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STUDIES ON VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR YIELD AND YIELD RELATED TRAITS IN GREENGRAM [*VIGNA RADIATA* (L.) WILCZEK]

AMAN MISHRA*[1], SHWETA[1], TARUN RATHORE[1] AND ABHISHEK PATI TIWARI[2]

[1]Department of Genetics and plant Breeding, CSAUA&T, Kanpur, India
[2]Department of Seed Science and Technology, CSAUA&T, Kanpur, India

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Abstract– This investigation was conducted to evaluate 19 parents (16 lines x 3 testers), 48 F_1 and 48 F_2. Analysis of variance showed high significant differences among 115 greengram genotypes for 13 studied quantitative traits. In F_1, the highest phenotypic and genotypic coefficient of variation was observed for 100 seed weight followed by harvest index. Moderate phenotypic and genotypic coefficient of variation was observed in seed yield per plant and subsequently number of clusters per plant. While low PCV and GCV were observed in days to maturity followed by seed protein content. In the F_2 generation, phenotype coefficient of variation (PCV) estimates was higher than genotypic coefficient of variation (GCV) for all traits. The highest phenotypic and genotypic coefficient of variation was observed for the harvest index. A high phenotypic and medium genotypic coefficient of variation was observed for biological yield. Moderate phenotypic and genotypic coefficient of variation was observed in seed yield per plant and subsequently number of clusters per plant. While low PCV and GCV were observed in days to maturity followed by seed protein content. In the F_1 generation, high heritability estimates were observed for 100 seed weight, followed by harvest index, biological yield, seed yield per plant, plant height, days to 50% flowering, seed protein content. Medium heritability was observed in number of clusters per plant, number of pods per plant, pod length and number of seeds per pod. Low heritability was observed for the number of branches per plant. High heritability associated with high genetic progress as a percentage of mean was observed for 100 seed weight, biological yield and harvest index. High heritability with moderate genetic progress was observed from days to 50% flowering and plant height. In the F_2 generation, high heritability estimates were observed for harvest index followed by seed yield per plant, 100 seed weight, plant height, days to 50% flowering, days to maturity, number of pods per plant and seed protein content. Medium heritability was observed in number of clusters per plant followed by pod length. Low heritability was observed for number of branches per plant followed by number of seeds per pod and biological yield. High heritability associated with high genetic progress as a percentage of mean was observed using harvest index, followed by seed yield per plant, 100 seed weight. High heritability with moderate genetic progress was observed for plant height followed by days to 50% flowering and number of pods per plant and days to maturity. Medium heritability was observed in number of clusters per plant, number of pods per plant, pod length and number of seeds per pod. Low heritability was observed for the number of branches per plant. High heritability associated with high genetic progress as a percentage of mean was observed for 100 seed weight, biological yield and harvest index. High heritability with moderate genetic progress was observed from days to 50% flowering and plant height.

INTRODUCTION

Greengram (*Vigna radiata* L. Wilczek) also known as mungbean or moong dal. Also India is the primary centre of origin of greengram and central asia is known to its secondary centre of origin. It is one of the most important legumes of India which belongs to family fabaceae sub-order paplionaceae and the lineage phaseolae with chromosome number (2n=2x=22). it is annual crop, erect or sub-erect plant having trifoliate with paplionaceous flower.

Selection of superior parents flaunting better heritability and genetic advance for numerous characters is an essential prerequisite for any yield

enhancement programme. The knowledge of inheritable variability being within the different parameters contributing to the yield is an important criterion for yield improvement but in highly self-pollinating crops like greengram, natural variation is narrow performing in limited selection intensity. The efficacy of selection depends upon the magnitude of inheritable variability for yield and yield contributing traits in the parentage material. The knowledge of heritability and genetic advance harness the breeder to pick superior parents to initiate an effective and fruitful crossing programme.

MATERIALS AND METHODS

The research experiment was conducted during *Kharif* 2022, at Students Instruction Farm, Chandra Shekhar Azad University of Agriculture and technology Kanpur, comprising 115 greengram genotypes (19 parents + 48 F_1s + 48F_2s) with three replications. Data were recorded for thirteen quantitative characters i.e., Days to 50% flowering, Days to maturity, plant height (cm), number of branches per plant, number of clusters per plant, Number of pods per plant, Number of seeds per pod, 100-seed weight (g), Biological yield (g), Harvest index (%), Seed protein content (%) and Seed yield per plant (g) for the estimation of PCV, GCV, heritability (broad sense) and genetic advance.

RESULTS AND DISCUSSION

The analysis of variance of F_1 and F_2 showed that the genotypes differed significantly among themselves for all the characters under study except for days to 50% flowering indicating the presence of adequate variability (Table 1 and 2).

The estimates of genotypic and phenotypic coefficient of variation for thirteen characters of greengram F_1 and F_2 generation has been presented in Table 3 and 4.

Phenotypic and Genotypic Coefficient of Variation

In F_1 generation the estimates of phenotypic coefficient of variation (PCV) were bigger than genotypic coefficient of variation (GCV) for all the characters. The loftiest phenotypic and genotypic coefficient of variation were seen in 100 seed weight (100% and 99.8%) followed by harvest index (27.66% and 27.42%). The mrdium phenotypic and genotypic coefficient of variation were observed in seed yield per plant (19.90% and 19.58%) followed by number of clusters per plant (18.03% and 11.95%). While, the low PCV and GCV were observed in days to maturity (3.95% 3.07%) followed by seed protein content (5.12% and 4.00%).

In F_2 generation the estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the characters. The highest phenotypic and genotypic coefficient of variation were observed in harvest index (29.64% and 29.40%). The high phenotypic and moderate genotypic coefficient of variation was observed by biological yield (30.70% and 15.23%). The moderate phenotypic and genotypic coefficient of variation were observed in seed yield per plant

Table 1. Analysis of Variance for Thirteen Quantitative Characters in F_1 generation in Greengram.

Traits	Mean Sum of Squares		
	Source of Replication Df 2	Treatment 66	Error 132
Days to 50% flowering	7.11	16.05**	1.63
Days to maturity	4.80	14.48**	2.60
Plant height (cm)	20.83	38.21**	3.22
Number of branches per plant	0.70	0.27	0.25
Number of clusters per plant	0.85	2.86**	0.85
Number of pods per plant	15.88	13.87**	2.92
Pod length (cm)	0.004	0.58**	0.21
Number of seeds per pod	0.82	5.49**	2.29
100-seed weight (g)	0.10	56.41**	0.083
Biological yield (g)	0.002	59.97**	0.34
Harvest index (%)	4.69	475.22**	2.52
Seed protein content (%)	0.19	2.95**	0.51
Seed yield per plant (g)	0.0007	4.89**	0.05

(19.51% and 19.19%) followed by number of clusters per plant (15.87% and 9.64%). While, the low PCV and GCV were observed in days to maturity (3.45% and 2.97%) followed by seed protein content (5.09% and 3.96%). Similar results were reported by Makeen *et al.* (2007)

Heritability and Genetic Advance

It was suggested by Burton (1952) that genetic variation together with heritability estimates would give a better understanding of the anticipated effectiveness of selection, so that a character with a high GCV together with a high heritability would be valuable in a breeding program. In the F_1 generation, broad sense heritability ranged from 1.67% in number of branches per plant to 99.56% in 100 seed weight. High heritability estimates (> 60%) were seen for 100 seed weight (99.56%), followed by harvest index (98.42%), biological yield (98.29%), seed yield per plant (96.80%), plant height (78.33%), days to 50% flowering (74.62%), seed protein content (61.28%) and days to maturity (60.26%). Moderate heritability (31%-60%) was seen in number of clusters per plant (43.76%), number of pods per plant (55.54%), pod length (37.01%) and number of seeds per pod (31, 71%). Low heritability (<30%) was seen for the number of branches per plant (01.67%).

High heritability along with high genetic advance as percent of mean were observed by 100 seed weight (99.56% and 205.14), biological yield (98.29% and 56%) and harvest index (98.42% and 60.49).

Table 2. Analysis of Variance for Thirteen Quantitative Characters in F_2 generation in Greengram.

Traits	Mean Sum of Squares		
	Source of Replication Df 2	Treatment 66	Error 132
Days to 50% flowering	1.98	19.97**	1.65
Days to maturity	4.42	12.65**	1.32
Plant height (cm)	5.99	36.02**	2.82
Number of branches per plant	0.06	0.24	0.26
Number of clusters per plant	0.23	1.93**	0.70
Number of pods per plant	4.43	10.88**	1.74
Pod length (cm)	0.03	0.43**	0.13
Number of seeds per pod	4.12	3.89**	2.32
100-seed weight (g)	14903.91	210.77**	113.19
Biological yield (g)	2305.03	35.40**	17.88
Harvest index (%)	4.32	473.39**	2.55
Seed protein content (%)	0.18	2.91**	0.51
Seed yield per plant (g)	0.00063	4.74**	0.05

Table 3. Estimation of Genetic Parameters in Thirteen Characters in F_1 generation in Greengram.

Characters	Genotypic Variance (Vg)	Phenotypic Variance (Vp)	Genotypic Coefficient of Variation (%)	Phenotypic Coefficient of Variation (%)	Heritability (%) (broad (h^2) sense)	Genetic advance (5% LOS)	Genetic advance as per cent of mean
Days to 50% flowering	4.80	6.44	5.85%	6.77%	74.62%	3.9011	10.4071
Days to maturity	3.95	6.56	3.07%	3.95%	60.26%	3.1811	4.905
Plant height (cm)	11.66	14.88	9.86%	11.15%	78.33%	6.226	17.9852
Number of branches per plant	0.004	0.26	2.78%	21.51%	01.67%	0.0176	0.7409
Number of clusters per plant	0.66	1.52	11.95%	18.03%	43.76%	1.11	16.25
Number of pods per plant	3.64	6.57	7.93%	10.65%	55.54%	2.9329	12.1807
Pod length (cm)	0.12	0.33	7.69%	12.65%	37.01%	0.4431	9.6414
Number of seeds per pod	1.06	3.36	12.83%	22.78%	31.71%	1.198	14.8833
100-seed weight (g)	18.77	18.86	99.80%	100.00%	99.56%	8.9069	205.14
Biological yield (g)	19.87	20.22	27.42%	27.66%	98.29%	9.105	56.0036
Harvest index (%)	157.56	160.09	29.60%	29.84%	98.42%	25.6536	60.4942
Seed protein content (%)	0.812	1.32	4.00%	5.12%	61.28%	1.4535	6.4569
Seed Yield Per Plant (g)	1.612	1.66	19.58%	19.90%	96.80%	2.574	39.6773

Table 4. Estimation of Genetic Parameters in Thirteen Characters in F_2 generation in Greengram.

Characters	Genotypic Variance (Vg)	Phenotypic Variance (Vp)	Genotypic Coefficient of Variation (%)	Phenotypic Coefficient of Variation (%)	Heritability (h^2) (%) (broad sense)	Genetic advance (5% LOS)	Genetic advance as per cent of mean
Days to 50% flowering	6.10	7.75	6.66%	7.51%	78.71%	4.51	12.17
Days to maturity	3.77	5.10	2.97%	3.45%	74.08%	3.44	5.26
Plant height (cm)	11.06	13.89	9.46%	10.60%	79.64%	6.11	17.38
Number of branches per plant	0.008	0.25	3.86%	21.37%	3.27%	0.03	1.43
Number of clusters per plant	0.41	1.11	9.64%	15.87%	36.93%	0.80	12.06
Number of pods per plant	3.04	4.78	7.37%	9.24%	63.64%	2.86	12.10
Pod length (cm)	0.09	0.23	6.86%	10.48%	42.82%	0.42	9.24
Number of seeds per pod	0.52	2.84	8.95%	20.83%	18.47%	0.64	7.92
100-seed weight (g)	0.218	0.236	11.91%	12.40%	92.2%	0.92	23.55
Biological yield (g)	5.84	23.72	15.23%	30.70%	24.62%	2.47	15.57
Harvest index (%)	156.94	159.50	29.40%	29.64%	98.4%	25.59	60.07
Seed protein content (%)	0.79	1.31	3.96%	5.09%	60.57%	1.43	6.35
Seed Yield Per Plant (g)	1.56	1.61	19.19%	19.51%	96.66%	2.53	38.85

High heritability along with moderate genetic advance were observed by days to 50% flowering (74.62% and 10.40) and plant height (78.33% and 17.98). Similar results were also shown by Singh *et al*. (2021).

In F_2 generation, heritability in broad sense varied from 3.27% in number of branches per plant to 98.4% in harvest index. High estimates of heritability (>60%) were seen for harvest index (98.4%) followed by seed yield per plant (96.66%), 100 seed weight (92.2%), plant height (79.64%), days to 50% flowering (78.71%), days to maturity (74.08%), number of pods per plant (63.64%) and seed protein content (60.57%). Medium heritability (31%-60%) were observed in number of clusters per plant (36.93%) followed by pod length (42.82%). Low estimates of heritability (<30%) were seen for number of branches per plant (3.27%) followed by number of seeds per pod (18.47%) and biological yield (24.62%).

High heritability along with high genetic advance as percent of mean were seen by harvest index (98.4% and 60.07), followed by seed yield per plant (96.66% and 38.85), 100 seed weight (92.2% and 23.55). High heritability along with medium genetic advance were observed by plant height (79.64% and 17.38) followed by days to 50% flowering (78.71% and 12.17) and number of pods per plant (63.64% and 12.10). Similar results were also shown by Sabatina *et al.* (2021).

Estimates of heritability are helpful in predicting the transmission of traits from parents to their offspring. It is a great index of the transmission of traits from parents to their offspring (Falconer, 1981). Characters expressing high heritability do not necessarily confer high genetic progress. It was explained by Johnson and Robinson (1955) that high heritability should be harness by high genetic progress to reach a more adequate conclusion. The breeder must be careful in picking the best inheritance because it includes both additive and non-additive gene effects.

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