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Genetic analysis for yield and quality related traits in moth bean [*Vigna aconitifolia* (Jacq.) Marechal]

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Abstract
Grain yield is a complex phenomenon, which results from the interaction of various contributing causes highly influenced by environmental variation. Phenotypic selection cannot directly improve the characters in heterozygous crops like moth bean unless dissected by genetic analysis. A study undertaken to determine the extent of genetic variability for seed yield and ten other quantitative characters in 40 genotypes of moth bean. The analysis of variance revealed significant differences among genotypes for all the characters. High genotypic coefficient and phenotypic coefficient of variation recorded for number of branch per plant, seed yield per plant, harvest index and leaf area indicated potential variability available for these traits and small difference between them suggesting positive selection in desired direction for improvement of this character. The high heritability along with high genetic advance in day to flowering, number of pod per plant, seed yield per plant, harvest index, number of branch per plant, test weight and leaf area per plant suggested that genotypic variation for the characters probably attributed to high additive genetic effect and selection would be wrathful based on phenotypic performance.

1. Introduction

Moth bean [*Vigna aconitifolia* (*Jacq*) *Marechal*] belongs to family: Leguminosae /Fabaceae, sub family: Papilionaceae. It is a self-pollinated diploid (2n= 22) crop. Popularly, it is an also known as "Mat", "Matki" and "Moth bean" in different regions. Plant is an annual with spreading prostrate habit forming a mat like cover on soil, hence its name as a mat or moth bean. Canopy of moth bean covers surface area, which conserves moisture and protects the soil from erosion. Moth bean is mainly use as "Dal" and some other preparations. Green pods used as vegetables. It can also be use as green fodder for animals. It is an important crop of dry and semi-arid areas of India and some countries of Asia. Among Kharif pulses, it has maximum capacity to resist drought condition. It is an excellent source of high quality protein (23.6%) in the diet of low-income group in developing countries. Moth bean is cultivated for food as well as forage. In extremely low rainfall areas, it is grown alone as pure crop, while, in areas receiving adequate rains it may be grown as intercrop with pearl millet, sorghum, cotton, green gram or some other fodder grasses. India has major area under moth bean cultivated in world. In India moth-bean mainly grown in Rajasthan, which contribute about 75% of total area and production of the country. Other important states for cultivation of moth bean are Maharashtra, Gujarat, Jammu & Kashmir and Punjab.

Information on genetic variability, heritability and genetic advance is most essential for formulating effective selection schemes in any crop improvement programmed. A very limited work done on moth bean. Therefore, the present investigations undertaken to determine genetic variability, heritability and genetic advance in moth bean.

2. Material and Method

The experimental materials consisting 40 germplasm of moth bean collected from Pulses Research Station, S. D. Agricultural University Sardarkrushinagar, Gujarat (Table 1).

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The experiment was carryout in RBD with three replications at Agronomy Instructional farm, C.P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar during *kharif* 2018. By adopting a spacing of 45 cm between rows and 20 cm between plants respectively, at recommended package of practices followed to raise good and healthy crop stand. Data were collected on 12 quantitative characters *viz.,* days to flowering, day's to maturity, plant height (cm), number of branch per plant, number of pod per plant, pod length (cm), number of seed per pod, seed yield per plant (g), test weight (g), harvest index (%), leaf area per plant (cm^2) and protein content (%). The mean of five plants subjected to statistical analysis. The data for different characters were statistically analyze for significance by using analysis of variance

technique described by Panse and Sukhatme (1978) [22]. The adapted design was Randomized Block Design (RBD) with three replications. The significance of mean sum of square for each character tested against the corresponding error degrees of freedom using "F" Test (Fisher and Yates, 1967). The components of variances used to estimate genetic parameters like phenotypic and genotypic coefficient of variation (PCV and GCV) as per the formula given by Burton and De Vane (1952) [4]. Heritability in broad sense calculated according to the formula given by Allard (1960) and expressed in percentage. Genetic advance estimated by using Johanson *et al.* (1955) [17]. Statistical analysis done by using WINDOSTAT program.

Table 1: Genotypes included in the studied

No.	Genotype	Source	No.	Genotype	Source
1	GMO-1	PRS, SDAU, Gujarat	21	MGD-05/87	PRS, SDAU, Gujarat
2	GMO-2	PRS, SDAU, Gujarat	22	MGD-05/88	PRS, SDAU, Gujarat
3	CZM-2	PRS, SDAU, Gujarat	23	MGD-05/90	PRS, SDAU, Gujarat
4	JAWALA	PRS, SDAU, Gujarat	24	MGD-05/93	PRS, SDAU, Gujarat
5	JADIYA	PRS, SDAU, Gujarat	25	GP-7	PRS, SDAU, Gujarat
6	RMO-40	PRS, SDAU, Gujarat	26	GMO-9002	PRS, SDAU, Gujarat
7	RMO-225	PRS, SDAU, Gujarat	27	GMO-9120	PRS, SDAU, Gujarat
8	RMO-257	PRS, SDAU, Gujarat	28	GMO-9908	PRS, SDAU, Gujarat
9	MB-1	PRS, SDAU, Gujarat	29	GMO-9136	PRS, SDAU, Gujarat
10	MB-2	PRS, SDAU, Gujarat	30	GMO-9703	PRS, SDAU, Gujarat
11	MGD-05/17	PRS, SDAU, Gujarat	31	GMO-9704	PRS, SDAU, Gujarat
12	MGD-05/26	PRS, SDAU, Gujarat	32	GMO-0117	PRS, SDAU, Gujarat
13	MGD-05/35	PRS, SDAU, Gujarat	33	GMO-8905	PRS, SDAU, Gujarat
14	MGD-05/36	PRS, SDAU, Gujarat	34	GMO-9114	PRS, SDAU, Gujarat
15	MGD-05/49	PRS, SDAU, Gujarat	35	GMO-0501	PRS, SDAU, Gujarat
16	MGD-05/69	PRS, SDAU, Gujarat	36	IC-36468	PRS, SDAU, Gujarat
17	MGD-05/72	PRS, SDAU, Gujarat	37	IC-36490	PRS, SDAU, Gujarat
18	MGD-05/81	PRS, SDAU, Gujarat	38	IC-39671	PRS, SDAU, Gujarat
19	MGD-05/85	PRS, SDAU, Gujarat	39	IC-39700	PRS, SDAU, Gujarat
20	MGD-05/86	PRS, SDAU, Gujarat	40	MGD-06/371	PRS, SDAU, Gujarat

3. Result and Discussion

Analysis of variance revealed significant differences among genotypes for all the characters. Significant treatment differences at genotypic and phenotypic levels revealed the existence of substantial amount of variability for all characters under studies. Heritability (broad sense) of all characters was high in magnitude, for days to flowering (75.80%), days to maturity (85.70%), number of branch per plant (82.30%), seed yield per plant (77.50%), number of pod per plant (88.20%), protein content (67.77%), leaf area per plant (74.90%), harvest index (77.20%) and test weight (80.70%). High heritability coupled with high genetic advance were observed for days to maturity, number of pod per plant, seed yield per plant, harvest index, number of branch per plant and

leaf area per plant. High heritability accompanied with high genetic advance indicated that heritability is due to additive gene effects and selection may be effective (Table 4). It shows that the presence of variability and choice of material is appropriate. Improvement of economic characters like yield through selection conditioned by the nature and magnitude of variability existing in such populations. However, the phenotypic expression of complex character like yield is a combination of genotype, environment and their interaction. This indicates the need for partition of overall variability into heritable and non-heritable components with the help of appropriate statistical techniques. Possibility of achieving improvement in any crop plants depends largely on the magnitude of genetic variability.

Table 2: Analysis of variance (ANOVA) for different characters of moth bean genotypes / accessions

Sr. No.	Character	Mean sum of square		
		Replications	Treatments	Error
	Degree of freedom	**2**	**39**	**78**
1	Days to flowering	6.91	82.85**	7.98
2	Days to maturity	61.05	527.81**	27.90
3	Plant height (cm)	9.11	36.77**	18.28
4	Number of branch per plant	0.46	6.88**	0.46
5	Number of pod per plant	4.24	399.35**	17.12
6	Pod length (cm)	0.27	0.95**	0.21
7	Number of seed per pod	0.33	0.70**	0.14
8	Seed yield per plant (g)	0.07	4.14**	0.36
9	Test weight (g)	0.03	0.21**	0.02

10	Harvest index (%)	12.36	81.84**	7.34
11	Leaf area per plant(cm^2)	2377256.00	10980654.41**	1103266.97
12	Protein content (%)	0.57	1.79**	0.25

Phenotypic variability expressed by a genotype or a group of genotypes in any species can be partitioned into genotypic and environmental components. The genotypic component being the heritable part of the total variability, its magnitude for yield and its component characters influence the selection strategies to adopt by the breeders.

The difference between GCV and PCV found to be less for the characters days to flowering, days to maturity, test weight and protein content indicated that these characters not much more influenced by environment. While remaining characters like plant height, number of branch per plant, number of pod per plant, pod length, number of seed per pod, seed yield per plant, harvest index and leaf area per plant highly difference value between GCV and PCV indicated that these characters were more influenced by environment (Table 4). The estimates of GCV (9.29%) and PCV (10.67%) were low to moderate indicating presence of moderate variability in the population for days to flowering. The close estimates of GCV and PCV values suggested that variability were primarily due to genotypic differences. High heritability coupled with high genetic advance reveals the presence of lesser environmental influence and prevalence of additive gene action in their expression (Panse, 1957) [21]. Lower values of genetic advance indicate the prevalence of narrow range of variability, high G X E interaction (non-additive gene action). In the present investigation, heritability obtained for all character was of moderate to high magnitudes except plant height indicating that these character were least influenced by environment. Tikka *et al.* (1973) [29] obt1ained similar results for days to flowering, number of pods per pant, number of branch per plant and seed yield per plant. Bhavsar and Birari (1989) [3] obtained similar results for days to flowering, days to maturity, number of branch per plant, number of pod per plant, seed yield per plant and harvest index. Kakani *et al.* (2003a) [18] reported high heritability for days to flowering and days to maturity. Sihag *et al.* (2004) [26] obtained similar results for number of pod per plant (Table 3).

Table 3: Genetic parameters of variation for seed yield and its contributing characters in moth bean

Sr. No.	Characters	Range	Mean	σ^2_g	σ^2_p	σ^2_e
1	Days to flowering	46.10-65.69	53.80	24.96	32.93	7.98
2	Days to maturity	70.56-117.00	89.73	166.64	194.53	27.90
3	Plant height (cm)	36.13-49.62	41.92	6.16	24.44	18.28
4	Number of branch per plant	2.82-8.01	6.41	2.14	2.60	0.46
5	Number of pod per plant	16.31-60.97	28.82	127.41	144.53	17.12
6	Pod length (cm)	2.85-5.67	4.33	0.25	0.46	0.21
7	Number of seed per pod	3.43-5.66	3.99	0.19	0.32	0.14
8	Seed yield per plant (g)	3.60-9.06	5.03	1.26	1.62	0.36
9	Test weight (g)	2.07-3.07	2.54	0.06	0.08	0.02
10	Harvest index (%)	13.43-35.35	22.04	24.84	32.17	7.34
11	Leaf area per plant (cm^2)	5450.43-12513.24	8673.54	3292462.48	4395729.45	1103266.97
12	Protein content (%)	18.26-21.64	20.20	0.52	0.76	0.25

Note: σ^2g, σ^2p and σ^2e are the genotypic, phenotypic and environmental variance, respectively

Table 4: Genetic parameters of variation for seed yield and its contributing characters in moth bean

Sr. No.	Characters	GCV (%)	PCV (%)	ECV (%)	h$^2_{(b.s)}$ (%)	GA	GAM (%)
1	Days to flowering	9.29	10.67	5.25	75.80	8.96	16.65
2	Days to maturity	14.39	15.54	5.89	85.70	24.61	27.43
3	Plant height	5.92	11.80	10.20	25.20	2.57	6.13
4	Number of branch per plant	22.83	25.17	10.60	82.30	2.73	42.66
5	Number of pod per plant	39.17	41.72	14.36	88.20	21.83	75.76
6	Pod length	11.48	15.60	10.56	54.20	0.75	17.40
7	Number of seed per pod	10.92	14.29	9.22	58.40	0.69	17.19
8	Seed yield per plant	22.33	25.36	12.02	77.50	2.04	40.50
9	Test weight	10.00	11.14	4.89	80.70	0.47	18.51
10	Harvest index	22.61	25.74	12.29	77.20	9.02	40.93
11	Leaf area per plant	20.92	24.17	12.11	74.90	3234.99	37.30
12	Protein content	3.56	4.32	2.45	67.77	1.22	6.03

Note: GCV (%) and PCV (%) are genotypic and phenotypic coefficient of variance, respectively. h$^2_{(b.s)}$(%), GA and GAM are broad sense

4. Conclusion
The material chosen differed in their genotypic make up as evidenced by the significant differences among them in respect of all the quantitative characters studied. Phenotypic coefficients of variations estimate was slightly higher than the genotypic coefficients of variation for the entire trait, indicating low environmental influence on the expression of all the traits. The high heritability along with high genetic advance in day to flowering, number of pod per plant, seed yield per plant, harvest index, number of branch per plant, test weight and leaf area per plant suggested that genotypic variation for the characters probably attributed to high additive genetic effect and selection would be useful based on phenotypic performance.

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