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Genetic variability studies in mungbean (*Vigna radiata* L.)

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Abstract
The genetic improvement in greengram depends on the nature and amount of variability present in the population. The trait, yield, is highly influenced by environmental factors indicating the need to have clear understanding on existed amount of variability in the breeding material for the yield contributing traits including yield. In the present study, thirty genotypes of advanced breeding lines of greengram were evaluated to know the variability parameters for yield and yield contributing traits for their exploitation in the breeding programmes. The analysis of variance was significant for yield and yield traits indicating the existence of sufficient variability for their exploitation. The mean range of the traits was huge for most of the traits indicating use of simple selection while exploiting genetic variability of the material. The phenotypic coefficient of variation was higher than the genotypic coefficient variation indicating the influence of environment on the expression of the traits. Among the traits, no. of branches/plant, no. of clusters/plant, no. of pods/plant, test weight (gm) and seed yield/ha showed more heritability and genetic advance indicating the importance of simple selection procedures for their exploitation in the breeding programmes.

Keywords: Advanced breeding lines, greengram, variability parameters

Introduction

Greengram is an important pulse crop of India and widely cultivated in tropical and sub-tropical regions of the world. It is normally used for human consumption, animal feed, cover crop and as supplementary crop in cereal based cropping systems. India is one of the major producer of the world and accounts for 12% of total pulse area of the country. It is mainly grown in Madhya Pradesh, Maharashtra, Uttar Pradesh, Andhra Pradesh and Rajasthan. Recently consumption of greengram has increased because of the rising popularity in greengram foods due to their health benefits (Datta *et al*., 2012) [7]. Mungbean enables land to restore fertility by nitrogen fixation to produce reasonable yields of succeeding crops and provides proteinaceous grain and nutritive fodder (Dash and Pattanayak, 2007) [6]. The protein is comparatively rich in lysine, an amino acid which is predominantly deficit in cereal grains. Greengram seeds are rich in minerals like Calcium, iron, magnesium, phosphorus, potassium and vitamins like ascorbic acid, thiamine, riboflavin, niacin, pantothenic acid and vitamin A (Tang *et al*., 2014) [22]. The major constraints for achieving higher yields in greengram are inherently low yielding potential of the varieties that lack genetic variability, inefficient plant type and susceptibility to various biotic and abiotic stresses (Souframanien and Gopalakrishnan, 2004) [21]. The extent of improvement expected by selection in any population depends on the nature and amount of genetic variability present in the population. Further, complex trait like yield is highly influenced by environmental factors and needs thorough understanding of yield and yield traits for their exploitation in the crop improvement programmes. The studies on variability parameters clearly indicates the amount of genetic variability present in the material and also reveal the amount of heritability and genetic advance of the traits with suitable breeding methods for their exploitation in the breeding programmes. Heritability along with genetic advance is more useful than heritability alone (Singh *et al*., 2010) [20]. Hence, the present study was conducted to know the genetic parameters such as phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance in the advanced breedling lines developed at RARS, Lam, Guntur, Andhra Pradesh, India.

Material and Methods

The present investigation was carried out during *rabi*, 2019-2020 at Regional Agricultural Research Station, Lam, Guntur with 30 genotypes of greengram in a randomized block design with three replications. Seeds were sown with row to row spacing of 30 cm and plant to plant spacing of 10 cm. Recommended package of practices were followed to raise the good crop. The data were recorded on ten randomly selected plants of each replication for eight quantitative characters *viz*., no. of branches/plant, no. of clusters/plant, no. of pods/plant, pod length, no. of seeds/pod, test weight, seed yield/ha but in case of days to 50% flowering and days to maturity, the observations were recorded on plot basis. The data was subjected to statistical analysis to estimate the analysis of variance, genotypic and phenotypic coefficients of variation (Burton,1953) [5], heritability in broad sense and genetic advance (Johnson *et al*., 1955) [12].

Results and Discussion

Analysis of variance (ANOVA) was carried out for 30 genotypes of greengram for all the traits *viz*., days to 50% of flowering, days to maturity, plant height, no. of branches/plant, no. of clusters/plant, no. of pods/plant, pod length, no. of seeds/pod, test weight and seed yield/ha and was significant indicating the presence of considerable genetic variability in the experimental material under study. Rao *et al*. (2006) [16], Singh *et al*. (2009) [19], Reddy *et al*. (2011) [17], Hemavathy *et al*. (2015) [11] and Dhoot *et al*. (2017) [8] also reported significant differences for all the studied characters (Table 1).

Genetic variability studies

The advanced breeding lines recorded huge to low variability for seed yield and yield contributing traits as they are generated form very few individuals. Genetic improvement of the traits can be achieved through a clear understanding of nature and amount of variability present in the breeding material for the component traits including yield and the extent to which these traits are heritable. Information on genetic variability parameters such as variance and heritability in conjunction with genetic advance would give a more reliable selection value. There are reports that variability and heritability will give better idea of expected genetic advance during selection.

The estimated values of mean, range, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability ($h^2_{(b)}$) and genetic advance as per cent of mean (GAM) are presented in **Table 2** and are described character-wise hereunder.

Days to 50% flowering

This trait exhibited the lowest phenotypic and genotypic coefficients of variation *i.e*., 6.05 and 5.60, respectively, indicating the presence of little variability for this trait. The environmental influence on the expression of this trait is also less as the PCV and GCV values were very close to each other.

High heritability (85.5%) and low genetic advance as per cent of mean (10.68) were observed for this trait indicating the action of both additive and non-additive genes in the expression of this trait. Similar results were obtained by Makeen *et al*. (2007) [14], Nand and Anuradha (2013) [15] and Kumar and Choudary (2007) [13] for this trait in their studies in greengram.

Days to maturity

The phenotypic and genotypic coefficients of variation observed were low for days to maturity *i.e*., 3.30 and 3.10, respectively. High heritability (88.2%) and low genetic advance as per cent of mean (6.00) indicated the action of both additive and non-additive genes in the expression of this trait. Similar result were obtained by Rao *et al*. (2006) [16] and Makeen *et al*. (2007) [14] in their study in greengram.

Plant height

The mean value of plant height was 40.20 cm with the range 33.80 cm to 49.20 cm. The phenotypic coefficient of variation value was moderate (12.14) while the genotypic coefficient of variation was low (6.16) indicating the presence of huge environmental influence on the expression of this trait. Low heritability (25.75) and low genetic advance as per cent of mean (6.43) were observed for this character indicating the predominance of non additive gene effects in the expression of this trait.

No. of branches per plant

The range for number of branches per plant observed in the material was 0.93 to 2.20 with a mean value of 1.52. The highest phenotypic coefficient of variation (24.25) and moderate genotypic coefficient of variation (19.14) were observed for this trait indicating the presence of huge variability for this trait in the studied material. Higher heritability (62.31) and high genetic advance as per cent of mean (31.1387) were observed for this character indicating the predominance of additive gene action with low environmental influence in the expression of this trait and use of simple selection for further genetic improvement. Similar result was also reported by with Rao *et al*. (2006) [16].

No. of clusters per plant

This trait showed a mean value of 4.68 and the observed values for this trait in the studied material varied from 1.26 to 6.93. High phenotypic (32.03) and genotypic coefficients of variation (29.49) were observed indicating the presence of high variability in the material for this trait. This difference between the PCV and GCV indicated the role of environment on the expression of this trait. Ritu *et al*. (2005) [18] and Rao *et al*. (2006) [16] also reported similar results in their studies in greengram. High values of heritability (84.58) and genetic advance as per cent of mean (55.81) were observed indicating the role of additive gene effects and simple selection in the improvement of this trait. These results were in conformity with the results of Azam *et al*. (2018) [3].

No. of pods per plant

Among all the lines, the trait no. of pods/plant mean value was 14.00 and the observed range was 8.40 to 17.50. High levels of phenotypic (18.2246) and genotypic coefficients of variation (15.56) were observed signifying the existence of more variability and less environmental influence on the expression of this trait. High heritability (72.91) and high genetic advance as per cent of mean (27.37) were observed for this trait indicating the predominance of additive gene action which could be targeted for phenotypic selection and further genetic improvement through simple selection method. These results are in conformity with Hemavathyi (2015) [11], Anand *et al*. (2016) [2], Baisakh *et al*. (2016) [4], Godakh *et al*. (2013) [10] and Tiwari *et al*. (2014) [23] in greengram for number of pods per plant.

Pod length

The range of pod length was 6.05 to 9.29 with a mean value of 7.33cm. Moderate level of phenotypic coefficient of variation (14.18) and low level of genotypic coefficient of variation (7.30) were observed indicating the huge effects of environment on the expression of this trait. Low heritability (26.52) and low genetic advance as per cent of mean (7.75) were reported for this trait indicating the preponderance of non-additive gene action in controlling the trait, where simple selection is ineffective and could be better exploited through recombination breeding. Similar results were reported by Alam *et al*. (2015) [1] for pod length in greengram.

No. of seeds/pod

The trait, no. of seeds/pod, mean value was 10.19 with a range of 8.40 to 12.00. Moderate level of phenotypic coefficient of variation (10.03) and low genotypic coefficient of variation (7.04) were observed indicating the presence of more environmental influence on the expression of this trait. High heritability (49.22) coupled with moderate genetic advance as per cent of mean (10.17) was recorded indicating the existence of both additive and non-additive gene actions in the expression of this character. Hence, simple selection is not useful for improving this trait. Similar observations were reported for number of seeds per pod in greengram by Singh *et al*. (2009) [19].

Test weight (g)

The trait, test weight, recorded a mean value of 3.91g with the range of 3.35 to 4.96g. The moderate levels of phenotypic (11.35) and genotypic coefficients of variation (11.31) were observed for this trait. Nand and Anuradha (2013) [15] also reported similar results. High heritability (99.32) coupled with high genetic advance (23.23) was observed for this trait indicating the preponderance of additive gene effects in the expression of the trait which is easily fixable and can be exploited using simple selection. Garg *et al*. (2017) [9] in greengram observed similar results of additive gene effects role in the expression of this trait.

Seed yield/ha

The mean value for the trait, seed yield/ha was 705.07 Kg and the observed range was 427.22 to 981.11Kg. High level of phenotypic coefficient of variation (22.40) and moderate level of genotypic coefficient of variation (17.19) were observed in the material. High heritability (58.89) and high genetic advance as per cent of mean (27.18) were observed for this trait indicating the predominance of additive gene action with low environmental influence in the determination of this character. Further genetic improvement of this character is possible through simple selection method. Rao *et al*. (2006) [16] also noted similar results for this trait in their study.

Thus, the study clearly indicated the existence of sufficient variability for the yield traits in the advanced breeding lines of greengram developed at Regional Research Station, lam, Guntur, Andhra Pradesh and their exploitation in the breeding programmes.

Table 1: Analysis of variance for Green gram yield and yield components in Green gram (*Vigna raidiata* L.)

Source of variation	Replications	Treatments	Error
Degrees of freedom	2	29	58
50% of flowering	1.26	524.23	55.40
Days to maturity	1.62	426.88	37.04
Plant height (cm)	2.77	1049.30	1028.64
No. of branches/plant	0.03	8.88	2.98
No. of clusters/plant	1.71	175.59	20.12
No. of pods/plant	4.33	464.74	102.42
Pod length	0.41	48.01	46.10
No. of seeds/pod	1.36	60.24	30.83
Test weight (gm)	0.01	17.09	0.07
Seed yield/ha	8281.05	1576392.10	595057.87

Table 2: Mean, genetic variability, heritability (broad sense) and genetic advance as per cent of mean for seed yield and yield components in Green gram (*Vigna radiata* L.).

S. No.	Character	Mean	Range		Coefficient of Variation		Heritability (%) (broad sense)	Genetic advance as per cent of mean (5%)
			Minimum	Maximum	PCV (%)	GCV (%)		
1.	Days to 50% of flowering	42.63	37.66	46.00	6.05	5.60	85.5	10.68
2.	Days to maturity	69.77	63.66	73.00	3.30	3.10	88.2	6.00
3.	Plant height (cm)	40.24	33.89	49.26	12.14	6.16	25.75	6.43
4.	No. of branches/ plant	1.52	0.93	2.20	24.25	19.14	62.31	31.13
5.	No. of clusters/ plant	4.68	1.26	6.93	32.03	29.49	84.58	55.81
6.	No. of pods/plant	14.01	8.46	17.53	18.22	15.56	72.91	27.37
7.	Pod length	7.33	6.05	9.29	14.18	7.30	26.52	7.75
8.	No. of seeds/pod	10.19	8.40	12.00	10.03	7.04	49.22	10.17
9.	Test weight (gm)	3.91	3.35	4.96	11.35	11.31	99.32	23.23
10.	Seed yield/ha	705.07	427.22	981.11	22.40	17.19	58.89	27.18

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