (g)	0.0005	0.458**	0.01
11	Biological Yield(g)	0.67	64.64**	1.78
12	Seed Yield per Plant(g)	0.18	6.413**	0.15
13	Harvest Index(%)	11.04	218.61**	6.15

Results 2

Table-2 Genotypic and Phenotypic variance, Genotypic and phenotypic co efficient of Variation and Heritability for 13 characters in Black gram

SN	Characters	Vg	Vp	GCV	PCV	h^2
1	Days to 50% Flowering	11.40	13.64	8.66	9.48	83.50
2	Days to 50% Pod setting	17.52	19.69	8.94	9.47	89.00
3	Days to maturity	13.69	16.68	5.60	6.18	82.00
4	Plant Height(cm)	76.78	79.09	15.45	15.68	97.00
5	Branches per Plant	0.393	0.44	20.74	22.12	88.00
6	Clusters per Plant	2.91	4.39	16.415	20.15	66.00
7	Pods per Plant	29.84	31.81	20.76	21.44	93.00
8	Seeds per pod	0.37	0.88	10.47	16.04	42.00
9	Pod Length(cm)	0.06	0.10	6.24	8.06	60.00
10	100 seed weight	0.14	0.15	9.77	10.10	93.00
11	Biological yield	20.95	22.73	6.89	24.63	92.00
12	Seed yield per Plant(g)	2.085	2.24	6.54	24.61	92.90
13	Harvest index (%)	70.82	76.97	7.58	26.84	92.00

Discussions

The analysis of variance revealed that the 36 genotypes varied significantly for all 13 characters studied indicating the presence of wide range of variability present among them [Table-1]. Similar findings were observed for Dharmendra Kumar *et al*.,(2017); Kondagari Hemalatha, *et al*., (2017) [1,2]. The estimates of PCV values were higher than GCV for all the characters [Table-2]. High estimates of GCV were observed for pods per plant, Branches per plant, cluster per plant Higher magnitude of PCV was recorded for Harvest index (26.84), followed by biological yield (24.63), seed yield per plant (24.61),on the other hand lower values of GCV and PCV were observed from days to maturity (5.60,6.18) and pod length (6.24,8.06) respectively, but for Harvest Index, Seed yield per plant, Biological Yield showed higher differences between PCV and GCV indicates that influence of Environment is high for these three traits when compared to the other characters. In general, High heritability was observed for all characters except number of seeds per pod and pod length these similar findings were observed by Sushmitha raj, *et al*., (2018) [4].

Results 3 Table-3 Mean, Range Genetic Advance for 13 characters in Black gram

SN	Characters	Genetic Advance as % of mean 1%	Genetic Advance (1%)	Per se performance Range (min and max)	Mean
1	Days to 50% Flowering	20.91	8.14	33.66 - 49.66	38.95
2	Days to 50% Pod setting	22.26	10.42	39.96 - 57.33	46.81
3	Days to maturity	13.41	8.85	58.33 - 72.00	66.00
4	Plant Height(cm)	40.20	22.79	42.86 - 74.06	56.69
5	Branches per Plant	51.36	1.55	1.86 - 4.26	3.022
6	Clusters per Plant	35.29	3.67	7.13 - 13.66	10.40
7	Pods per Plant	53.09	13.96	14.66 - 37.01	26.30
8	Seeds per pod	18.06	1.06	4.33-7.00	5.87
9	Pod Length(cm)	12.84	0.51	3.55-4.80	3.98
10	100 seed weight	24.98	0.98	3.00-4.64	3.95
11	Biological yield	59.95	11.60	13.51- 32.33	19.35
12	Seed yield per Plant(g)	60.39	3.67	3.30-9.65	6.08
13	Harvest index (%)	65.21	21.31	14.52-5.80	32.67

Highest heritability was recorded for the traits plant height(97%) followed by 100 seed weight (93%),pods per plant (93%), Biological Yield, Seed yield per Plant, Harvest Index (92%). High GAM was registered for the traits Harvest Index (65.21) followed by seed yield per plant (60.39), Biological Yield (59.95) and number of Pods per plant (53.09) therefore selection for these traits would be more effective. High Heritability coupled with high genetic advance ([Table-3] were recorded for Plant Height (cm), pods per plant, 100 seed weight, seed yield per plant and Biological Yield indicating under the control of additive genes effects, and the selection should be fruitful for this traits. This is in agreement with the findings of, Sushmitha raj, *et al.,* (2018) [4]. According to per se performance exhibited wide range of variations for the characters studied [Table-3] Days to 50% flowering (33.66 -49.66), Days to 50% Pod setting (39.96 - 57.33), Days to maturity (58.33 - 72.00), Plant Height(cm) (42.86 - 74.06),Number of branches per plant (1.86 - 4.26),Number of clusters per plant (7.13- 13.66),Number of Pods per plant (14.66 - 37.01), Number of seeds per pod (4.33-7.00), Pod length (cm) (3.55-4.80), seed weight (3.00-4.64), Biological Yield (13.51- 32.33), Seed yield per plant (3.30-9.65), Harvest Index (14.52-5.80) shows that considerable amount of variation is present among the genotypes for all characters studied. For seed yield per plant the genotype SHUATS URD 45 (9.65) recorded more yield followed by SHUATS URD 43 (9.21).

Conclusion

Analysis of variance and per se performance concluded that the presence of sufficient amount of variability among 36 genotypes. In case of GCV and PCV, Harvest index, biological yield and seed yield per plant characters expression was highly influenced by the environment when compare to the other traits. High heritability coupled with high genetic advance were observed in Plant height, Pods per plant, Seed index, biological yield revealed that there was the presence of additive gene effects and selection for improvement of such characters would be rewarding.

Application of research

The main tool of breeding programme is variation, if variation is there it will leads to the selection of elite genotypes that will be helpful for the farmers

Abbreviations

VG: Genotypic Variance
ECV: Environmental coefficient of variation

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References:

[1] Dharmendra Kumar, Rolaniya, Mahendra Kumar Jinjwadiya, Deva Ram Meghawal and Lal G.M. (2017) *Journal of Pharmacognosy and Phytochemistry,* 6(4), 1506-1508.
[2] Kondagari Hemalatha, Sapna Lal S. and Lal G.M (2017) *Journal of Pharmacognosy and Phytochemistry,* 6(4), 674-676.
[3] Priyanka S., Rangaiah S. and Showkathbabu B.M. (2016) *International Journal of Agriculture Sciences*, 8(40), 1821-1824.
[4] Sushmitharaj D.V., Shoba D. and Arumugam Pillai D. (2018 *International Journal of Current Microbiology and Applied Sciences* (6), 2849-2856.