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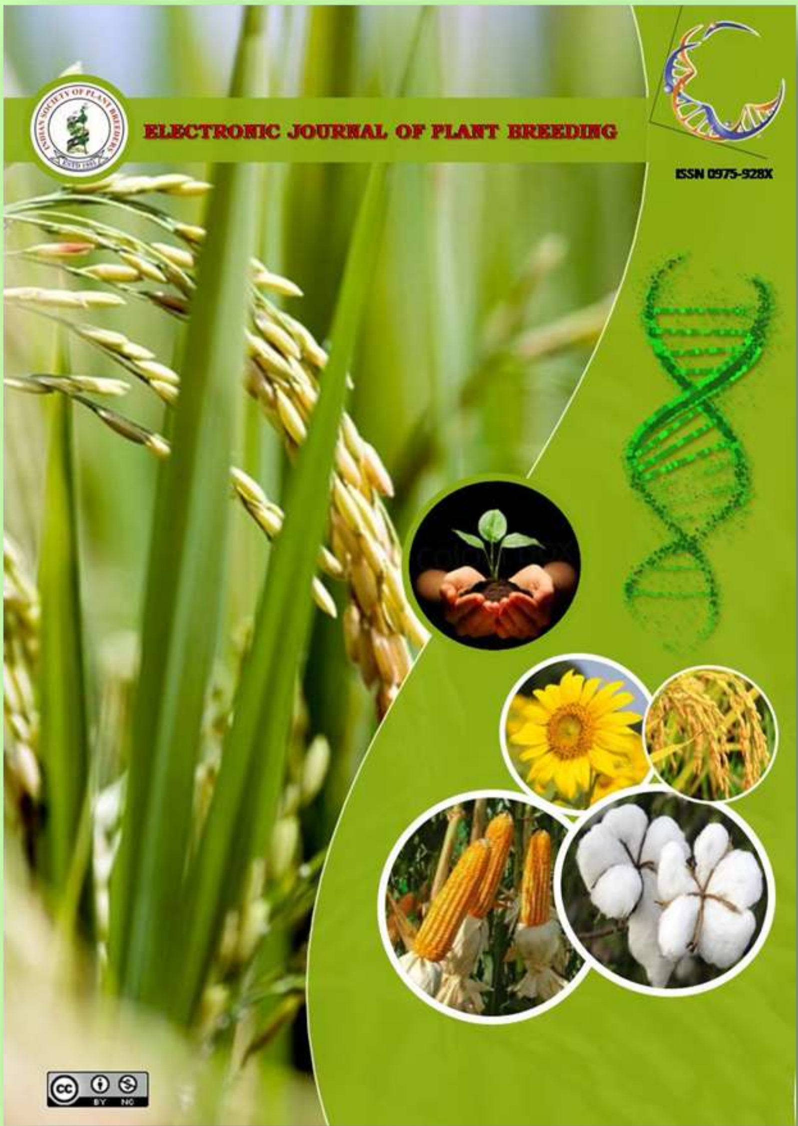

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Research Article

Validation of genetic parameter for yield related traits among indigenous mung bean (*Vigna radiata* L.) germplasm

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Abstract
The present study was conducted during Rabi 2018 utilizing selected mung bean germplasm for validation of genetic variability and correlation among yield and yield contributing traits of mung bean. One hundred and ten indigenous mungbean germplasm were investigated for this study for ten biometrical traits *viz.,* day to 50% flowering (days), plant height (cm), number of primary branches per plant, no. of clusters per plant, no. of pods per cluster, no. of pods per plant, no. of seeds per pod, pod length (cm), 100 seed weight (g) and single plant yield (g). Phenotypic co-efficient of variation (PCV) was slightly higher than genotypic co-efficient of variation (GCV) for most of the traits that pronounces the expression of these traits being influenced by both genotype and environment. Higher estimates of PCV and GCV were observed in the traits pods per plant, 100 seed weight and single plant yield suggesting that these traits offer a scope of direct selection. The traits days to 50% flowering (98 per cent), plant height (83 per cent), number of pods per plant (86 per cent) and single plant yield (98 per cent) have shown high heritability besides higher genetic advance as percent of mean (20 per cent) indicating that the above mentioned characters display a strong additive gene action and they can be subjected to genetic improvement through simple selection. Genotypic correlation construes higher values than phenotypic correlation for most of the traits. Single plant yield showed highly significant correlation with all the characters at 1 per cent level. Path analysis of the 110 green gram genotypes indicated that the number of pods per plant exhibited a direct effect which is very high positive effect whereas number of seeds per pod showed moderate direct effect. Hence, simultaneous selection for the above traits would be more rewarding to bring improvement in mung bean.

Key words
Mung bean (*Vigna radiata*), Variability, Correlation, Heritability.

Introduction

Greengram(*Vigna radiate* (L.) Wilczek, 2n=22 Fabaceae) also known as mung bean, golden bean, maash, or moongbeanis a major pulse crop in India cultivated mainly for protein (23.6 per cent) with carbohydrate (58 per cent). Greengram is cultivated in the temperate, tropical and sub-tropical zones of Asia which include India, Pakistan, Myanmar, Indonesia, Bangladesh, Srilanka, Nepal, China, Korea, and Japan. India contributes 75% of the world greengram production account an area of 3.83 million hectares, 1.60 m tonnes of annual production and 418 kg per hectare productivity (Anonymous, 2017). To meet the needs of growing population, the yield potential of the crop has to be improved. One of the constraints listed for lack of breakthrough in greengram production has been the deficit of genetic variability for high yield potential. Interpretation on genetic improvement is precisely decided on extent of genetic variability available among the base population constituting the genetic superiority (Sarath Chandra *et al.,* 2017). Genetic variability studies support to differentiate regarding nature and extent of genetic variability imputable among different cases, sensitive nature of the crop to the environmental influences, heritability of the characters and genetic advance that can be realized in practical breeding. The extent of variability and heritability of the characters among the genotypes is the basic source for the exploitation of superior potentiality of genotypes. Heritability provides the information on the magnitude of inheritance of quantitative traits, while genetic advance will be helpful in formulating suitable selection procedures. Further, utilization of diverse genotypes as parents in hybridization programme serves the purpose of combining desirable recombinations. Hence, a thorough knowledge on the genetic architecture along with nature of gene action governing yield and its component characters would help to design the appropriate breeding strategy for evolution of genetically superior greengram genotype. Further, studies on genotypic and phenotypic correlation will provide us an idea of determining the traits which are effective on yield. Cause and effect relation of traits towards yield is not explained by correlation and hence path analysis was interpreted for determining the direct and indirect effect of traits on yield. Hence, the path and correlation analysis are used in concord by the plant breeders to establish the yield and its contributing characters.

Materials and Methods

The experimental material for the present investigation constitutes 110 greengram genotypes. The experiment was conducted during rabi season of 2018 at the experimental student field of Agricultural College and Research Institute, Killikulam, Tamil Nadu Agricultural University. The experiment was conducted on a RBD with a spacing of 30×10 cm in two replications following standard agronomic practices at appropriate stages of crop growth.

Observations on ten biometrical traits *viz.*, days to 50% flowering, plant height (cm), number of primary branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, pod length (cm), 100 seed weight (g) and single plant yield (g) were recorded in five randomly selected plants from each replication for all the genotypes and subjected for the statistical analysis. Genetic variability was interpreted as per procedure provided by Burton (1952) while, heritability calculated *vide* protocol given by Lush (1940) besides Johnson *et al*. (1955) for genetic advance as percent of mean were adopted to find out the respective estimates.

Results and Discussion

The analysis of variance ANOVA is useful for testing the significance as well as to gauge the different genetic components of variance. The data pertaining to different traits were analyzed and presented in Table 1. Analysis of variance revealed highly significant difference among all the genotypes for all the traits studied suggesting the feasibility for further estimation of parameters of variability. Kate *et al*. (2017) also reported similar results. A wide range of mean values was interpreted for days to 50 per cent flowering [SML 17111(26.67) and AGG 10-087 (50.33)], plant height [IPM 0214 (28.56) and AGG 09-079 (58.40)], number of primary branches per plant [Annur-2 (2.13) and AGG 11 019 (4.73)], number of clusters per plant [CO 4 (8) and LM 13 (22.33)], number of pods per cluster [IPM 0219 (2.00) and AGG 09073/AGG01085 (4.00), number of pods per plant [IPM 0219 (23.93) and PLS 629A (69.87)], number of seeds per pod [CO 7 (11.73) and IC 39317 (8.07)], pod length [AGG 09038 (6.29) and GPB 1784 (7.92), 100 seed weight [EC591388 (1.39) and MGG 329/1 (6.90)] and single plant yield [IPM 0219 (5.57) and LM 13 (23.76)] indicating the existence of wide variation among the genotypes studied. The larger gap of mean values among germplasm would ensure to exhibit greater genetic variability providing better avenues for genetic analysis (Sandhiya and Saravanan, 2018) (Table 2).

The availability of genetic variability among germplasm constitute a vital factor in any crop improvement programme besides adoption of breeding programme is usually decided after assessment of heritable and non-heritable components of the total variability (Cobb *et al.*, 2019).The results revealed that for all the characters, the phenotypic co-efficient of variation (PCV) was slightly higher than genotypic co-efficient of variation (GCV) that pronounces the expression of these traits being influenced by environment. Higher estimates of PCV and GCV were observed in the traits *viz.*, pods per plant, 100 seed weight and single plant yield suggesting that these traits offer a scope of direct selection (Muthusamy *et al.*, 2019; Govardhan *et al.*, 2018 and Chandra *et al.*, 2017). The traits *viz.*, days to 50% flowering, plant height, number of primary branches per plant, number of clusters per plant exhibited moderate level of PCV and GCV while, low PCV and GCV were observed for number of seeds per pod and pod length (Pavan *et al.*, 2019). A very slight variation between PCV and GCV indicated that there is a very slight influence of environment.

Heritability is an index for the transmission of characters from parents to offspring and genetic advance is the genetic gain under selection. The selection of the traits based on heritability and genetic advance is immensely important. The traits days to 50% flowering (98 per cent), plant height (83 per cent), number of pods per plant (86 per cent) and single plant yield (98 per cent) recorded high heritability besides higher genetic advance as percent of mean (20 per cent) indicating that the above mentioned characters display a strong additive gene action and they can be subjected to genetic improvement through simple selection. The characters like number of primary branches per plant, pods per cluster and pod length shown moderate heritability (30 – 60 per cent) and moderate genetic advance (10 – 20 per cent) specifying non- additive gene action coupled with high environmental impact. Whereas, the number of seeds per pod had high heritability and moderate genetic advance (10 – 20 per cent) indicating non additive gene action coupled with low environmental effect. 100 seed weight recorded moderate heritability and high genetic advance showing additive gene action with high environmental effect (Table 3).

Correlation analyses attribute better understanding of the relationship of each trait towards yield upon which selection of superior progeny directed (Govardhan *et al.*, 2018). Genotypic correlation interpreted higher values than phenotypic correlation for most of the traits. Single plant yield showed highly significant correlation with all the characters. Number of clusters per plant and number of pods per plant were highly significant and exhibited highly positive correlation with single plant yield (Table 3). Days to 50 per cent flowering showed negative correlation with all the characters including single plant yield. Both genotypic and phenotypic correlation coefficients were highly significant for number of primary branches, number of clusters per plant and number of pods per plant whereas, 100 seed weight registered significant at genotypic level only. Plant height exhibited positive correlation with number of primary branches, number of cluster per plant and number of pods per plant. Number of primary branches per plant exhibited significantly positive correlation with number of cluster per plant and number of pods per plant at both phenotypic and genotypic levels. Number of clusters per plant showed positive correlation with number of pods per plant and single plant yield. Highly significant and positive correlation exhibited by number of pods per cluster with number of pods per plant and single plant yield. Selection of plants with higher number of clusters per plant and high number of pods per plant would ensure in retrieval of progenies with desirable single plant yield. The results are in agreement with earlier findings of Muthusamy *et al.,* (2019), Sandhiya and Saravanan (2018) and Kate *et al.,* (2017).

Path analysis will give the effect of the each trait on the single plant yield. Path analysis of the 110 greengram genotypes indicated that the number of pods per plant exhibited a direct effect which had high positive effect whereas, number of seeds per pod showed moderate direct effect (Table 4). Very low direct effect was shown by number of primary branches per plant and 100 seed weight exhibited high direct effect on seed yield. Number of clusters per plant and number of pods per cluster depicted a high and indirect effect *via* number of pods per plant. But pods per cluster had low negative direct effect on seed yield. High and positive indirect effect was exhibited by number of primary branches per plant but had low positive direct effect on seed yield. Days to 50% flowering showed negative direct effect but low positive indirect effect through number of cluster per plant, number of pods per plant and pod length. Plant height depicted low and negative direct effect and indirect positive effects through number of pods per plant, number of primary branches per plant and number of seeds per plant. Divya Ramakrishnan *et al.,* (2018) and Roshan *et al.* (2018) for 100 seed weight. However, similar results were reported by Keerthika *et.al.* (2018), Kanimozhi *et al* (2018) and Asif *et al.* (2019). The present study revealed that the improvement of seed yield through simultaneous selection of number of pods per plant and 100 grain weight.

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Table 1.Analysis of variance for different characters in green gram

Source of Variation	Mean Sum of Squares										
	Df	DFF	Plant height (cm)	Primary branches/ plant	No. of clusters/ plant	No. of pods/cl uster	No. of pods/plan t	No. of seeds/ pod	100 seed weight (g)	Pod length (cm)	Single plant yield (g)
Genotypes	119	103.8**	140.60**	0.64**	24.90**	0.46**	376.65**	2.46**	1.31**	1.69**	66.36**
Error	119	0.66	8.74	0.15	0.13	0.13	09.64	0.36	0.35	0.48	0.28

** Significant at 1% level

Table 2. Parameters of genetic variability for yield and yield contributing traits

Character	Range	Mean	GCV%	PCV%	H^2%	GA	GAM%
Days to 50% flowering	27.33 – 50.00	37.55	15.62	15.76	98.11	11.90	31.86
Plant height	28.56 – 55.56	44.10	15.03	16.46	83.40	12.46	28.28
Primary branches	2.13 – 4.73	3.19	12.77	17.66	52.32	4.77	19.03
Number of clusters per plant	9.07 – 22.33	14.38	18.91	22.13	73.01	0.59	33.28
Number of pods per cluster	2.47 – 4.00	3.22	10.31	15.30	45.45	0.45	14.32
Number of pods per plant	20.67 – 69.60	46.08	23.67	25.55	85.83	20.80	45.18
Number of seeds per pod	8.07 – 11.87	9.78	8.55	10.54	65.88	1.23	14.30
Pod length	1.39 - 6.90	6.62	9.59	14.26	45.21	0.90	13.28
100 seed weight	5.05 – 8.24	2.57	21.95	31.91	47.32	0.76	31.10
Single plant Yield	3.74 - 23.76	11.66	40.27	40.53	98.72	9.59	82.41

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Table 3. Correlation among yield and yield influencing nine quantitative traits of green gram.

Character		Days to 50 per cent flowering	Plant height (cm)	Number of primary branches per plant	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Number of seeds per pod	Pod length (cm)	100 seed weight (g)	Single plant yield (g)
Days to 50 percent flowering	**G**	1.000	-0.160	-0.270**	-0.270**	-0.130	-0.250**	-0.140	-0.210*	-0.290**	-0.360**
	P	1.000	-0.150	-0.210**	-0.240**	-0.080	-0.230**	-0.110	-0.150	-0.200*	-0.350**
Plant height (cm)	**G**		1.000	0.370**	0.350**	0.060	0.280**	0.130	0.000	0.270**	0.280**
	P		1.000	0.250**	0.280**	0.030	0.240**	0.130	-0.030	0.160	0.250**
Number of primary branches	**G**			1.000	0.700**	0.260**	0.640**	0.100	0.070	0.290**	0.520**
	P			1.000	0.710**	-0.070	0.540**	-0.010	0.060	0.070	0.400**
Number of clusters per plant	**G**				1.000	0.320**	0.920**	0.230*	0.200*	0.530**	0.800**
	P				1.000	-0.040	0.800**	0.110	0.120	0.240**	0.700**
Number of pods per cluster	**G**					1.000	0.660**	0.260**	0.200*	0.180*	0.520**
	P					1.000	0.540**	0.000	0.050	0.130	0.360**
Number of pods per plant	**G**						1.000	0.320**	0.250**	0.470**	0.850**
	P						1.000	0.120	0.140	0.280*	0.810**
Number of seeds per pod	**G**							1.000	0.430**	0.190*	0.510**
	P							1.000	0.310**	0.110	0.420**
Pod length (cm)	**G**								1.000	0.290**	0.350**
	P								1.000	0.120	0.250**
100 seed weight (g)	**G**									1.000	0.720**
	P									1.000	0.490**
Single plant yield (g)	**G**										1.000
	P										1.000

* Correlation is significant at 5% level. ** Correlation is significant at 1% level.

Table 4. Path analysis of yield and yield contributing traits.

character	Days to 50% flowering	Plant height (cm)	Number of Primary branches	Number of clusters / plant	Number of pods / cluster	Number of pods / plant	Number of seeds / pod	Pod length (cm)	100 seed weight (g)
Days to 50% flowering	-0.081	0.005	-0.001	0.114	0.027	-0.278	-0.033	0.007	-0.120
Plant height (cm)	0.013	-0.032	0.002	-0.149	-0.012	0.313	0.030	000	0.111
Number of primary branches	.022	-0.012	0.005	-0.298	-0.056	0.716	0.023	-0.002	0.121
Number of clusters per plant	0.021	-0.011	0.004	-0.427	-0.067	1.018	0.052	-0.006	0.218
Number of pods per cluster	0.010	-0.001	0.001	-0.134	-0.215	0.734	0.061	-0.006	0.076
Number of pods per plant	0.020	-0.009	0.003	-0.391	-0.142	1.113	0.074	-0.008	0.193
Number of seeds per pod	0.011	-0.004	0.005	-0.097	-0.056	0.356	0.231	-0.014	0.078
Pod length (cm)	0.016	000	0.004	-0.083	-0.042	0.274	0.098	-0.033	0.119
100 seed weight (g)	0.023	-0.008	0.001	-0.226	-0.039	0.520	0.043	-0.009	0.414

Residual effect =0.27

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