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Moth bean [*Vigna aconitifolia* (Jacq.) Marechal] germplasm : Evaluation for genetic variability and inter characters relationship in hot arid climate of western Rajasthan, India

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ABSTRACT

The 44 accessions which were collected from Rajasthan, Gujarat and M.P. were evaluated in a randomized complete block design with three replicates during *summer* and *kharif* seasons in the hot arid climate of western Rajasthan to estimate the presence of genetic variability, inter-characters associations, to identify a suitable accession for cultivation during *summer* and to compare the relative performance of the genotypes in two seasons. The high degree of genetic variability was estimated during both seasons for seed yield per plant (g), plant height (cm.), pod length (cm.), peduncle length (cm.), number of branches per plant (cm), number of clusters per plant, number of cluster per branch and cluster length (cm.). The moderate to high heritabilities coupled with moderate expected genetic advance were observed for all studied traits. The plant height, pod length, number of branches per plant exhibited positive and significant association with seed yield whereas the incidence of leaf crinkle virus and yellow mosaic virus correlated negatively and significantly with seed yield. The accession IC 39786 exhibited absolute genetic resistance to crinkle virus disease in the field conditions. The accessions IC 36245, IC-36555, IC 36667, IC 36577 and IC 36604 exhibited yield advantage over best check during *summer* whereas accessions IC- 39675, IC-36607, IC-251908, IC 36245 and IC-36563 performed better than best check in terms of seed yield during *kharif* season.

Key words: Correlation, Genetic variability, Leaf crinkle virus disease, Moth bean, Summer.

INTRODUCTION

The moth bean ((*Vigna aconitifolia* (Jacq.) Marecha) is an important pulse crop of hot arid regions of lndia and adapts to extremes ecological niches particularly extreme drought and hot climatic conditions. The crop is mainly grown in Rajasthan as a mixed crop with cotton sorghum and other pulses during *kharif* season. Rajasthan occupies 85 per cent of the total area and 55% of the total production of the country. The Uttar Pradesh, Punjab, Haryana and M.P are the other states where moth bean is grown on marginal lands. Moth bean seed is rich source of protein (22%) and simultaneously cheaper than other pulses therefore, it is consumed by the low income people and tribal community in the rural areas of its growing regions. The national productivity of moth bean is 4 quintals per hectare because it is being grown on poor and marginal soils without applying required inputs. In the past not much effort have been done for the genetic improvement of the crop however, a lot of variability exists in the germplasm for useful traits. Traditionally, moth bean is grown during *kharif* season but in the present study efforts have been made to evaluate germplasm during *summer* for morphological traits and for the identification of genotype(s) that can be used to release directly as a variety for summer season or may be used in the breeding programme for the development of variety for summer season that can fit well between the harvest of *rabi* crops like cumin, wheat and mustard and sowing of *kharif* crops like bajra, rice and pulses. So far no sincere efforts have been made to screen germplasm during summer season and consequently no variety is released for *summer* cultivation of moth bean. The cultivation of moth bean in *summer* can benefit farmers in two ways, i) extra income can be generated by the summer crop as fields lie vacant during *summer* and ii) by improving soil fertility for the next *kharif* crop as moth bean is a leguminous crop and it fixes atmospheric nitrogen in the soils through the swellings in its roots. The other objectives of the study were to generate basic information like to detect the presence and magnitude of genetic variability and inter-characters associations in the hot arid climate of Rajasthan during both *summer* and *kharif* seasons.

MATERIALS AND METHODS

The 44 accessions of moth bean which were collected from Rajasthan, Gujarat and M.P. were evaluated during summer and *kharif* 2012 at the experimental farm of National Bureau of Plant Genetic Research Station, Jodhpur.

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The soil of the experiment site was sandy loam with a pH 7.86 having 0.19 per cent organic carbon and 125.0, 13.5 and 225 kg/ha available N, P_2O_5 K_2O, respectively. The experiments were laid out in randomized complete block design with three replicates during summer and *kharif* seasons keeping line to line distance of 45 cm. and plant to plant distance of 15 cm. Plot size was consisted of three rows of 2 meters length each. In the summer four sprinkler irrigations were given uniformly at the interval of 20 days including pre-sowing irrigation. Only pre-sowing irrigation was given to *kharif* experiments as rains were sufficient after sowing of the experiments during the season. Summer experiments were sown on March 6, 2012 whereas, *kharif* experiments were sown on July 23, 2012. At maturity five plants were selected randomly from each plot and tagged. The data of selected plants were recorded on seed yield (gm), plant height(cm.), pod length (cm), peduncle length (cm), number of branches per plant, number of clusters per plant, number of cluster per branch, cluster length (cm), incidence of yellow mosaic virus (scale 3-9) and leaf crinkle virus disease (scale 3-9), being 3- resistant, 5- moderately resistant, 7- moderately susceptible and 9- susceptible in both diseases. The mean values of these observations were statistically analysed separately for each season. The analysis of variance, heritability, genetic advance and inter-character associations were carried out by using Windostate software following the methods given by Singh and Chaudhary (1985).

RESULTS AND DISCUSSIONS

Analysis of variance on the studied traits presented in the Table 1. revealed significant differences among accessions for all the characters during both summer and *kharif* seasons. Bhaskar *et.al.*, (1990), Bhavsar and Birari (1991), Kumar (2001), Yaqoob *et al.*, (2007) and Yogesh *et.al.*, (2012) studied the moth bean genotypes and reported higher genetic variability for yield and its attributing traits. The effect of seasons on the expression of various traits indicated the influence of climatic conditions attributed towards climatic data during two seasons. Henry and Kacker (2002) studied the adaptability and performance of 15 genotypes of mothbean for 3 years in 4 different environments and observed the presence of genotype x environment interaction of higher magnitude for seed yield and yield components. The Mean of the recorded data revealed the high range of most of the studied traits (Table2). Seed yield per plant ranged from 4.12 to 19.60 gm. per plant during summer and 7.0 to 29.22 gm. during *kharif*, plant height 20.5 to 32.8 in *summer* and 22.0 to 36.6 in *kharif*, pod length 3.36 to 4.46 in summer and 3.47 to 5.80 in *kharif*, peduncle length 2.34 to 6.64 in summer and 2.60 to 5.24 in *kharif*, number of branches per plant 1.40 to 11 in *summer* and 2.80 to 9.60 in *kharif*, number of clusters per plant 14.2 to 124 during summer and 21.80 to 103.0 during *kharif*, number of cluster per branches 3.57 to 12.61 in *summer* and

TABLE 1: Mean squares of morphological traits in mothbean over two seasons.

Source of Variation	Degree of freedom season	Seed yield/ Plant (gm.)	Plant height (cm.)	Pod length (cm.)	Peduncle length (cm.)	Branches per plant (numbers)	Cluster per plant (numbers)	Cluster on branches (numbers)	Cluster length (cm.)	YMV incidence (score)	Crinkle virus incidence (score)
Genotypes	43 Summer	89.75*	65.32*	9.46*	8.92*	13.88*	7.66*	8.36*	20.17*	9.55*	6.59*
	Kharif	113.82*	81.26*	14.71*	41.48*	62.81*	10.16*	15.62*	89.85*	12.08*	9.15*
Replications	02 Summer	3.18	1.55	0.57	0.87	0.92	0.22	0.46	0.31	0.19	0.14
	Kharif	4.05	2.81	0.86	1.06	0.73	0.49	0.69	0.56	0.37	0.69
Error	86 Summer	1.96	0.91	0.63	0.56	0.48	0.53	0.26	0.85	0.33	0.01
	Kharif	0.84	0.73	0.68	0.77	0.93	0.32	0.55	0.61	0.38	0.54

- Significant at 5% level of significance

3.43 to 10.20 in *kharif*, cluster length 4.30 to 9.26 in summer and 4.52 to 10.05 in *kharif*, yellow mosaic virus disease incidence 5 to 9 in both seasons and leaf crinkle virus disease incidence 3-9 in both seasons. The best five accessions that yielded highest seed yield per plant were IC 36245 (26.61 gm.), IC 36555 (25.64 gm.), IC 36667 (25.21 gm.), IC 36577 (24.51 gm.) and IC 36604 (24.32 gm.) in summer season whereas the best five per plant seed yielding accessions in *kharif* were IC 39675 (29.23 gm.), IC 36607 (28.69 gm.), IC 251908 (25.75 gm.), IC 36245 (25.55) and IC 36563 (22.98 gm.). The accession IC 36245 had performed better in terms of seed yield in both seasons. During summer 2012 there was a break out of leaf crinkle virus disease that damaged experiments very severely. Out of the 44 accessions 35 accessions scored 9 on the scale of 3-9 being 3 resistance and 9 highly susceptible. Five accessions scored 7 (susceptible) and two accessions scored 5 (moderately resistance). The accession IC 36786 had shown absolute genetic resistance against leaf crinkle virus disease. Mathur and Sharma (2002) described leaf crinkle virus a serious disease of moth bean. However, little work has been done on leaf crinkle virus disease on moth bean therefore, on the basis of scanty available literature it is also worth to mention that leaf crinkle virus disease resistance gene(s) source in moth bean may have not be known earlier.

The estimates of phenotypic coefficients of variation (PCV), genotypic coefficients of variation (GCV), heritability and genetic advance (expressed as percentage of mean) for all studied traits are also given in Table 2. In most of the cases phenotypic coefficients of variation were higher than genotypic ones (Khatri *et al.*,2002 b) thus, indicating the presence of environmental influence in the expression of these traits. The highest genotypic coefficient of variation was estimated for seed yield per plant followed by plant height and number of clusters per plant during both *summer* and *kharif* seasons indicating the presence of higher degree of genetic variability for these traits (Sinhag *et al.*, 2004; Yogesh *et.al.*, 2012). A higher heritability (broad sense) estimates associated with good estimates of expected genetic advance for seed yield, plant height, pod length, peduncle length, number of branches per plant, number of clusters per plant, number of clusters per branch, cluster length, incidence of YMV and leaf crinkle virul disease suggest that these characters are governed by additive genetic effect to a large extent and thus improvement of these characters would be effective through phenotypic selection. Yaqoob (1995), Kumar et.al., (2001), Henry *et. al.*, (2002), Khatri *et. at.*, (2002 a & b), Yaqoob *et. at.*, (2005), Yaqoob *et. at.*, (2007) and Yogesh *et. at.*, (2012) have also reported similar results in moth bean.

Phenotypic correlation coefficients and genotypic correlation coefficients estimate for both *summer* and *kharif* seasons for the studied traits are given in Table 3. In most of

TABLE 2. Estimation of basic genetic parameters for quantitative traits in the germplasm of mothbean over *Summer* and *Kharif* seasons.

Characters	Range		Mean±SE		PCV(%)		GCV(%)		Heritability(%)		Genetic Advance (% of mean)	
	Summer	*kharif*	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*	*kharif*	*summer*	*kharif*	*summer*	*kharif*
Seed yield/plant (g)	4.12 – 19.60	7.00 - 29.22	09.75±1.36	13.24±1.22	46.71	36.84	39.66	30.26	64.53	71.44	34.23	23.69
Plant height(cm)	20.5 - 32.80	22.00– 36.60	25.50±2.11	27.90±1.05	29.45	19.34	21.59	16.97	72.15	75.33	26.58	28.65
Pod length (cm)	3.36 – 4.46	3.47 - 5.80	3.69±0.12	3.95±0.09	20.62	11.65	16.88	09.75	61.23	54.46	14.66	11.39
Peduncle length(cm.)	2.34 – 6.64	2.60 – 5.24	3.95±0.14	3.82± 0.18	11.33	14.52	08.96	10.23	56.33	49.05	15.85	13.61
No. of Branches/plant	1.40 – 11.00	2.80 – 9.60	7.32±0.62	6.74±0.51	15.20	11.66	12.85	0.8.96	54.42	50.14	13.54	10.88
No. of cluster/plant	14.20 –124.0	21.80–103.0	61.46±6.22	49.48±5.86	22.67	17.36	18.24	16.33	65.76	69.80	27.65	31.14
No. of cluster/ branches	3.57 – 12.61	3.43 – 10.20	6.85±0.57	5.82±0.51	17.19	21.57	14.61	18.77	42.38	48.76	28.46	32.58
Cluster length (cm)	4.30 - 9.26	4.52- 10.05	6.74±0.81	7.54±0.48	18.09	22.73	15.29	17.52	66.34	59.08	19.48	18.57
YMV (score)	5.00 - 9.00	5.0 – 9.0	6.12±1.84	6.50±1.88	12.58	15.69	10.78	13.08	73.08	77.54	43.67	47.28
Tungro Virus Disease (Score)	3.00 – 9.00	3.00-9.00	8.65±2.98	8.25±2.65	05.61	06.87	05.62	05.95	75.34	73.48	55.84	50.37

TABLE 3: Estimates of Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients for morphological traits in mothbean germplasm over *summer* (S) and *kharif* (K) seasons

Characters		seed Yield	plant height	pod length	peduncle length	Branches per plant	cluster per plant	cluster per branch	cluster length	YMV incidence	Tungro incidence
Seed yield	(S)	1.00	0.34*	0.35*	0.22	0.48*	0.37*	-0.11	-0.19	-0.37*	-0.62*
	(K)	1.00	0.41*	0.57*	0.17	0.33*	0.29	-0.28	-0.13	-0.41*	0.45*
Plant height	(S)	0.70	1.00	-0.36*	-0.09	0.14	-0.32*	-0.16	0.10	-0.09	-0.40*
	(K)	0.49	1.00	-0.22	0.12	0.31*	-0.24	-0.11	0.14	-0.15	-0.32*
Pod length	(S)	0.35	-0.26	1.00	-0.13	0.18	0.07	0.15	0.06	0.08	-0.03
	(K)	0.59	0.11	1.00	0.08	0.12	-0.02	0.23	-0.04	0.10	-0.15
Peduncle	(S)	0.25	0.17	0.09	1.00	0.19	0.03	0.10	-0.13	0.07	-0.04
Length	(K)	0.18	0.16	0.08	1.00	-0.07	0.14	0.04	-0.11	0.12	0.01
No. Branches	(S)	0.50	0.17	0.23	0.19	1.00	-0.30*	0.12	0.05	-0.02	-0.27
Per plant	(K)	0.35	0.38	0.15	-0.01	1.00	-0.21	-0.09	-0.08	-0.04	-0.25
No. Of cluster	(S)	0.40	-0.19	0.05	0.06	-0.29	1.00	0.33*	0.06	0.25	0.08
Per plant	(K)	0.34	-0.11	-0.02	0.14	-0.20	1.00	0.37*	0.14	0.19	-0.11
No. of cluster	(S)	-0.10	0.02	0.18	0.13	0.01	0.42	1.00	-0.37*	-0.21	-0.24
Per branch	(K)	-0.13	0.12	0.21	0.04	-0.02	0.38	1.00	-0.22	-0.05	-0.25
Cluster length	(s)	-0.03	0.10	-0.01	-0.09	0.06	0.10	-0.08	1.00	0.02	-0.21
	(k)	0.01	0.16	-0.08	-0.11	0.04	0.12	-0.22	1.00	-0.14	-0.19
YMV	(S)	-0.37	0.12	0.13	0.10	0.05	0.26	-0.02	0.06	1.00	0.21
	(K)	-0.32	-0.11	0.13	0.17	-0.01	0.19	-0.05	-0.01	1.00	0.22
Crinkle virus	(S)	-0.60	-0.32	0.10	-0.01	-0.18	0.09	- 0.05	-0.11	0.21	1.00
Disease	(K)	-0.41	-0.31	-0.05	0.01	-0.21	0.07	-0.09	-0.08	0.25	1.00

Significant @ 5% level of significance.

the cases genotypic correlations coefficients were higher in magnitude than their corresponding phenotypic correlation coefficients. Plant height, pod length and number of branches per plant in both seasons and number of clusters per plant during *summer* season exhibited positive and significant associations with seed yield. Patil *et al.*, (2007), Yaqoob *et al.*, (2007), Rahim *et. al.*, (2010) and Srivastava and Singh (2012) also reported similar correlation with seed yield in moth bean and mung bean. It means that with increase of plant height, pod length, number of branches per plant and number of clusters per plant there was a significant increase in seed yield. These results suggest that genotypes those were tall, having more number of branches per plant, larger pod length and higher number of clusters per plant yielded higher. The occurrence of two diseases namely, leaf crinkle virus disease and yellow mosaic virus had significant and negative associations with most sought trait seed yield during both *rabi* and *kharif* seasons. Khatri *et al.*, (2002a) surveyed farmers' fields in Bikaner district of Rajasthan and declared YMV as a dreaded disease of mothbean. Thus, these two diseases should be managed through breeding strategies of moth bean. In the present study leaf crinkle virus disease resistance source of gene(s) has already been identified and mentioned in this manuscript earlier. Plant height had negative and significant correlations with pod length, number of clusters per plant during *summer* season whereas, it was negatively associated with number of branches per plant during *kharif* season. Leaf crinkle virus disease had negative and significant association with plant height. Leaf crinkle virus disease causes the stunted growth of mothbean plant. The number of clusters per branch had positive and significant association with number of clusters per plant in both seasons. Number of branches per plant had negative association with number of clusters per plant during *summer* season. The cluster length was negatively correlated with number of clusters per branch. The variation observed in the magnitude of correlation coefficients between two seasons could be due to the presence of genotype x environment interaction for the traits.

On the basis of present study it may be concluded that moth bean can be cultivated during *summer* season in the hyper hot arid climate of Rajasthan provided 3-4 sprinkler irrigations are given to the crop. There is not much difference in the performance of *summer* and *kharif* crops of mothben however, gxe interactions for individual traits do present. The accessions gave highest yield during *summer* may further be tested for their performance during *summer* season and if found promising they may be recommended for commercial cultivation. The accession IC 36786 possesses strong genetic resistance to leaf crinkle virus disease however it was not highest yielder therefore, this accessions may be used in breeding programme to transfer its resistance genes into high yielding otherwise leaf crinkle virus disease susceptible variety of moth bean.

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