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Research Article

GENETIC VARIABILITY STUDIES IN MUNGBEAN (*Vigna radiata* L. Wilczek)

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Abstract: The present study was carried out to estimate the genetic parameters on sixteen morpho-physiological traits with thirty-one mungbean genotypes. The results revealed that based on the *per se* performance, the genotypes LGG 450 and MGG 350 showed superior performance for yield as well as drought tolerance traits suggesting that these genotypes could be exploited in the breeding programme to develop drought tolerant lines coupled with high yield. High to moderate GCV estimates and high heritability with high genetic advance as percent of mean were observed for number of pods per plant, 100 seed weight, relative injury, chlorophyll stability index, specific leaf area and chlorophyll content indicating that the variation in the above characters most likely due to additive gene effects, hence simple directional selection may be effective to improve these characters.

Keywords: Mungbean, Genetic parameters, Morpho-Physiological traits.

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Introduction

The productivity in mungbean is being hampered by different biotic and abiotic stresses. Among which drought could be considered as the major one. Therefore, the genetic reconstruction of a plant type is required for developing high yielding varieties by incorporating and improving the drought tolerant characters. Hence, evaluation of germplasm for genetic variability is essential for the present as wel1 as future crop improvement programmes. The adequate information on extent of variability parameters may be helpful to improve the yield as well as drought tolerance by selecting the yield component and drought related traits. Heritability and genetic advance when calculated together would be more useful in predicting the effectiveness of the character for improvement [2]. In view of the above perspectives, the present study was taken up to assess genetic parameters in mungbean genotypes to identify the superior genotypes for yield as well as drought tolerance.

Materials and Methods

The experimental material for the present investigation consisted of thirty one mungbean genotypes. The experiment was conducted in randomized block design (RBD) with three replications at wet land farm, Sri Venkateswara Agricultural College, Tirupati. The inter and intra- row spacing adapted was 30 x 10cm. Each genotype was sown in three rows of 3m length and observations were recorded on five randomly selected plants without border effect of each genotype in each replication for characters viz., plant height, number of clusters per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, hundred seed weight, harvest index, SPAD Chlorophyll Meter Reading (SCMR), Relative Water Content (RWC), Relative Injury (RI), Chlorophyll Stability Index (CSI), Specific Leaf Area (SLA), chlorophyll content and seed yield per plant. However, the data for days to 50% flowering and days to maturity were recorded on plot basis. Recommended cultural practices and plant protection measures were followed to raise a healthy crop. Variability parameters were calculated using standard procedures.

Results and Discussion

Analysis of variance revealed that the genotypes differed significantly for all the characters indicating the existence of considerable amount of variation among the genotypes studied (Table 1). The variability among the genotypes suggested ample scope for improvement through selection. Based on mean performance, the genotypes LGG 450, KM 122, GIVT 203, TM 96-2 and MGG 350were showed superior performance for yield and yield contributing traits. For drought tolerance parameters the genotypes WGG 2, MGG 347, EC 396117, MGG 350 and Asha were showed better performance (Table 2). In the present study, the estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) indicating that the variation is due to the influence of environment. Genotypic coefficient of variation would be more useful for assessing the variability, since it depends upon the heritable portion of variability. The character chlorophyll content showed higher estimates of genotypic and phenotypic coefficient of variation indicating the presence of ample variation among the genotypes for this trait. Therefore, simple selection could be effective for further improvement of this character. Moderate estimates of GCV and PCV were observed for the traits relative injury, number of pods per plant, number of clusters per plant, seed yield per plant, chlorophyll stability index, 100 seed weight, plant height and specific leaf area (Table 3). Similar results were also reported by [3] for seed yield per plant; [5] for plant height, number of clusters per plant, number of pods per plant and 100 seed weight and [6] for chlorophyll stability index and specific leaf area. Heritability measures the relative amount of heritable portion of variability. It is a good index of the transmission of characters from parents to offspring. The perusal of the Table 3 revealed the estimates of heritability in broad sense for sixteen characters studied, which ranged from 27.87 to 83.21 percent. The highest heritability was registered for days to 50% flowering followed by chlorophyll content, relative injury, 100 seed weight, days to maturity, chlorophyll stability index, number of pods per plant, plant height and specific leaf area. Genetic variation along with the heritability estimates would give a better idea about the expected efficiency of selection [1].

Table-1 Analysis of variance for sixteen quantitative characters in thirty one genotypes of mungbean

SN	Characters	Mean sum of squares		
		Replications (df: 2)	Treatments (df: 30)	Error (df: 60)
1.	Days to 50% flowering	11.33	19.23**	1.21
2.	Days to maturity	13.00	19.40**	2.13
3.	Plant height (cm)	170.76	103.84**	17.98
4.	No. of clusters/ plant	6.21	6.16**	1.15
5.	No. of pods/ cluster	0.38	0.19**	0.09
6.	No. of pods/ plant	25.96	68.04**	10.56
7.	No. of seeds/ pod	0.30	0.81**	0.36
8.	100 seed weight (g)	0.12	0.74**	0.07
9.	Harvest index (%)	34.31	16.91**	3.16
10.	SPAD Chlorophyll Meter Reading	20.65	18.79**	6.04
11.	Relative water content (%)	81.48	27.75**	8.83
12.	Relative injury (%)	190.46	404.05**	35.67
13.	Chlorophyll stability index	74.75	210.36**	28.78
14.	Specific leaf area (cm^2 g^{-1})	1395.47	1304.41**	235.20
15.	Chlorophyll content (mg g^{-1})	0.07	0.74**	0.05
16.	Seed yield (g)	11.89	5.99**	1.24

Table- 2 Mean performance of thirty one genotypes of mungbean for sixteen quantitative characters

SN	Genotype	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of clusters/ plant	No. of pods/ cluster	No. of pods/ plant	No. of Seeds/ pod	100 seed weight (g)	Harvest Index (%)	SCMR	Relative water content (%)	Relative injury (%)	Chlorophyll stability index	Specific leaf area (cm^2 g^{-1})	Chlorophyll content (mg g^{-1})	Seed yield/ plant (g)
1	AKM 9904	40.67	64.67	47.40	10.67	3.11	32.73	12.47	3.75	42.39	51.20	87.92	67.37	63.61	188.77	2.40	10.70
2	Asha	39.00	63.00	48.47	7.93	3.21	25.73	11.73	3.99	39.62	52.23	84.71	38.17	52.98	140.26	2.42	8.47
3	COGG 974	36.67	62.00	56.67	8.20	3.19	26.00	11.87	3.89	42.58	53.40	86.76	62.87	62.40	198.57	2.91	8.76
4.	EC 396117	31.00	56.67	33.93	6.20	3.48	20.07	11.07	6.34	41.99	55.57	90.39	64.79	61.29	153.14	1.68	8.35
5.	GVIT 203	36.67	63.67	57.07	9.87	3.32	33.00	11.83	3.56	43.76	51.77	84.40	60.22	58.20	182.38	2.28	10.94
6.	IPM- 02-03	32.67	57.33	43.33	8.20	3.41	27.47	12.60	4.08	46.45	54.63	88.07	54.48	61.82	123.41	2.98	9.02
7.	IPM- 02-19	33.00	57.67	47.13	6.00	3.30	20.60	11.53	4.40	44.85	51.67	87.70	51.25	61.00	194.96	2.20	7.82
8.	KM- 8-657	34.67	59.67	53.93	7.93	3.21	25.47	11.57	3.82	43.95	50.97	83.26	50.55	56.51	179.09	3.21	9.04
9.	KM 122	36.67	62.00	52.60	10.87	3.69	39.60	12.37	3.48	41.48	51.43	88.07	70.48	60.39	191.61	2.18	12.39
10.	LGG 407	36.33	61.67	46.87	10.07	3.16	31.87	12.10	3.79	43.35	50.17	86.64	85.39	71.46	183.24	2.40	9.86
11.	LGG 410	39.33	62.00	52.73	9.20	3.45	31.60	11.90	3.98	42.47	51.07	87.36	69.60	54.95	152.63	2.41	9.77
12.	LGG 450	39.67	65.67	49.20	12.00	3.87	43.53	12.80	3.61	44.85	50.17	86.60	62.40	69.04	208.84	2.28	14.02
13.	LGG 460	40.00	65.00	51.80	8.87	3.19	28.33	11.93	3.79	45.08	52.87	86.65	68.12	64.29	178.75	2.53	10.32
14.	LGG 528	36.33	62.33	57.13	9.07	3.17	28.67	12.13	3.94	45.54	53.50	81.73	64.76	55.53	163.19	3.07	9.60
15.	MGG 295	38.67	60.00	43.93	8.67	2.85	27.53	11.90	3.93	46.88	50.77	83.36	69.32	70.38	156.74	1.58	9.27
16.	MGG 347	37.33	61.67	49.27	8.40	3.43	28.80	12.43	4.01	42.42	54.77	88.74	50.53	54.50	156.61	2.55	8.80
17.	MGG 350	35.00	64.00	52.47	11.40	3.13	35.60	12.00	3.74	44.57	55.20	79.26	60.02	76.08	176.01	2.10	10.76
18.	MH-3-18	39.00	62.00	48.07	8.73	3.32	29.0	11.37	3.95	430	54.0	86.45	72.55	52.72	172.86	1.60	9.79
19.	MH 565	33.33	58.67	33.07	7.13	3.58	25.	11.17	4.00	45.66	46.80	88.74	83.35	72.05	205.77	1.61	8.03
20.	ML 145	367	600	453	9.7	43	320	11.77	3.88	39.31	51.83	86.89	52.14	69.89	175.41	1.12	9.60
21.	ML 267	33.67	63.33	42.33	8.53	3.49	9.67	12.93	3.68	45.84	53.97	83.04	72.59	54.37	166.24	3.22	9.18
22.	PM 110	38.67	61.67	46.07	7.87	3.70	28.33	11.73	4.03	44.76	49.23	85.95	74.37	71.73	196.41	2.29	10.50
23.	PUSA 9531	36.00	62.33	53.67	9.73	3.17	30.40	11.07	3.46	41.57	52.13	85.65	56.99	38.87	184.23	2.54	9.34
24.	PUSA VISHAL	36.00	60.33	55.00	7.13	3.48	27.13	11.43	3.54	36.15	45.53	81.43	55.70	64.10	218.42	2.53	6.87
25.	RMG 492	34.33	59.67	46.33	7.67	3.80	29.20	11.63	3.60	44.41	51.20	87.44	78.19	74.35	185.52	2.27	9.88
26.	TLM 7	32.33	58.00	41.40	7.93	3.44	27.00	11.40	4.24	47.00	49.67	81.44	87.57	71.14	185.57	1.77	10.09
27.	TM 96-2	37.67	59.33	49.80	10.60	3.02	32.00	12.13	4.17	44.03	53.07	84.73	56.60	60.91	188.27	1.97	10.93
28.	VG-6197A	34.67	59.67	49.67	8.47	3.85	30.20	12.43	4.09	44.56	48.70	83.74	83.54	67.49	198.01	2.12	10.02
29.	VG-7098A	32.67	58.67	44.87	7.00	3.47	24.27	11.00	3.83	44.80	48.13	85.15	70.31	69.81	177.73	1.89	7.89
30.	WGG 2	35.67	66.67	54.07	7.93	3.24	25.53	12.63	3.89	40.63	55.83	92.21	73.47	66.89	171.50	2.49	7.78
31.	WGG 37	36.67	63.67	52.20	8.47	3.78	31.93	12.20	3.95	43.46	50.97	79.11	65.95	75.15	203.86	2.49	9.81
	Genera Mean	36.10	61.39	48.68	8.71	3.39	29.28	11.91	3.95	43.48	51.71	85.60	65.60	63.35	179.29	2.29	9.60
	S.Ed.	0.90	1.19	3.46	0.88	0.25	2.65	0.49	0.22	1.45	2.01	2.43	4.88	4.38	12.52	0.19	0.91
	CD at 5%	1.80	2.39	6.94	1.76	0.49	5.32	0.98	0.44	2.91	4.02	4.87	9.78	8.78	25.11	0.37	1.82
	CD at 1%	2.39	3.17	9.21	2.33	0.65	7.06	1.30	0.58	3.86	5.34	6.46	12.97	11.65	33.31	0.49	2.42
	C.V.(%)	3.05	2.38	8.71	12.31	8.86	11.10	5.05	6.80	4.09	4.75	3.47	9.10	8.47	8.55	9.91	11.58

Thus, a character possessing high GCV along with the high heritability will be valuable in a selection programme.High GCV combining with high heritability were observed for chlorophyll content, whereas moderate GCV with high heritability were observed for plant height, number of pods per plant, 100 seed weight, relative injury, chlorophyll stability index and specific leaf area. Hence, there is less environmental influence on these traits and offer scope for improvement by simple selection procedures.

Heritability estimates along with genetic advance are more useful than heritability alone in predicting the effectiveness of selection. Further, the heritability estimates coupled with expected genetic advance as percent of mean indicates the mode of gene action in choosing an appropriate breeding methodology. High heritability coupled with high genetic advance as percent of mean was recorded for number of pods per plant, 100 seed weight, relative injury, chlorophyll stability index and chlorophyll content indicating the preponderance of additive gene action and hence simple selection would be more effective for improvement of these characters. Similar kind of findings were also reported by [6] for relative injury, number of pods per plant, 100 seed weight and chlorophyll stability index.

High heritability coupled with moderate genetic advance as percent of mean was recorded for the characters plant height, specific leaf area and days to 50% flowering indicating that these characters were governed by additive gene effects and may express consistently in succeeding generations, leading to greater efficiency of breeding programme. These findings agreed with [4] for days to 50% flowering. In contrast, low heritability coupled with low genetic advance was reported for number of seeds per pod and number of pods per cluster indicating that these characters were governed by non-additive gene effects and highly influenced by environmental effects. Hence direct selection for such characters would be ineffective. Recombination breeding or heterosis breeding may be used for the improvement of these characters. These findings agreed with [4] for number of seeds per pod. High heritability coupled with low genetic advance as percent of mean was recorded for days to maturity

Table-3 Mean coefficient of variability, heritability (broad sense) and genetic advance as percent of mean for sixteen characters in thirty one mungbean genotypes

SN	Character	Mean	Range		Variance		Coefficientof Variation		Heritability (Broad sense) (%)	Genetic advance (GA)	Genetic advance as percent of mean (%)
			Min.	Max.	Genotypic	Phenotypic	Genotypic	Phenotypic			
1.	Days to 50% flowering	36.10	31.00	40.67	6.01	7.22	6.79	7.44	83.21	4.60	12.76
2.	Days to maturity	61.39	56.67	66.67	5.76	7.89	3.91	4.58	72.96	4.22	6.88
3.	Plant height (cm)	48.68	33.07	57.13	28.62	46.60	10.99	14.02	61.41	8.64	17.74
4.	No. of Clusters per plant	8.71	6.00	12.00	1.67	2.82	14.83	19.27	59.23	2.05	23.52
5.	No. of Pods per cluster	3.39	2.85	3.87	0.03	0.12	5.51	10.43	27.87	0.20	5.99
6.	No. of Pods per plant	29.28	20.07	43.53	19.16	29.72	14.95	18.62	64.46	7.24	24.72
7.	No. of Seeds per pod	11.91	11.00	12.93	0.15	0.51	3.27	6.01	29.52	0.44	3.66
8.	100 seed weight (g)	3.95	3.46	6.34	0.22	0.29	11.94	13.74	75.52	0.84	21.37
9.	Harvest index (%)	43.48	36.15	47.00	4.58	7.74	4.93	6.40	59.24	3.40	7.81
10.	SCMR	51.71	45.53	55.83	4.25	10.29	3.99	6.20	41.32	2.73	5.28
11.	Relative water content (%)	85.60	79.11	92.21	6.31	15.14	2.93	4.55	41.67	3.34	3.90
12.	Relative injury (%)	65.60	38.17	87.57	122.79	158.46	16.89	19.19	77.49	20.09	30.63
13.	Chlorophyll stability index	63.	38.87	76.08	60.53	89.31	12.28	14.92	67.78	13.19	20.83
14.	Specific leaf area ($cm^2 g^{-1}$)	179.29	123.41	21.42	356.40	591.60	10.53	13.57	60.24	30.18	16.83
15.	Chlorophyll content ($mg g^{-1}$)	2.29	1.12	3.22	0.23	0.28	84	2.08	81.54	0.89	38.76
16.	Seed yield per plant (g)	9.60	6.87	14.02	1.58	2.82	13.11	17.50	56.16	1.94	20.24

indicating the influence of non-additive gene effects (dominance) in the inheritance of this trait. In this case simple selection alone may not be effective. These results agreed with the findings of [5]. From the foregoing discussion, based on genetic parameters it can be concluded that high to moderate GCV estimates and high heritability with high genetic advance as percent of mean were observed for number of pods per plant, 100 seed weight, relative injury, chlorophyll stability index, specific leaf area and chlorophyll content indicating that the variation in the above characters most likely due to additive gene effects, hence, simple directional selection may be effective to improve these characters.

Conclusion

Based on the present study it was concluded that most of the drought related traits like relative injury, chlorophyll stability index, specific leaf area and chlorophyll content exhibiting high to moderate GCV estimates and high heritability with high genetic advance as percent of mean indicating that there is greater scope for improvement of drought tolerance ability in the green gram genotypes by direct selection for this traits. Seed yield exhibiting moderate GCV and heritability estimates with high genetic advance as percent of mean suggested that there is better chance for improvement of seed yield in mungbean.

Application of Research: The results obtained in the experiment would helpful to making of breeding strategy for improvement of yield and drought tolerance in mungbean.

Research Category: Genetics and Plant Breeding

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