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Study of genetic variability parameters for seed yield and component traits in mothbean [*vigna aconitifolia* (jacq) Marechal]

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Abstract

Field and laboratory experiments were conducted to estimating the genetic variability parameters for seed yield and its component traits in mothbean at Swami Keshwan and Rajasthan Agricultural University, Bikaner during *Kharif*-2019. Significant differences were existed among genotypes for all 37 characters under study. The high degree of genetic variability along with high heritability and high genetic advance as percent of mean were recorded for harvest index, seed yield per plant, proline content, number of pods per plant, biological yield, chlorophyll-b, days to 50 percent flowering, water absorption index, seedling fresh weight at 30°C and 40°C, root length at 30 °C and 40 °C, plant height, seedling length at 30°C, seedling vigour index at 30°C, 100 seed weight, shoot length at 30 °C, total chlorophyll, seed volume, days to maturity, water absorption capacity, germination percent at 40 °C, membrane stability index which indicates that these characters were under the control of additive gene action and therefore, form the basis of selection for mothbean improvement programme. Genotypes/ varieties exhibited higher seed yield along with other desirable traits were IC-370469, GP-387, IC-415116, IC-310670, IC-329040, RMO-225, RMO-257, IC-983, IC-415138, IC-415167, RMO-435, RMO-2251, FMM-12-6-134, RMO-40. Besides quantitative traits, all these genotypes were also found early in flowering and maturity, which are considered as the most desirable traits for crop cultivation in an arid environment.

Keywords: Genotypes, mothbean, seed yield, variability parameters, quantitative traits

Introduction

Pulses are an important commodity group of crops that provide high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. Mothbean is an essential dietary component in Indian arid zone. It is the potential reservoir of protein (22-24 percent), essential minerals and vitamins. It is the cheapest source of protein and providing nutritional security to vegetarians in the arid zone. It is consumed in the form of *Dal* (*Mogar*) and sprouts. It is the principal ingredient of a famous spicy snack *Bikaneri Bhujiya*. It is also consumed in the preparation of other food products like *Papad*, *Namkeen*, *Mangori*, *Dal vada* etc. About 80 percent of mothbean production of Rajasthan is consumed in agri-industries at Bikaner. (Sharma, 2016) [7]

Moth bean is grown in India over an area of 10.43 lakh hectares with an annual production of 3.37 lakh tonnes and productivity 323 kg per ha. (Anonymous, 2016-17) [1] Rajasthan ranks first in area and production and occupies 9.78 lakh hectares area with annual production of 2.22 lakh tonnes and productivity 228 kg per hectares. (Commissionerate of Agriculture, Rajasthan- Jaipur, 2018-19) Other major states for cultivation of mothbean are Maharashtra, Gujarat, Jammu & Kashmir and Punjab.

The efficacy of selection depends upon the magnitude of genetic variability for yield and yield contributing traits in the breeding material. Collection, maintenance and evaluation of germplasm for studying genetic variability of economically important traits basic steps for initiating breeding programme. The genetic facts are inferred from phenotypic observations. The observed variability may be grouped with parameters like genotypic and phenotypic coefficient of variation, heritability, genetic gain to form the basis of selection that guides the breeders to select superior parents to initiate an effective and fruitful crossing programme.

Material and Methods

The present investigation was carried out during *Kharif*, 2019 at experimental farm & under Laboratory conditions at Swami Keshwanand Rajasthan Agricultural University, Bikaner. Field sowing was done on July 13, 2019. The experimental material consisted of 49 genotypes (Table 1) was evaluated in randomized block design with three replications accommodating 3 meters long two rows per replication at 30 cm spacing under sprinkler irrigated situation. Observations recorded for 37 characters *viz.*, days to 50 percent flowering, days to maturity, plant height, number of pods per plant, seeds per pod, pod length, 100 seed weight, biological yield, harvest index, seed yield, chlorophyll-a, chlorophyll-b, total chlorophyll, membrane stability index, relative water content, proline content, protein content in grain, seed volume, particle/ true density, bulk density, porosity, water absorption capacity, water absorption index, germination percent at 30°C, shoot length at 30 °C, root length at 30 °C, seedling length at 30 °C, seedling fresh weight at 30 °C, seedling dry weight at 30 °C, seedling vigour index at 30 °C, germination percent at 40 °C, shoot length at 40°C, root length at 40 °C, seedling length at 40 °C, seedling fresh weight at 40 °C, seedling dry weight at 40 °C, seedling vigour index at 40 °C were subjected to genetic variability analysis using standard procedures.

Result and Discussion

The analysis of variance (Table 2) showed significant differences among genotypes for all 37 characters indicating that the material has adequate genetic variability to support the breeding programme for improving the seed yield of mothbean. These results are in agreement with the studies conducted by Garg *et al.* (2003) [3], Solanki *et al.* (2003) [9], Patel *et al.* (2008) [5], Yogeesh *et al.* (2012) [10], Kohakade *et al.* (2017) [4], Sahoo *et al.* (2019) [6].

Genetic variability parameters estimated for different characters of mothbean are given in Table 3. The estimates of GCV and PCV were high for harvest index followed by seed yield per plant, proline content, number of pods per plant and biological yield per plant, chlorophyll-b, seedling dry weight, seedling fresh weight at 40 °C, water absorption index, days to 50 percent flowering, seedling fresh weight at 30 °C; and moderate for root length, seedling vigour index, plant height,

100 seed weight, seedling length at 30°C, shoot length, germination percent at 40°C, seed volume, days to maturity, porosity, water absorption capacity which suggests that improvement in these characters might be gained to a reasonable extent. These results are in agreement with the studies conducted by Garg *et al.* (2003), Solanki *et al.* (2003) [9], Patel *et al.* (2008) [5], Yogeesh *et al.* (2012) [10], Kohakade *et al.* (2017) [4], Sahoo *et al.* (2019) [6].

The heritability values coupled with genetic advance would be more reliable and useful in predicting the gain under selection than the heritability estimates alone. High heritability along with high genetic advance as percent of mean was observed for harvest index, seed yield per plant, proline content, number of pods per plant, biological yield, chlorophyll-b, days to 50 percent flowering, water absorption index, seedling fresh weight at 30°C, root length at 30°C, seedling fresh weight at 40°C, plant height, seedling length at 30°C, seedling vigour index at 30°C, 100 seed weight, shoot length at 30°C, total chlorophyll, seed volume, days to maturity, water absorption capacity, germination percent at 40°C, root length at 40°C, membrane stability index, which indicate that these characters were under the control of additive gene action. Therefore, these characters may be taken into consideration for breeding programme of mothbean. These results are in agreement with the studies conducted by Garg *et al.* (2003), Patel *et al.* (2008) [5], Yogeesh *et al.* (2012) [10], Kohakade *et al.* (2017) [4].

Genotypes/ varieties exhibited higher seed yield along with other desirable traits are IC-983, IC-120968, IC-121065, IC-140616, IC-140663, IC-251877, IC-310670, IC-311396, IC-311399, IC-324034, IC-329040, IC-370469, IC-415104, IC-415116, IC-415167 GP-387, MOTH-259, JADIYA, JWALA, RMO-40, RMO-225, RMO-435, RMO-2251, FMM-12-6-134. Besides higher seed yield IC-370469, GP-387, IC-415116, IC-310670, IC-329040, RMO-225, RMO-257, IC-983, IC-415138, IC-415167, RMO-435, RMO-2251, FMM-12-6-134, RMO-40 genotypes were also found early in flowering and maturity which are considered as most desirable traits for crop cultivation in arid zone. Mothbean is a self-pollinated crop therefore; all above mentioned varieties/genotypes could directly be utilized for cultivation for arid as well as in future breeding programme to develop superior varieties.

Table 1: Name and Source of Mothbean Genotypes

S. No.	Name of genotype	Source of Seed
1.	IC-983	NBPGR, Regional Station, Jodhpur
2.	IC-9103	NBPGR, Regional Station, Jodhpur
3.	IC-11304	NBPGR, Regional Station, Jodhpur
4.	IC-11352	NBPGR, Regional Station, Jodhpur
5.	IC-11368	NBPGR, Regional Station, Jodhpur
6.	IC-16219	NBPGR, Regional Station, Jodhpur
7.	IC-16263	NBPGR, Regional Station, Jodhpur
8.	IC-18920	NBPGR, Regional Station, Jodhpur
9.	IC-120963	NBPGR, Regional Station, Jodhpur
10.	IC-120966	NBPGR, Regional Station, Jodhpur
11.	IC-120968	NBPGR, Regional Station, Jodhpur
12.	IC-120973	NBPGR, Regional Station, Jodhpur
13.	IC-121005	NBPGR, Regional Station, Jodhpur
14.	IC-121064	NBPGR, Regional Station, Jodhpur
15.	IC-121065	NBPGR, Regional Station, Jodhpur
16.	IC-140616	NBPGR, Regional Station, Jodhpur
17.	IC-140660	NBPGR, Regional Station, Jodhpur
18.	IC-140663	NBPGR, Regional Station, Jodhpur
19.	IC-140725	NBPGR, Regional Station, Jodhpur
20.	IC-251877	NBPGR, Regional Station, Jodhpur
21.	IC-310670	NBPGR, Regional Station, Jodhpur

22.	IC-311396	NBPGR, Regional Station, Jodhpur
23.	IC-311399	NBPGR, Regional Station, Jodhpur
24.	IC-324034	NBPGR, Regional Station, Jodhpur
25.	IC-329040	NBPGR, Regional Station, Jodhpur
26.	IC-370469	NBPGR, Regional Station, Jodhpur
27.	IC-415104	NBPGR, Regional Station, Jodhpur
28.	IC-415116	NBPGR, Regional Station, Jodhpur
29.	IC-415138	NBPGR Regional Station, Jodhpur
30.	IC-415167	NBPGR, Regional Station, Jodhpur
31.	GP-47	Agriculture Research Station, Bikaner
32.	GP-387	Agriculture Research Station, Bikaner
33.	GP-449	Agriculture Research Station, Bikaner
34.	GP-580	Agriculture Research Station, Bikaner
35.	GP-591	Agriculture Research Station, Bikaner
36.	GP-682	Agriculture Research Station, Bikaner
37.	GP-690	Agriculture Research Station, Bikaner
38.	GP-722	Agriculture Research Station, Bikaner
39.	GP-940	Agriculture Research Station, Bikaner
40.	PLMO-16	NBPGR, Regional Station, Jodhpur
41.	MOTH-259	NBPGR, Regional Station, Jodhpur
42.	JADIYA	NBPGR, Regional Station, Jodhpur
43.	JWALA	NBPGR, Regional Station, Jodhpur
44.	RMO-40	NBPGR, Regional Station, Jodhpur
45.	RMO-225	Agriculture Research Station, Bikaner
46.	RMO-257	Agriculture Research Station, Bikaner
47.	RMO-435	Agriculture Research Station, Bikaner
48.	RMO-2251	Agriculture Research Station, Bikaner
49.	FMM-12-6-134	NBPGR, Regional station, Jodhpur

Table 2: Analysis of Variance for Different Characters of Mothbean

S. No.	Characters	Sources of variation		
		Replications	Genotypes	Error
	D.F.	2	48	96
1	Days to 50% flowering	1.550	396.44**	0.530
2	Days to maturity	3.040	327.87**	6.240
3	Plant height [cm]	13.445	256.611**	5.415
4	Number of pods per plant	0.463	460.703**	5.041
5	Seeds per pod	0.055	0.45**	0.062
6	Pod length (cm)	0.007	0.131**	0.028
7	100 Seed weight (g)	0.025	0.69**	0.033
8	Biological yield (g)	3.100	650.985**	1.614
9	Harvest index (%)	2.489	261.435**	1.713
10	Seed yield per plant(g)	0.280	21.832**	0.160
11	Chlorophyll a (mg/g)	0.057	0.374**	0.103
12	Chlorophyll b (mg/g)	0.001	0.121**	0.011
13	Total chlorophyll (mg/g)	0.049	0.669**	0.115
14	Membrane stability index	1.709	64.373**	1.010
15	Relative water content	0.507	112.551**	0.495
16	Proline content (mg/g fresh weight)	0.035	3.605**	0.029
17	Protein content in grain (%)	2.442	2.785**	0.930
18	Seed volume (μ l/seed)	0.414	46.012**	0.477
19	Particle/ true density (g/cm^3)	0.004	0.037**	0.001
20	Bulk density (g/cm^3)	0.001	0.011**	0.001
21	Porosity (%)	1.600	41.063**	1.751
22	Water absorption capacity (mg/seed)	0.099	69.622**	0.939
23	Water absorption index (WAI)	0.003	0.386**	0.023
24	Germination % at 30°C	75.510	215.221**	38.010
25	Shoot length at 30°C (cm)	0.059	3.141**	0.033
26	Root length at 30°C (cm)	0.141	6.517**	0.114
27	Seedling length at 30°C (cm)	0.272	0.086**	0.195
28	Seedling fresh wt. at 30°C (g)	0.008	0.103**	0.002
29	Seedling dry wt. at 30°C (g)	0.001	0.006**	0.001
30	Seedling vigour index at 30°C	26507.210	138386.238**	9511.549
31	Germination % at 40°C	0.680	292.743**	45.124
32	Shoot length at 40°C (cm)	0.715	1.554**	0.244
33	Root length at 40°C (cm)	0.537	1.965**	0.306
34	Seedling length at 40°C (cm)	1.758	4.187**	0.578
35	Seedling fresh weight at 40°C (g)	0.005	0.085**	0.012
36	Seedling dry weight at 40°C (g)	0.0004	0.002**	0.0004
37	Seedling vigour index at 40°C	11985.280	48533.782**	9974.756

* Significant at P = 0.05

** Significant at P = 0.01

Table 3: Genetic Variability Parameters for Different Characters in Mothbean

S. No.	Characters	Range	Mean	GCV	PCV	h ² (%)	GA (5%)	GA as % of Mean (5%)
1	Days to 50% flowering	32-73	51.89	22.136	22.18	99.60	23.61	45.50
2	Days to maturity	59-96	74.36	13.924	14.324	94.50	20.73	27.88
3	Plant height [cm]	28.60 - 68.90	49.03	18.66	19.258	93.90	18.268	37.261
4	No. of pods	12.20-53.90	31.69	38.89	39.534	96.80	24.977	78.824
5	Seeds per pod	4.60-6.80	5.97	6.074	7.384	67.70	0.614	10.292
6	Pod length (cm)	3.69-4.57	4.03	4.601	6.206	55.00	0.283	7.026
7	100 Seed weight (g)	1.80-3.76	2.73	17.120	18.4	86.60	0.897	32.814
8	Biological yield (g)	17.69-70.80	39.86	36.913	37.05	99.30	30.195	75.758
9	Harvest index (%)	2.55-36.67	15.10	61.623	62.23	98.10	18.98	125.706
10	Seed yield (g)	0.90-10.22	5.31	50.663	51.221	97.80	5.477	103.229
11	Chlorophyll a (mg/g)	0.73-2.14	1.67	18.076	26.437	46.70	0.424	25.46
12	Chlorophyll b (mg/g)	0.30-1.09	0.66	29.114	33.497	75.50	0.342	52.128
13	Total chlorophyll (mg/g)	1.30-2.92	2.32	18.506	23.59	61.50	0.694	29.906
14	Membrane stability index	39.04-55.80	45.50	10.101	10.34	95.40	9.249	20.327
15	Relative water content	68.63-92.72	82.76	7.385	7.434	98.70	12.507	15.113
16	Proline content (mg/g fresh wt.)	1.12-4.96	2.60	42.018	42.537	97.60	2.221	85.502
17	Protein content in grain (%)	21.03- 23.68	22.25	3.534	5.593	39.90	1.024	4.601
18	Seed volume (µl/seed)	20-30	26.80	14.536	14.763	97.00	7.902	29.483
19	Particle/ true density (g/cm ³)	1.08-1.52	1.31	8.355	8.881	88.50	0.211	16.192
20	Bulk density (g/cm ³)	0.78- 1.07	0.93	6.274	7.185	76.30	0.105	11.286
21	Porosity (%)	24.22-37.60	28.65	12.635	13.453	88.20	7.004	24.446
22	Water absorption capacity (mg/seed)	32.88-50.11	40.22	11.897	12.138	96.10	9.661	24.02
23	Water absorption index (WAI)	1.01-2.43	1.53	22.762	24.839	84.00	0.657	42.969
24	Germination % at 30°C	70.00-97.00	83.47	9.208	11.804	60.80	12.35	14.796
25	Shoot length at 30°C (cm)	3.79-8.62	6.29	16.179	16.441	96.80	2.063	32.8
26	Root length at 30°C (cm)	3.84-10.39	7.48	19.522	20.04	94.90	2.932	39.175
27	Seedling length at 30°C (cm)	7.76-18.71	13.78	16.706	17.011	96.40	4.656	33.795
28	Seedling fresh weight at 30°C (g)	0.62-1.36	0.91	20.137	20.991	92.00	0.361	39.794
29	Seedling dry weight at 30°C (g)	0.16-0.34	0.23	18.2	23.067	62.30	0.067	29.581
30	Seedling vigour index at 30°C	631.87- 1548.00	1148.47	18.047	19.945	81.90	386.331	33.639
31	Germination % at 40°C	50-90	69.12	13.145	16.348	64.70	15.049	21.773
32	Shoot length at 40°C (cm)	3.92-7.09	5.52	11.962	14.94	64.10	1.089	19.723
33	Root length at 40°C (cm)	3.80-8.00	5.81	12.8	15.96	64.30	1.229	21.148
34	Seedling length at 40°C (cm)	7.80-13.80	11.34	9.67	11.769	67.50	1.856	16.368
35	Seedling fresh weight at 40°C (g)	0.37-0.99	0.67	23.131	28.591	65.50	0.26	38.55
36	Seedling dry weight at 40°C (g)	0.05-0.16	0.11	23.464	30.486	59.20	0.04	37.204
37	Seedling vigour index at 40°C	536.30-1099.20	782.05	14.497	19.319	56.30	175.243	22.408

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