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Genetic Variability Studies in Segregating Populations (F_2 and F_3 Generations) in Green Gram (*Vigna radiata* (L.) Wilczek.)

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A B S T R A C T

An estimate of the extent of variability available in a crop could be of immense value to the breeder to efficiently design the breeding procedure for crop improvement. Success of any crop improvement program essentially depends upon the nature and magnitude of the genetic variability present in the crop. An investigation was carried out among the progenies of nine crosses of green gram (*Vigna radiata* L.) in F_2 and F_3 generations, to study the variability and genetic parameters. Extent of mean, variability, heritability and genetic advance as percent of mean were worked out for yield and yield attributing traits. In the present investigation, cross ML 1451 x VBN 2 registered higher mean values for number of primary branches, pod length and hundred seed weight in both F_2 and F_3 generations and for number of pods and yield per plant in F_3. Among the segregating generations of the crosses, PUSA 0672 x VBN 2 was found to be of early flowering type. High heritability coupled with high genetic advance as per cent of mean in both generations was recorded by F_2 and F_3 populations of ML 1451 x VBN 2 for the characters number of primary branches, number of pods, hundred seed weight and yield per plant and for number of seeds per pod in F_2 and plant height in F_3 generation only. Thus, these two crosses were suggested for advancement of generations and selection.

Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) is an important pulse crop in Asia particularly in Indian sub-continent (Rahman *et al.*, 2003) and it ranks third after pigeon pea and chickpea. Being the third important pulse crop in India, it occupies 4.07 mha area with a total production of 1.90 million tonnes and average productivity of 466 kg/ha. Green gram has substantial amounts of low flatulence proteins, which makes the crop indispensable in Indian vegetarian diet.

In Tamil Nadu, greengram occupies an area of 1.85 lakh hectares with a production and productivity of about 0.95 lakh tonnes and 516 kg ha^{-1} respectively, during 2017-18(Anonymous, 2018). In recent years, there has been a significant decline in pulse

production in Tamil Nadu. Unfortunately, the per capita availability of pulses in India has declined from 65.50g/capita/day to 31.60g/ capita/day in the past five decades as against the demand of 80g/capita/day. In view of the above, increase in production and productivity of this crop is very crucial to meet the protein requirement especially of under-nourished people depending on the vegetable protein.

Seed yield is the primary objective in all field crop breeding programs. Grain yield is a complex character and is the product of many yield components. Selection for yield components has been suggested as a solution for further advance in increasing yield. Understanding the inheritance of yield components is necessary for the intelligent choice of breeding programmes for developing high -yielding varieties (Azizi *et al.,* 2006). Information regarding inheritance of grain yield and its closely related components is essential to efficiently exploit the available genetic diversity in mungbean for seed yield (Khattak *et al.,* 2004).

Variability is a pre-requisite for selection of superior progenies and can be created by many ways including hybridization and mutation. Genetic improvement for quantitative traits can be achieved through a clear understanding of the nature and amount of variability present in genetic stocks and the extent to which the desirable traits are heritable. F_2 is an ideal generation in which segregation and recombination are maximum for imposing selection. A population is said to be superior when it shows high mean combined with high variability. The F_2 or F_3 derived lines are far from being homozygous and early generation selection relies on the assumption that the performance of a line at an early generation of selfing is predictive of its performance at homozygosity (Chahota *et al.,* 2007).

Empirical studies in different self-pollinated crops have indicated that early generation selection is sometimes effective and sometimes ineffective (Bernardo, 2003). In order to improve the yield through selection, it is essential to have a thorough knowledge on genetic variability available in the germplasm and the extent to which the desirable traits are heritable, which requires a better insight of the ancillary characters for better selection. Therefore, the present study was aimed to determine the extent of the variability available in F_2 and F_3 generations of green gram and also to determine the scope of selection through heritability and genetic advance.

Materials and Methods

The present investigation was carried out at Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Killikulam, Tamil Nadu. The experimental material consisted of $F_2$and F_3 populations of green gram (*Vigna radiata* (L.) Wilczek), derived from nine cross combinations *viz*., PUSA 0672 x VBN 2, PUSA 0672 x CO 6, PUSA 0871 x CO 6, PUSA 0871 x TNY Local, MH 565 x VBN 2, MH 565 x CO 6, MH 521 x TNY Local, ML 1451 x VBN 2 and ML 1451 x CO 6. The variety CO 6 was considered as a check to evaluate F_2 and F_3 generations. The details of the parental genotypes are presented in Table 1.

The F_2generation was raised during July 2013 and F_3 was raised in the February 2014.Nine high yielding cross combinations and parents were sown in three replications along with CO 6 variety as a standard check in Randomized Block Design. The row to row spacing was 30 cm and spacing between the individual plants was 10 cm. A total of 225 plants were selected in both F_2 and F_3 generations for taking the observations. Data was recorded for yield and yield attributing traits *viz*., days to 50%

flowering, plant height (cm), number of primary branches per plant, number of pods per plant, pod length (cm), number of seeds per pod, hundred seed weight (g) and yield per plant (g).

The data thus, generated was subjected to statistical analysis. Mean and variances were computed for the parents, F_2's and F_3's by adopting the statistical methods suggested by Panse and Sukhatme(1964). Phenotypic coefficient of variance and genotypic coefficient of variance (PCV and GCV) were calculated by using the formulae suggested by Burton (1952). The PCV and GCV values were categorized as low (< 10%), moderate (10.1- 20.0 %) and high (>20%) as suggested by Sivasubramanian and Menon (1973). The estimation of heritability helps breeder in selection of elite genotypes from diverse populations and was calculated according to Lush (1940). The range of heritability was categorized as given by Robinson *et al.,* (1949) as 0 to 30 percent – low, 31 to 60 percent – moderate, 61 and above percent – high. Genetic advance (GA) was expressed as percentage of mean by formula given by Govindasamy *et al.,* (1973)and was categorised as high (GA > 20%), moderate (10-20%) and low (<10%).

Results and Discussion

The study was undertaken to identify the potential parents and F_2 and F_3 generations of superior crosses to conceptualize breeding strategies for yield improvement of green gram. Nine crosses were evaluated with their parents for eight characters. The breeding nature of segregants was investigated by estimating parameters of variability.

The mean yield per plant ranged from 2.08 g (TNY Local) to 16.06 g (CO 6) when grown as parents in F_2 and from 1.98 g (TNY Local) to 12.82 g (CO 6) in F_3. Based on mean performance of the parents recorded (Table 2) in both seasons grown along with F_2 and F_3, Pusa 0672 was early flowering type with highest number of seeds per pod. CO 6 was the tallest having highest number of primary branches, number of pods per plant, hundred seed weight and yield per plant in both F_2 and F_3 but with maximum number of seeds per pod in F_2, while TNY Local was late in flowering, short stature and low performing in all the traits studied.

To understand the extent of variation present in F_2 and F_3 generations, the range, mean, variances (PCV and GCV), heritability and genetic advance as per cent of mean (GAM) for eight traits are presented(Tables 3 to 6).

Days to flowering

The range was high in MH 521 x TNY Local (27.00 - 39.00 days in F_2, 30.00 - 41.00 days in F_3) and low in PUSA 0672 x VBN 2 (23.00 - 34.00 days in F_2, 25.00 - 35.00 days in F_3) (Table 3).The cross combination PUSA 0672 x VBN 2 was found to be early (27.60 days in F_2 and 30.03 days in F_3), while MH 521 x TNY Local was found to be late in flowering (34.11 days in F_2 and 36.99 days in F_3) in both the generations. The estimates of GCV and PCV were low of all the crosses in both the generations except ML 1451 x CO 6 with moderate PCV values. Similar reports of low PCV and GCV were given by Shiv *et al.,* (2017) and Sanjupretham *et al.,* (2019).Low to moderate heritability and low GA as percent of mean were exhibited by this trait. The crosses ML 1451 x CO 6, MH 565 x CO 6 and MH 521 x TNY Local exhibited moderate heritability in both F_2 and F_3 generations indicating the predominant role of non-additive gene action in expression of the trait (Mehandi *et al.,* 2013). Similar results of low GA as percent of mean were exhibited by Sanjupretham *et al.,* (2019) and Talukdar *et al.,* (2020).

Plant height (cm)

The maximum range of plant height was observed in the $F_2$of MH 565 x CO 6(21.00 - 57.00 cm) and in $F_3$of ML 1451 x VBN 2 (26.00 - 75.00 cm) (Table 3).The mean plant height ranged from 30.19 cm (MH 521 x TNY Local) to 46.16 cm(MH 565 x CO 6) in F_2 and from 33.13 cm (MH 521 x TNY Local) to 44.25 cm(PUSA 0871 x CO 6) in F_3 (Table 3).GCV was recorded low to moderate and PCV was moderate in both the generations except F_3 of ML 1451 x CO 6 recorded low PCV (9.14) and F_2 of PUSA 0871 x TNY Local exhibited high PCV (20.57).These findings are in confirmation with Marak and Sarkar (2017) and Sanjupretham *et al.,* (2019). Heritability estimates for plant height in F_2 and F_3 generations can be grouped into high, moderate and low. High heritability values ranged from 61.05 to 91.11 were observed in both segregating generations of the crosses ML 1451 x VBN 2, ML 1451 x CO 6, MH 565 x VBN 2 and PUSA 0672 x CO 6. The GA as per cent of mean in the F_2 generation of most of crosses except MH 521 x TNY Local (low) and F_3 generation of all crosses had moderate to high values. High heritability coupled with high GA as per cent of mean was observed in PUSA 0672 x CO 6 (both in F_2 and F_3), PUSA 0672 x VBN 2 and ML 1451 x CO 6 (in F_2) and MH 565 x VBN 2, MH 565 x CO 6 and ML 1451 x VBN 2 (in F_3). Muralidhara *et al.,*(2016), Rambabu *et al.,* (2018) and Pavan *et al.,* (2019)also got the same results. High heritability coupled with moderate GAM was found in F_2 of MH 565 x VBN 2 and ML 1451 x VBN 2 and F_3 of ML 1451 x CO 6. Similar reports were given by Shiv *et al.,* (2017).

Number of primary branches per plant

There was no prominent variation in this trait for all the crosses in both F_2 and F_3generations. Most of the crosses showed similar range for this trait (Table 4).The mean value was found to be high in ML 1451 x VBN 2 (3.26 in F_2 and 2.91 in F_3). PCV and GCV recorded moderate to high in both the generations. High GCV and PCV values were recorded in the crosses *viz*., MH 521 x TNY local (F_2 and F_3), PUSA 0672 x CO 6, PUSA 0672 x VBN 2, PUSA 0871 x CO 6 and MH 565 x CO 6 (F_2) and PUSA 0871 x TNY Local and MH 565 x VBN 2 (F_3).

Similar reports were given by Muthuswamy *et al.,* (2019), Sanjupretham *et al.,* (2019) and Talukdar *et al.,* (2020).

Moderate to high heritability with high genetic advance as percent of mean were exhibited by most of the crosses in both the generations. High heritability coupled with high GA as percent of mean was observed in the crosses MH 565 x VBN 2, ML 1451 x VBN 2 and ML 1451 x CO 6 in both F_2 and F_3, and in PUSA 0672 x VBN 2 and PUSA 0672 x CO 6 in only F_2. This confirms the earlier findings of Garg *et al.,* (2017), Muthuswamy *et al.,* (2019) and Pavan *et al.,* (2019). GA as percent of mean was moderate in segregating generations of PUSA 0871 x CO 6 (18.09) and PUSA 0672 x CO 6 (15.36).

Number of pods per plant

The maximum range observed was 12.00 - 79.00 (PUSA 0672 x VBN 2) in F_2 and 21.00 - 139.00 (ML 1451 x VBN 2) in $F_3$with maximum mean values of 40.94 and 42.51 respectively (Table 4). The crosses *viz.,* ML 1451 x VBN 2, ML 1451 x CO 6, MH 565 x VBN2,PUSA 0672 x VBN 2 and PUSA 0672 x CO 6 exhibited high PCV and GCV in both the generations. Concomitant results were reported by Rambabu *et al.,* (2018) and Talukdar *et al.,* (2020). Moderate PCV and GCV were observed for this trait in PUSA 0871 x TNY local (F_3). Similar reports were given by Sanjupretham *et al.,* (2019).

Heritability and GA as percent of mean were found to be moderate to high. High heritability associated with high GAM was observed in F_2 and F_3 of crosses ML 1451 x VBN 2, ML 1451 x CO 6, MH 565 x VBN 2 and Pusa 0672 x VBN 2 and in F_3 of PUSA 0672 x CO 6, PUSA 0871 x TNY Local and MH 565 x CO 6. These results are in coincidence with the results of Rambabu *et al.,* (2018), Pavan *et al.,* (2019) and Talukdar *et al.,* (2020).

Pod length (cm)

The maximum range recorded in F_2 was 6.06 - 10.95cm (PUSA 0672 x VBN 2) and in F_3 was 5.98 - 9.50cm (MH 565 x CO 6) (Table 5).Mean for pod length ranged from 6.39cm (PUSA 0871 x CO 6) to 8.59cm (ML 1451 x VBN 2) in F_2 and from 6.92cm (MH 521 x TNY Local) to 7.84cm (ML 1451 x CO 6) in F_3.The PCV and GCV were recorded low in all cross combinations in both the generations except PUSA 0672 x VBN 2 (14.63, 12.99)and MH 565 x VBN 2 (12.46, 11.07)which showed moderate values of PCV and GCV in F_2. This low variability was in agreement with the results of Marak and Sarkar (2017) and Sindhu *et al.,* (2019).

Heritability and GA as percent of mean were exhibited low to high in most of the cross combinations by this trait. Pod length reported high heritability with high GA as percent of mean in F_2 of crosses PUSA 0672 x VBN 2 and MH 565 x VBN 2.

It indicated that most likely the heritability is due to additive gene effects and selection may be effective. Similar results were reported by Muralidhara *et al.,* (2016). High heritability coupled with moderate GA as percent of mean was observed in $F_2$of ML 1451 x VBN 2 and ML 1451 x CO 6 and in F_3 of crosses PUSA 0672 x VBN 2 and MH 565 x CO 6. These were collaborated findings of Sindhu *et al.,* (2019).

Number of seeds per pod

In F_2 and F_3, the maximum range was found to be 8.04 - 12.66 (MH 565 x VBN 2) and 7.41–12.71 (PUSA 0871 x CO 6), respectively (Table 5).

The mean value ranged from 6.63 (MH 521 x TNY Local) to10.05 (MH 565 x VBN 2) in F_2 and from 7.33 (MH 521 x TNY Local) to 9.67(PUSA 0871 x CO 6) in F_3.

The PCV and GCV values of most of the crosses were low. Moderate PCV(12.78, 11.92) and GCV (10.37, 11.62) were recorded in the crosses PUSA 0672 x VBN 2and ML 1451 x VBN 2 in F_2 generation. Similar reports were given by Muralidhara *et al.,* (2016) and Talukdar *et al.,* (2020).

In F_3, the crosses PUSA 0871 x CO 6 and MH 521 x TNY Local exhibited moderate PCV and low GCV, which are in concordance with the reports of Marak and Sarkar (2017).

Almost all the crosses recorded moderate to high heritability with low to moderate GA as percent of mean. The cross PUSA0672 x CO 6 (22.17, 3.00) in F_2 and MH 521 x TNY Local (17.53, 3.66) in F_3 showed low heritability and low GAM which are in accordance with the findings of Sindhu *et al.,* (2019).

High heritability (94.98) associated with high GAM (23.33) was observed in $F_2$of ML 1451 x VBN2. The same results were shown by Talukdar *et al.,* (2020).

High heritability coupled with moderate GA as percent of mean was observed in the crosses *viz.,* PUSA 0672 x VBN 2 and ML 1451 x CO 6 (F_2 and F_3), MH 565 x VBN 2 (F_2), PUSA 0871 x CO 6, ML 1451 x VBN 2 and MH 565 x CO 6 (F_3) which are in agreement with the results of Marak and Sarkar (2017).

Table.1 Details of greengram parental genotypes

Parent	Cross combination/ Source	Special attributes
PUSA 0672	11/395 x ML 267 (IARI)	MYMV resistance
PUSA 0871	IARI	MYMV resistance
MH 565	Hisar	Multiple disease resistance
MH 521	Hisar	MYMV resistance
ML 1451	Ludhiana	MYMV + leaf crincle + bacterial leaf spot + 20 Macrophomina blight + PM resistance
VBN 2	VGG 4 x MH 309	Moderately resistant to yellow mosaic virus. It is moderately resistant to Pod borer.
CO 6	WGG 37 x CO 5	Suitable for all season, resistant to YMV
TNY Local	Tirunelveli Local	-

Table.2 Mean performance of parents in F_2 andF_3 generations for yield and yield attributing traits in greengram

Parents	G	Days to 50% flowering	Plant height (cm)	No. of primary branches	No. of pods per plant	Pod length (cm)	No. of seeds per pod	100 seed weight (g)	Yield per plant (kg)
PUSA 0672	F_2	29.33	44.07	1.73	37.13	7.53	9.01	3.07	8.91
	F_3	30.13	45.13	2.06	35.06	7.64	8.93	2.97	8.61
PUSA 0871	F_2	33.26	35.13	1.86	38.60	7.80	8.43	2.77	8.05
	F_3	34.06	33.34	1.66	36.60	7.89	8.01	2.58	6.28
MH 565	F_2	31.06	34.53	2.26	45.66	7.76	8.57	3.16	10.51
	F_3	32.20	33.66	2.06	41.73	7.53	8.70	2.92	9.94
MH521	F_2	36.53	38.60	2.13	10.46	7.14	7.90	2.62	2.29
	F_3	36.20	36.93	2.80	11.46	7.29	8.03	2.55	2.41
ML 1451	F_2	31.73	45.54	2.66	28.73	7.62	8.62	3.01	6.85
	F_3	32.53	44.90	2.53	31.93	7.72	8.44	3.12	7.79
VBN2	F_2	34.86	48.13	2.40	26.78	7.93	8.24	2.80	5.89
	F_3	35.13	50.80	2.33	30.06	7.86	7.82	3.06	6.95
CO 6	F_2	32.20	52.78	3.33	55.26	7.87	9.13	3.40	16.06
	F_3	33.33	54.04	3.20	52.20	7.32	8.84	3.25	12.82
TNY Local	F_2	37.66	32.06	1.40	13.40	6.95	7.73	2.43	2.08
	F_3	39.06	31.46	1.60	15.13	7.02	7.66	2.31	1.98

Table.3 Estimates of parameters of variability for traits days to 50% flowering and plant height in greengram.

Trait	Crosses	G	Range	Mean	GCV	PCV	Heritability (%)	GA as % of mean
Days to 50% flowering	**PUSA 0672 x VBN 2**	F_2	23.00 - 34.00	27.6	5.48	8.74	39.28	7.08
		F_3	25.00 - 35.00	30.03	4.21	9.22	20.85	3.96
	PUSA 0672 x CO 6	F_2	26.00 - 35.00	31.58	3.58	6.6	29.51	4.01
		F_3	27.00 - 37.00	33.5	3.16	7.75	16.66	2.65
	PUSA 0871 x CO 6	F_2	25.00 - 36.00	30.64	6.77	9.64	49.34	9.8
		F_3	26.00 - 37.00	32.54	4.76	9.17	27	5.1
	PUSA 0871 x TNY Local	F_2	25.00 - 38.00	33.29	4.39	8.66	25.74	4.59
		F_3	25.00 - 39.00	35.07	6.11	9.19	44.26	8.38
	MH 565 x VBN 2	F_2	26.00 - 36.00	31.25	4.54	8.58	28.04	4.96
		F_3	27.00 - 38.00	32.82	5.83	9	41.95	7.78
	MH 565 x CO6	F_2	26.00 - 36.00	32.08	4.34	7.3	35.38	5.32
		F_3	27.00 - 38.00	31.66	5.1	7.47	46.66	7.18
	MH 521 x TNY Local	F_2	27.00 - 39.00	34.11	5.65	9.56	34.93	6.88
		F_3	30. 00- 41.00	36.99	5.27	7.41	50.69	7.74
	ML 1451 x VBN 2	F_2	24.00 - 37.00	29.17	4.25	8.94	22.6	4.16
		F_3	25.00 - 38.00	31.26	5.72	9.45	36.65	7.14
	ML 1451 x CO 6	F_2	25.00 - 38.00	32.63	6.41	10.25	39.16	8.26
		F_3	25.00 - 39.00	33.07	6.08	10	36.98	7.62
Plant height (cm)	**PUSA 0672 x VBN 2**	F_2	20.00 - 47.00	32.81	13.41	15.55	74.33	23.82
		F_3	21.00 - 54.00	39.51	11.44	15.63	53.58	17.25
	PUSA 0672 x CO 6	F_2	20.00 - 51.00	32.99	11.33	12.81	78.28	20.66
		F_3	29.00 - 64.00	42.02	15.37	17.83	74.36	27.31
	PUSA 0871 x CO 6	F_2	28.00 - 56.00	42.32	11.1	14.85	55.89	17.1
		F_3	34.00 - 59.00	44.25	8.19	11.74	48.69	11.77
	PUSA 0871 x TNY Local	F_2	18.00 - 43.00	32.44	10.23	20.57	24.75	10.49
		F_3	31.00 - 52.00	40.3	7.01	10.01	49.07	10.12
	MH 565 x VBN 2	F_2	22.00 - 49.00	39.99	10.74	12.97	68.53	18.32
		F_3	28.00 - 47.00	38-55	10.94	11.46	91.11	21.51
	MH 565 x CO6	F_2	21.00 - 57.00	46.16	10.24	16.23	39.83	13.32
		F_3	24.00 - 59.00	42.59	13.28	16.7	63.26	21.77
	MH 521 x TNY Local	F_2	19.00 - 41.00	30.19	7.39	14.64	25.45	7.68
		F_3	20.00 - 43.00	33.13	11.22	16.74	44.92	15.49
	ML 1451 x VBN 2	F_2	24.00 - 46.00	39.95	9.68	12.39	61.05	15.58
		F_3	26.00 - 75.00	41.6	17.74	19.32	84.35	33.57
	ML 1451 x CO 6	F_2	24.00 - 45.00	36.54	12.63	15.13	69.72	21.73
		F_3	35.00 - 56.00	42.96	8.34	9.14	83.41	15.7

Table.4 Estimates of parameters of variability for traits number of primary branches and number of pods per plant in greengram

Trait	Crosses	G	Range	Mean	GCV	PCV	Heritability (%)	GA as % of mean
Number of primary branches	PUSA 0672 x VBN 2	F_2	1.00 - 4.00	2.49	20.32	23.67	73.68	35.93
		F_3	1.00 - 4.00	2.77	16.00	21.43	55.74	24.61
	PUSA 0672 x CO 6	F_2	1.00 - 3.00	2.32	27.79	33.49	68.87	47.51
		F_3	1.00 - 4.00	2.53	13.06	22.87	32.61	15.36
	PUSA 0871 x CO 6	F_2	1.00 - 3.00	2.02	20.31	31.78	40.87	26.75
		F_3	1.00 - 3.00	2.32	14.83	25.04	35.07	18.09
	PUSA 0871 x TNY Local	F_2	1.00 - 3.00	2.20	17.9	23.34	58.84	28.29
		F_3	1.00 - 3.00	1.66	20.69	28.55	52.54	30.9
	MH 565 x VBN 2	F_2	2.00 - 4.00	3.04	19.94	22.95	75.48	35.68
		F_3	1.00 - 4.00	2.44	24.65	29.06	71.96	43.08
	MH 565 x CO6	F_2	1.00 - 3.00	2.17	21.85	32.46	45.32	30.31
		F_3	1.00 - 4.00	2.57	16.61	22.23	55.84	25.58
	MH 521 x TNY Local	F_2	1.00 - 2.00	1.54	24.19	33.45	52.31	36.05
		F_3	1.00 - 2.00	1.64	22.81	30.34	56.55	35.34
	ML 1451 x VBN 2	F_2	2.00 - 4.00	3.26	15.65	18.91	68.56	26.71
		F_3	2.00 - 4.00	2.91	16.93	20.87	65.81	28.3
	ML 1451 x CO 6	F_2	1.00 - 3.00	2.65	14.74	17.67	69.55	25.33
		F_3	1.00 - 3.00	2.37	19.77	23.11	73.17	34.84
Number of pods per plant	PUSA 0672 x VBN 2	F_2	12.00 - 79.00	40.94	29.48	33.75	76.30	53.05
		F_3	15.00 - 61.00	32.47	21.42	24.74	74.95	38.2
	PUSA 0672 x CO 6	F_2	5.00 - 35.00	16.64	21.94	34.65	40.10	28.62
		F_3	17.00 - 66.00	30.97	25.4	26.11	94.63	50.91
	PUSA 0871 x CO 6	F_2	6.00 - 39.00	15.81	29.02	37.87	58.74	45.82
		F_3	12.00 - 53.00	29.89	17.73	24.28	53.34	26.68
	PUSA 0871 x TNY Local	F_2	5.00 - 24.00	13.63	16.73	22.76	54.06	25.35
		F_3	15.00 - 39.00	25.64	17.04	18.44	85.38	32.43
	MH 565 x VBN 2	F_2	10.00 - 64.00	33.5	28.91	33.33	75.24	51.67
		F_3	13.00 - 61.00	28.14	25.98	30.11	74.44	46.18
	MH 565 x CO6	F_2	7.00 - 41.00	18.33	15.91	26.98	34.79	19.34
		F_3	14.00 - 61.00	32.94	24.49	29.98	66.78	41.24
	MH 521 x TNY Local	F_2	6.00 - 19.00	11.23	12.98	22.34	33.76	15.53
		F_3	7.00 - 28.00	15.01	17.76	24.28	53.49	26.75
	ML 1451 x VBN 2	F_2	11.00 - 69.00	26.09	33.23	37.69	77.73	60.35
		F_3	21.00 - 139.00	42.51	27.14	28.65	89.74	52.97
	ML 1451 x CO 6	F_2	10.00 - 66.00	22.89	32.17	40.28	63.77	52.92
		F_3	8.00 - 61.00	25.78	31.92	35.04	82.99	59.90

Table.5 Estimates of parameters of variability for traits pod length and number of seeds per pod in greengram

Trait	Crosses	G	Range	Mean	GCV	PCV	Heritability (%)	GA as % of mean
Pod length (cm)	**PUSA 0672 x VBN 2**	F_2	6.06 - 10.95	8.08	12.99	14.63	78.84	23.77
		F_3	6.00 - 9.18	7.33	6.25	6.86	83.05	11.73
	PUSA 0672 x CO 6	F_2	6.00 - 8.75	7.10	4.47	7.93	31.86	5.20
		F_3	6.07 - 9.43	7.56	4.81	6.65	52.34	7.17
	PUSA 0871 x CO 6	F_2	5.24 - 8.64	6.39	6.25	9.49	43.41	8.48
		F_3	6.10 - 9.00	7.41	4.56	5.82	61.58	7.38
	PUSA 0871 x TNY Local	F_2	5.98 - 8.86	7.31	5.08	7.75	42.90	6.85
		F_3	6.16 - 8.85	7.62	2.6	5.45	22.84	2.56
	MH 565 x VBN 2	F_2	5.76 - 10.87	7.98	11.07	12.46	78.91	20.26
		F_3	6.19 - 8.78	7.34	3.73	4.74	61.75	6.04
	MH 565 x CO6	F_2	5.20 - 9.07	7.40	4.46	9.89	20.41	4.15
		F_3	5.98 - 9.50	7.60	7.30	8.07	81.97	13.63
	MH 521 x TNY Local	F_2	6.07 - 9.07	7.16	3.08	8.31	13.77	2.35
		F_3	5.39 - 8.18	6.92	6.78	8.81	59.14	10.74
	ML 1451 x VBN 2	F_2	6.20 - 10.09	8.59	7.78	9.07	73.63	13.76
		F_3	6.61 - 9.18	7.78	3.53	4.19	71.16	6.14
	ML 1451 x CO 6	F_2	6.28 - 10.20	8.09	7.52	9.39	64.04	12.40
		F_3	6.38 - 9.19	7.84	4.15	5.11	65.99	6.95
Number of seeds per pod	**PUSA 0672 x VBN 2**	F_2	7.09 - 12.21	8.90	10.37	12.78	65.81	17.33
		F_3	7.05 - 12.60	9.52	7.58	8.66	76.73	13.68
	PUSA 0672 x CO 6	F_2	7.09 - 10.22	8.75	3.09	6.57	22.17	3.00
		F_3	6.79 - 10.73	8.63	6.27	8.7	51.92	9.31
	PUSA 0871 x CO 6	F_2	6.74 - 10.90	9.06	4.46	6.5	47.05	6.30
		F_3	7.41 - 12.71	9.67	9.5	11.49	68.43	16.19
	PUSA 0871 x TNY Local	F_2	6.70 - 10.05	8.37	4.26	6.63	41.29	5.64
		F_3	6.97 - 10.11	8.41	3.98	6.99	32.47	4.67
	MH 565 x VBN 2	F_2	8.04 - 12.66	10.05	7.96	9.21	74.73	14.18
		F_3	7.17 - 10.69	8.90	4.85	6.05	64.43	8.03
	MH 565 x CO6	F_2	7.99 - 12.45	9.89	5.56	8.74	40.50	7.29
		F_3	7.26 - 12.32	9.05	7.52	9.27	65.92	12.59
	MH 521 x TNY Local	F_2	5.69 - 8.91	6.63	6.51	9.41	47.89	9.28
		F_3	6.03 - 8.97	7.33	4.24	10.14	17.53	3.66
	ML 1451 x VBN 2	F_2	7.62 - 11.77	9.42	11.62	11.92	94.98	23.33
		F_3	6.53 - 11.64	8.80	8.40	9.81	73.29	14.82
	ML 1451 x CO 6	F_2	7.62 - 12.10	9.54	6.2	7.43	69.65	10.67
		F_3	7.05 - 12.02	9.45	7.37	8.66	72.56	12.94

Table.6 Estimates of parameters of variability for traits hundred seed weightand yield per plant in greengram

Trait	Crosses	G	Range	Mean	GCV	PCV	Heritability (%)	GA as % of mean
Hundred seed weight (g)	**PUSA 0672 x VBN 2**	F_2	2.02 - 4.55	2.98	12.57	18.58	45.81	17.53
		F_3	2.04 - 4.59	3.14	13.04	16.39	63.31	21.37
	PUSA 0672 x CO 6	F_2	1.85 - 3.96	2.89	10.61	13.44	62.38	17.27
		F_3	1.94 - 4.70	3.19	15.45	17.53	77.66	28.05
	PUSA 0871 x CO 6	F_2	1.52 - 3.87	2.99	10.41	14.82	49.35	15.06
		F_3	2.07 - 5.06	3.34	13.45	16.6	65.65	22.45
	PUSA 0871 x TNY Local	F_2	1.75 - 4.73	3.01	14.12	15.54	82.55	26.44
		F_3	1.53 - 3.87	2.76	11.21	15.53	52.14	16.68
	MH 565 x VBN 2	F_2	2.06 - 4.39	3.08	11.26	14.26	62.36	18.31
		F_3	1.97 - 4.86	3.22	16.08	17.17	87.71	31.03
	MH 565 x CO6	F_2	2.09 - 4.78	3.26	10.39	15.82	43.18	14.07
		F_3	2.06 - 4.98	3.06	12.46	17.49	50.72	18.28
	MH 521 x TNY Local	F_2	1.13 - 3.84	2.68	10.73	16	44.96	14.82
		F_3	1.46 - 3.34	2.43	11.13	16.21	47.16	15.75
	ML 1451 x VBN 2	F_2	2.02 - 5.31	3.34	17.42	20.1	75.11	31.11
		F_3	2.15 - 5.20	3.25	16.81	17.5	92.31	33.28
	ML 1451 x CO 6	F_2	2.14 - 4.74	3.49	13.26	13.83	91.94	26.19
		F_3	1.63 - 4.51	3.15	16.3	17.46	87.15	31.34
Yield per plant (g)	**PUSA 0672 x VBN 2**	F_2	1.43 - 15.67	9.48	22.57	25.76	76.82	40.76
		F_3	3.78 - 17.21	8.71	23.02	27.23	71.52	40.11
	PUSA 0672 x CO 6	F_2	1.86 - 10.08	4.22	23.32	36.73	40.31	30.5
		F_3	2.51 - 18.76	7.72	30.2	31.47	92.08	59.69
	PUSA 0871 x CO 6	F_2	1.66 - 11.65	4.2	29.62	39.23	57	46.06
		F_3	3.44 - 19.70	8.74	24.45	29.09	70.64	42.33
	PUSA 0871 x TNY Local	F_2	1.03 - 9.39	3.54	17.77	30.78	33.35	21.14
		F_3	1.23 - 10.68	5.06	26.48	32.05	68.24	45.06
	MH 565 x VBN 2	F_2	2.44 - 29.65	9.87	34.65	41.55	69.53	59.52
		F_3	2.39 - 23.98	7.42	31.91	36.07	78.26	58.15
	MH 565 x CO6	F_2	1.17 - 10.87	5.81	16.59	28.48	33.92	19.9
		F_3	2.55 - 12.78	8.03	22.7	27.09	70.23	39.19
	MH 521 x TNY Local	F_2	0.67 - 3.76	2.1	16.74	25.47	43.2	22.67
		F_3	0.32 - 5.99	2.07	32.28	44.05	53.7	48.73
	ML 1451 x VBN 2	F_2	2.74 - 23.50	8.05	36.64	43.74	70.17	63.24
		F_3	3.66 - 24.99	11.21	25.22	27.76	82.52	47.2
	ML 1451 x CO 6	F_2	1.69 - 22.19	6.55	41.68	50.46	68.24	70.94
		F_3	1.33 - 14.89	6.95	37.37	40.14	86.67	71.68

Hundred seed weight (g)

ML 1451 x VBN 2 reported maximum range (2.02 - 5.31g and 2.15 - 5.20g) in both F_2 and F_3 generations, respectively (Table 6).Mean value was maximum inF_2 of ML 1451 x CO 6 (3.49 g) and F_3 of PUSA 0871 x CO 6 (3.34 g). In both generations, PCV and GCV values were moderate in all cross combinations except high PCV in F_2 of ML 1451 x VBN 2 (20.10). Similar reports were obtained by Talukdar *et al.,* (2020). Estimates of heritability and GA as percent of mean were noticed moderate to high in both the generations. In concurrence with the results of Marak and Sarkar (2017), Muthuswamy *et al.,* (2019) and Talukdar *et al.,* (2020), high heritability along with high GAM were observed in the crosses *viz.*, ML 1451 x VBN 2 and ML 1451 x CO 6 in both F_2 and F_3, PUSA 0871 x TNY Local in F_2, and MH 565 x VBN 2, PUSA 0672 x CO 6, PUSA 0672 x VBN 2 and PUSA 0871 x CO6 in F_3. High heritability coupled with moderate GAM was observed in the crosses PUSA 0672 x CO6 and MH 565 x VBN 2 in F_2 generation. Similar results were reported by Mehandi *et al.,*(2013).

Yield per plant (g)

The highest mean values were recorded in F_2 of MH 565 x VBN 2 (9.87g) which ranged from 2.44 to29.65 g and in F_3 of ML 1451 x VBN 2 (11.21g) exhibited the mean range of 3.66 to24.99 g (Table 6). High PCV and GCV for yield per plant were noticed in both F_2 and F_3 generations which is in accordance with the results of Muralidhara *et al.,* (2016) and Sindhu *et al.,* (2019). In F_2 generation, this trait showed high phenotypic and moderate genotypic variation in crosses PUSA 0871 x TNY local, MH 565 x CO 6 and MH 521 x TNY local. Similar findings were obtained by Loganathan *et al.,* (2001). This gives better chance for increasing the yield per plant in the present material. In F_2, the heritability estimates were moderate to high. High heritability associated with high genetic advance were observed in both the generations of crosses *viz.*, ML 1451 x CO 6, ML 1451 x VBN 2, MH 565 x VBN 2 and PUSA 0672 x VBN 2 and in F_3 of crosses PUSA 0672 x CO 6, PUSA 0871 x CO 6, PUSA 0871 x TNY Local and MH 565 x CO 6. These results are in concordance with the findings of Muralidhara *et al.,* (2016), Muthuswamy *et al.,*(2019) and Talukdar *et al.,* (2020). High heritability was due to additive gene effects and selection may be effective (Singh and Narayanam, 2006) in both F_2 and F_3 generations. This indicates that these crosses could be exploited for further selection programme to develop high yielding green gram genotypes.

The cross ML1451 x VBN 2 exhibited higher mean value for number of primary branches, pod length and hundred seed weight in both F_2 and F_3 generations and for number of pods and yield per plant in F_3. Among the crosses, PUSA0672 x VBN 2 was found to be early flowering type. The present study highlighted that moderate to high variability was observed for number of primary branches, number of pods per plant, hundred seed weight and yield per plant in all the crosses of F_2 and F_3, where variability for $F_3$was high indicating that the commencement of selection in F_3 would be ideal for development of new high yielding variety.

Among the traits, number of primary branches and hundred seed weight (ML 1451 x VBN 2, ML 1451 x CO 6), yield per plant and number of pods per plant (PUSA 0672 x VBN 2, MH 565 x VBN 2, ML 1451 x VBN 2, ML 1451 x CO 6) had high heritability coupled with high GA as percent of mean in both F_2 andF_3 generations. This indicated that additive genes were contributing the effect of the character in the above crosses. So selection will be

rewarded for the above traits. Selection will be effective in ML 1451 x VBN 2 as this exhibited higher mean value and high heritability along with high genetic advance as percent of mean for yield and its attributing traits.

References

Anonymous, 2018. Ministry of Agriculture. Selected state wise area, production and productivity of greengram, Govt. of India. In: http://www.indiastat.com.

Azizi, F., Rezai, A. M. and Saeidi, G. (2006). Generation mean analysis to estimate genetic parameters for different traits in two crosses of corn inbred line at three planting densities. Journal of Agricultural Science and Technology.8(2): 153-169.

Bernardo, R. (2003). On the effectiveness of early generation selection in self-pollinated crops**.** Crop Science.43: 1558-1560.

Burton, G. W. (1952). Quantitative inheritance in grassess. Proceedings of the Sixth International Grassland Conference.1: 277-283.

Chahota, R. K., Kisore, N., Dhiman, K. C., Sharma, T. R. and Sharma, S. K. (2007). Predicting transgressive segregants in early generation using single seed descent method derived *micro-macrosperma* genepool of lentil. Euphytica.156: 305-310.

Garg, G. K., Verma, P. K. and Kesh, H. (2017). Genetic Variability, Correlation and Path Analysis in Mungbean [*Vigna radiata* (L.)Wilczek]. International Journal of Current Microbiology and Applied Sciences. 6(11): 2166-2173.

Govindasamy, G., Gash, A. K. and Mahama, N. K. (1973). Genetic variability and correlation studies on protein content and some quantitative characters of rice.Oryza.10:1-8.

Khattak, G. S., Ashraf, M. and Khan, M. S. (2004).Assessment of genetic variation for yield and yield components in mungbean (*Vigna radiata*(L.)Wilczek) using generation mean analysis. Pakistan Journal of Botany.36(3): 583-588.

Loganathan, P., Saravanan, K. andGanesan, J. (2001).Genetic variability in greengram. Research on Crops.2(3): 396-397.

Lush, J. L. (1940).Intra-site Correlation and Regression of offspring in rams as a method of estimating heritability of characters. Proceedings of American Society of Animal Production.33: 292-301.

Marak, J. K. and Sarkar, K. K. (2017). Genetic variability for some quantitative traits related to yield in mungbean(*Vigna radiate* L. Wilezek). International Journal of Basic and Applied Biology. 4(2): 102-105.

Mehandi, S., Singh, C. M. and Kushwaha, V. K. (2013).Estimates of genetic variability and heritability for yield and yield component traits in mungbean (*Vigna radiata* (L.) Wilczek). The Bioscan.8(4): 1481-1484.

Muthuswamy, A., Jamunarani, M. and Ramakrishnan, P. (2019). Genetic variability, character association and path analysis studies in green gram (*Vigna radiata*(L.) Wilczek). International Journal of Current Microbiology and Applied Sciences. 8: 1136-1146.

Panse, V. G. and Sukhatme, P. V. (1964). Statistical Methods for Agricultural Workers. ICAR. New Delhi. 361pp.

Pavan, K., Reddy, P. and Mehta, C. M. (2019). Estimation of variability through genetic parameters and

identification of superior pure lines for yield attributing traits in greengram [*Vigna radiate* (L.). Journal of Pharmacognosy and Phytochemistry. 8: 55-61.

Rahman, M., Iqbal Hussain, A. S. M., Saykhul, A., Akhter, Z. and Hasanuzzaman, M. (2003). Genetic variability, correlation and path analysis in mungbean. Asian Journal of Plant Sciences.2(17-24):1209-1211.

Rambabu, V., Lavanya, G. R., Latha, V. S. and Jayaprada, T. A. (2018).Genetic variability and character association for seed yield and its attributing traits in mungbean (*Vigna radiata* (L.)Wilczek). Journal of Research ANGRAU.46 (4): 25-31.

Robinson, H. F., Comstock, R. E. and Harvey, P. H. (1949).Estimates of heritability and the degree of dominance in corn**.** Agronomy Journal. 41: 353-359.

Sanjupretham, S., Lavanya, G. R. and Vatsav, A. S. S. (2019).Estimation of genetic variability and heritability for seed yield characters in greengram [*Vigna radiate* (L.) Wilczek]. International Journal of Current Microbiology and Applied Sciences.*8*(12): 77-82.

Shiv, A., Vinita, R., Vadodariya, G. D., Modhas, K. J. and Patel, R. K. (2017). Genetic variability, heritability and genetic advance in F_3 progenies of mungbean(*Vigna radiata*(L.)Wilczek). International Journal of Current Microbiology and Sciences.12: 3086-3094.

Sindhu, S., Shanthi Priya, M., Prashanthi, L. and Sudhakar, P. (2019). Genetic variability for yield and yield attributing traits in F3 generation of green gram. International Journal of Current Microbiology and Applied Sciences.8(2): 2423-2431. doi.org/10.20546/ijcmas.2019.802.282

Singh P. and Narayanam.(2006). Biometrical Techniques in Plant Breeding.Kalyani Publishers, New Delhi, 323p.

Sivasubramanian, V. and Madhava Menon, P. (1973). Path analysis for yield and yield components of rice. Madras Agricultural Journal.60: 1217- 1221.

Talukdar, N., Borah, H. K. and Sarma, R. N. (2020). Genetic variability of traits related to synchronous maturity in greengram[*Vigna radiata* (L.) Wilczek]. International Journal of Current Microbiology and Applied Sciences.9(1): 1120-1133.

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