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Genetic Variability Studies for Yield, Yield Attributes and Drought Tolerant Traits in Mungbean (*Vigna radiata* (L.) Wilczek)

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ABSTRACT

An experiment was conducted during kharif, 2012 to access genetic variability among fifty eight mungbean genotypes for yield, yield attributes and drought related traits under irrigated and moisture stress conditions. Analysis of variance revealed that significant differences among the genotypes for all the characters studied except relative water content. Estimates of phenotypic co-efficient of variation (PCV) were higher than genotypic co-efficient of variation (GCV) for all the characters. High to moderate GCV estimates and high heritability coupled with high genetic advance as per cent of mean were observed for relative injury, number of branches per plant, number of pods per cluster, specific leaf area, 100 seed weight, plant height, harvest index, SCMR and seed yield under both irrigated (E_1) and moisture stress (E_2) condition suggesting that involvement of additive gene action for these characters. Hence, simple directional selection could be considered for these characters in the segregating generations to improve seed yield with drought tolerance.

Key words: *Mungbean, Genetic variability, Heritability, Irrigated and Moisture stress conditions*

INTRODUCTION

Mungbean is one of the important short duration pulse crops. It is grown over a wide range of soils throughout the world. Over the years, systematic breeding efforts have led to the development of a large number of improved varieties in this crop. However, its true yield potential has yet not been achieved owing to several constraints. One of the major constraints is its susceptibility to drought. Occurrence of drought at any stage of the crop causes considerable yield losses in mungbean. Due to complex nature of this drought and lack of appropriate screening techniques, outcomes achieved have been less. Drought being a complex trait, its expression depends on action and interaction of different morphological, physiological and biochemical traits. So, there is a need for evaluating genotypes to study genetic variability of economically important as well as drought tolerant traits for initiating breeding programme.

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Realizing the significance of drought on yield components the present investigation was undertaken to study the magnitude of genetic variability and mode of inheritance for yield and drought related traits on mungbean genotypes.

MATERIAL AND METHODS

The present investigation was carried out during *kharif*, 2012 at the dryland farm of Sri Venkateswara Agricultural College, Tirupati, Andhra Pradesh, India, with 58 genotypes of mungbean including four checks following Augmented Block Design with six blocks. Each genotype was grown in single row of three meters length with a spacing of 30cm between rows and 10cm between plants. All fifty eight mungbean genotypes were grown simultaneously in two water regimes *viz*., irrigated (E_1) and moisture stress (E_2) condition. Sufficient irrigation was provided for one set in field condition whereas moisture stress was imposed to the crop under rainout shelter. Rainout shelter was utilized to impose moisture stress as well as to avoid natural precipitation. The crop under rainout shelter was imposed to moisture stress by withholding irrigation from 42 days after sowing to crop maturity. This moisture stress treatment was synchronized with pod development stage of the crop. Recommended agronomic practices and plant protection package measures were followed to raise healthy crop in both the conditions. Observations were recorded on randomly selected five plants from each genotype on plant height (cm), number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, 100 seed weight (g), harvest index (%), SCMR (SPAD Chlorophyll Meter Reading), specific leaf area ($cm^2\ g^{-1}$), relative water content (%), relative injury (%), chlorophyll stability index (%) and seed yield per plant (g) except days to 50% flowering and days to maturity which were recorded on plot basis. The genetic parameters were studied by working out the genotypic and phenotypic coefficient of variation[21], heritability in broad sense[20] and genetic advance[19] for all traits.

RESULTS AND DISCUSSION

Analysis of variance revealed existence of significant differences among the genotypes for all the characters studied except relative water content indicating the presence of sufficient variability in the experimental material. Range, variance, coefficient of variation, heritability, genetic advance and genetic advance as per cent mean for 15 quantitative characters studied are summarized in Table 1 and presented. The range of the genotypes generally displayed considerable differences between the minimal and maximal values for all the characters evaluated. The phenotypic variance and genotypic variance were followed the similar trend of variation where the maximum variance was observed for the trait specific leaf area followed by relative injury, chlorophyll stability index, SCMR, plant height and relative water content indicating maximum scope for the selection of these characters for effective improvement. On contrary, the lowest variance was recorded for number of branches per plant under both the irrigated (E_1) and moisture stress (E_2) conditions. However, the estimates of PCV values were relatively higher than GCV values in respect of all the characters suggesting the environmental influence on the expression of the characters. In contrast, 100 seed weight and number of pods per plant exhibited relatively low magnitude of difference between PCV and GCV indicating less environmental influence on these characters. Similar results were also found by Samad and Lavanya[15] for number of pods per plant and Reddy *et al.*[14], for 100 seed weight.

Higher estimates of phenotypic and genotypic coefficient of variation were observed for the relative injury and number of branches per plant under both E_1 and E_2. However number of pods per cluster and specific leaf area under E_1 and 100 seed weight under E_2 registered higher estimates of phenotypic and genotypic coefficient of variation in the individual indicating the presence of ample variation among the genotypes for these traits. Therefore, simple selection could be effective for further improvement of these characters. Higher estimates of GCV and PCV for number of branches per plant were reported by Pandiyan *et al.*[10], Narasimhulu *et al.*[8], for number of pods per cluster by Kousar *et al.*[4], for 100 seed weight by Kousar *et al.*[4], Singh *et al.*[17], and for specific leaf area by Prakash *et al.*[13].

Moderate estimates of phenotypic and genotypic coefficient of variation were observed for the trait plant height, pods per plant, seed yield per plant, harvest index under both E_1 and E_2, indicate that selection can be operated in early generations to improve these characters. These results were in conformity with Pandey *et al.*[9], Wani *et al.*[18], Singh *et al.*[17], for plant height; Kumar *et al.*[5], for seed yield per plant and Paramesh[11] for harvest index. In contrast, 100 seed weight, number of clusters per plant and chlorophyll stability index under E_1 whereas number of clusters per plant, number of pods per cluster, SCMR, specific leaf area and chlorophyll stability index under E_2 showed moderate estimates of coefficient of variation. Similar findings were also obtained by Pandey *et al.*[9], for number of clusters per plant and for number of pods per cluster; Wani *et al.* [18], and Jyothsnanand and Anuradha[3] for 100 seed weight. However, low estimates of co-efficient of variation was observed for the characters days to maturity followed by days to 50% flowering and relative water content in both the conditions indicating the low range of variation for these characters in the genotypes, thus offering little scope for further improvement of these characters through simple selection. These results were in consonance with the findings of Singh *et al.*[17],for both days to 50% flowering and days to maturity.

The amount of genetic variation considered alone will not be much use to the breeder unless supplemented with the information on heritability along with genetic advance as per cent of mean, which would be more reliable and helpful in predicting the gain under selection than heritability estimate alone. In the present investigation, high heritability coupled with high genetic advance as per cent of mean was recorded for plant height, number of branches per plant, number of pods per cluster, number of pods per plant, 100 seed weight, specific leaf area and relative injury under both E_1 and E_2. In addition, number of clusters per plant, chlorophyll stability index, seed yield per plant under E_1 and harvest index under E_2 exhibited high heritability along with high genetic advance as per cent of mean. This indicates the preponderance of additive gene action for these characters and hence phenotypic selection would be more effective for these characters. Similarly, high heritability coupled with high genetic advance were reported by Lavanya[6], Peerjade *et al.*[12], Shweta[16] for plant height and number of pods per plant; Lavanya[6], Pandey[9] for number of pods per cluster and Hozayn *et al.*[2] for 100 seed weight; Paramesh[11] for relative injury and chlorophyll stability index; Nandini *et al.*[7], for specific leaf area.

The character days to 50% flowering and SCMR exhibited high heritability and moderate genetic advance under both E_1 and E_2 conditions while relative water content in E_2 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 were in agreement with Paramesh[11] for days to 50% flowering. In contrast, low heritability coupled with low genetic advance was reported for relative water content in irrigated condition (E_1) indicating that this character is governed by non-additive gene effects and highly influenced by environmental effects. Hence direct selection for such characters would be ineffective.

Table 1: Estimates of genetic parameters for seed yield, yield attributes and drought tolerant traits under irrigated (E_1) and drought (E_2) environments in mungbean

S. No.	Character	Environ -ment	Range		Variance		Coefficient of variation (%)		Heritability (broad sense) (%)	Genetic advance (GA)	Genetic advance as per cent of mean
			Max	Min	Genotypic (σ^2_g)	Phenotypic (σ^2_p)	Genotypic (GCV)	Phenotypic (PCV)			
1.	Days to 50% flowering	E_1	42.00	32.00	5.59	6.69	6.38	6.98	83.56	4.45	12.01
		E_2	42.00	31.00	4.82	6.02	6.01	6.72	80.07	4.05	11.08
2.	Days to maturity	E_1	75.00	62.00	4.38	4.98	3.06	3.27	87.95	4.04	5.92
		E_2	73.00	59.00	8.68	9.14	4.48	4.60	94.97	5.91	9.00
3.	Plant height (cm)	E_1	65.40	32.60	47.10	57.82	14.70	16.29	81.46	12.76	27.33
		E_2	54.00	26.60	31.81	34.68	13.83	14.44	91.72	11.13	27.29
4.	Number of branches per plant	E_1	2.60	0.40	0.18	0.24	27.49	31.75	75.00	0.76	49.05
		E_2	2.40	0.40	0.18	0.2	38.63	40.72	90.00	0.83	75.50
5.	Number of clusters per plant	E_1	9.60	4.40	1.53	2.24	18.05	21.83	68.30	2.11	30.73
		E_2	7.40	3.20	0.53	0.95	14.47	19.38	55.79	1.12	22.27
6.	Number of pods per cluster	E_1	5.12	2.58	2.34	2.46	42.17	43.24	95.12	3.07	84.73
		E_2	3.90	1.52	0.15	0.21	14.16	16.76	71.43	0.67	24.66
7.	Number of pods per plant	E_1	31.20	9.00	12.00	17.56	18.69	22.61	68.34	5.90	31.82
		E_2	18.20	6.40	6.07	8.27	18.03	21.05	73.40	4.35	31.82
8.	100 seed weight (g)	E_1	5.66	2.06	0.45	0.48	18.44	19.04	93.75	1.34	36.78
		E_2	5.52	1.96	0.55	0.58	21.51	22.09	94.83	1.49	43.15

Table 1. (Contd).

S. No.	Character	Environ -ment	Range		Variance		Coefficient of variation (%)		Heritability in broad sense (h^2_b) (%)	Genetic advance (GA)	Genetic advance as per cent of mean
			Max	Min	Genotypic (σ^2_g)	Phenotypic (σ^2_p)	Genotypic (GCV)	Phenotypic (PCV)			
9.	Harvest index (%)	E_1	39.16	21.46	10.70	18.77	10.47	13.86	57.01	5.09	16.28
		E_2	37.73	17.84	13.77	20.23	13.35	16.19	68.07	6.31	22.70
10.	SCMR (SPAD chlorophyll meter reading)	E_1	60.30	33.30	14.82	23.71	8.26	10.44	62.51	6.27	13.45
		E_2	58.60	31.20	26.48	37.4	11.24	13.36	70.80	8.92	19.48
11.	Specific leaf area (cm^2g^{-1})	E_1	525.79	152.13	2398.92	3213.86	22.88	26.48	74.64	87.17	40.72
		E_2	242.86	123.85	1397.38	1956.43	16.57	19.61	71.42	65.08	28.85
12.	Relative water content (%)	E_1	88.82	64.87	8.29	37.46	3.60	7.66	22.13	2.79	3.49
		E_2	83.70	59.12	28.08	55.24	6.93	9.71	50.83	7.78	10.17
13.	Relative injury (%)	E_1	69.34	15.03	174.25	178.85	32.31	32.74	97.43	26.04	65.71
		E_2	83.35	18.24	148.66	149.57	26.69	26.77	99.39	25.04	54.82
14.	Chlorophyll stability index (%)	E_1	97.00	33.51	156.28	206.89	18.98	21.84	75.54	22.38	33.98
		E_2	94.57	29.63	95.89	166.48	14.96	19.72	57.60	15.31	23.39
15.	Seed yield per plant (g)	E_1	11.52	5.64	1.25	1.96	12.93	16.19	63.78	1.84	21.27
		E_2	9.60	3.64	0.93	1.65	14.61	19.47	56.36	1.49	22.60

CONCLUSION

Based on genetic parameters it can be concluded that high to moderate GCV estimates and high heritability coupled with high genetic advance as per cent of mean were observed for relative injury, number of branches per plant, number of pods per cluster, specific leaf area, 100 seed weight, plant height, harvest index and SCMR under both E_1 and E_2 condition 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 for both the irrigated and moisture stress conditions. Further, it was observed that most of the drought related traits like SCMR, specific leaf area, relative injury and chlorophyll stability index exhibiting high to moderate GCV estimates and high heritability coupled with high genetic advance as per cent of mean indicating that there is greater scope for improvement of drought tolerance ability traits in mungbean genotypes by direct selection for these traits. Seed yield per plant exhibiting moderate GCV estimates, high heritability coupled with high genetic advance as per cent of mean under E_1 and E_2 suggesting that there is a better chance for improving seed yield for both the irrigated and moisture stress conditions.

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