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Study of genetic variability parameters for seed yield and its component traits in mungbean germplasm under arid environment

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Abstract
A field experiment was conducted to study the genetic variability parameters for seed yield and its component traits in mungbean at Swami Keshwanand Rajasthan Agricultural University, Bikaner during *Kharif*-2017. Significant differences were observed among genotypes for all 11 characters studied. The high degree of genetic variability along with high heritability and high genetic advance as per cent of mean were recorded for seed yield per plant, number of pods per plant, harvest index, biological yield per plant and plant height; which indicates that these characters were under the control of additive gene action and therefore, form the basis of selection for mungbean improvement programme. Genotypes/ varieties exhibited higher seed yield along with other desirable traits were Ganga-1, MUM-2, COGG-912, Keshwanand Mung-1, RMG-268, GM-4, SML-668, RMG-492, Samrat, MH 2-15, MH-421, ML-683, IPM 205-7, GAM-5, SML-832, RMG-344, IPM 99-125, IC-39409, Keshwanand Mung-2, Ganga-8, RMG-62, IPM 02-14 and IC-39288. 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, mungbean, seed yield, variability parameters

Introduction
Pulses compliment the daily human diet of Indians along with cereals. They are a rich source of proteins with a satisfactory proportion of carbohydrates. Mungbean [*Vigna radiata* (L.) Wilczek], also known as green gram is an ancient pulse crop widely cultivated in India. High protein, easy digestibility and low flatulence production made this crop more acceptable by the people world over. Mungbean is a short day, warm-season crop, grown mainly in arid and semi-arid regions. It is tolerant to moisture stress and heat as well; and has the ability to grow under low input conditions (Sharma, 2016) [9]. Because of short duration, wide adaptation, low water requirement and photo insensitiveness, it can be grown in various crop rotation practices (Singh *et al.*, 2015) [11].

Being highly self-pollinated crop, natural variability for yield and yield related traits is very narrow in mungbean making selection ineffective. However, proper evaluation of the extent of genetic variation available for yield components, their heritability values and genetic advance could be of great significance for the breeders in order to choose best genotypes for improvement (Degafa *et al.*, 2014) [4]. Estimates of genetic parameters provide an indication of the relative importance of the various types of gene effects affecting the total variation of a plant character. Therefore, the present study was conducted to assess genetic variability, heritability and genetic advance in mungbean germplasm under the arid environment of Rajasthan. So that promising genotypes could be identified for a breeding programme to develop high yielding varieties of mungbean for the arid zone.

Material and Methods
The present investigation was carried out during *Kharif*, 2017 at experimental farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. Sowing was done on July 6, 2017. The experimental material consisted of 79 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 11 characters *viz.*, days to 50 percent flowering, days to maturity, plant height,

number of branches per plant, number of pods per plant, number of seeds per pod, pod length, 100-seed weight, biological yield per plant, seed yield per plant and harvest index 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 11characters indicating that the material has adequate genetic variability to support the breeding programme for improving the seed yield of mungbean. A wide range of variability in mungbean germplasm was displayed by different characters namely; days to 50 per cent flowering (34-60), days to maturity (64-84), plant height (40.47-126.13 cm), number of branches per plant (1.5-3.03), number of pods per plant (1.53-55.60), number of seeds per pod (8.00-11.67), pod length (2.46-10.22 cm), 100-seed weight (2.45-5.41 g), biological yield per plant (12.20-104.33 g), seed yield per plant (0.47-26.07 g) and harvest index (1.10-38.41).

Genetic variability parameters estimated for different characters of mungbean are given in Table 3. The highest GCV and PCV in mungbean germplasm were observed for seed yield per plant followed by number of pods per plant, harvest index, biological yield per plant and plant height, respectively; thereby, suggesting a good scope of improvement, creating variability through hybridization followed by selection. The occurrence of moderate GCV and PCV was recorded for number of branches per plant, days to 50 per cent flowering, pod length and 100-seed weight which suggests that improvement in these characters might be gained to a reasonable extent. Similar findings were reported by Makeen *et al.* (2007) [7], Bisht *et al.* (2014) [2], Hemavathy *et al.* (2015) [6], Bhatia *et al.* (2016) [1] and Shiv *et al.* (2017) [10]. The response of selection depends upon the magnitude of heritable variation present in the population. A character with high GCV and high heritability will be more valuable in a selection programme. In the present investigation, high heritability estimates have been observed for days to 50 per cent flowering followed by seed yield per plant, number of pods per plant, biological yield per plant, 100-seed weight, harvest index, number of branches per plant, days to maturity, plant height, pod length and number of seeds per pod. According to Panse and Sukhatme (1985) [8], such characters are predominantly governed by additive gene action and could be improved through individual plant selection owing to their high heritability values. Similar findings were reported by Makeen *et al.* (2007) [7], Gadakh *et al.* (2013) [5], Tiwari *et al.* (2014) [12], Bhutia *et al.* (2016) [1] and Shiv *et al.* (2017) [10].

The genetic advance as per cent of mean provides an idea of the amount of progress that can be achieved by selection for the concerned trait. High genetic advance as percentage of mean was estimated for seed yield per plant, number of pods per plant, harvest index, biological yield per plant, plant height, days to 50 per cent flowering, number of branches per plant, 100-seed weight and pod length; however, moderate values were observed for days to maturity and number of seeds per pod.

The heritability values coupled with genetic advance would be more reliable and useful in predicting the gain under selection than the heritability estimates alone. The high estimate of heritability coupled with high genetic advance as percent of mean was recorded for seed yield per plant, number of pods per plant, harvest index, biological yield per plant, plant height, days to 50 per cent flowering, number of branches per plant, 100-seed weight and pod length. These traits are governed by additive gene effects and therefore, may be improved through direct selection. Similar findings were reported by Gadakh *et al.* (2013) [5], Tiwari *et al.* (2014) [12], Choudhary *et al.* (2017) [3] and Shiv *et al.* (2017) [10].

Genotypes/ varieties exhibited higher seed yield along with other desirable traits were Ganga-1, MUM-2, COGG-912, Keshwanand Mung-1, RMG-268, GM-4, SML-668, RMG-492, Samrat, MH 2-15, MH-421, ML-683, IPM 205-7, GAM-5, SML-832, RMG-344, IPM 99-125, IC-39409, Keshwanand Mung-2, Ganga-8, RMG-62, IPM 02-14 and IC-39288. 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 the arid zone. Mungbean is a self-pollinated crop, therefore; all above mentioned varieties/genotypes could directly be used for cultivation under irrigated normal soil and water situation of the arid zone as well as in future breeding programme to develop superior varieties.

Table 1: List of mungbean genotypes used for present investigation

S. No.	Name of germplasm	Year of Collection	Source of procurement
Germplasm procured from NBPGR, Regional Station, Jodhpur			
1	IC-39269	1993	Jodhpur, Rajasthan
2	IC-39275	1993	Kherapa, Jodhpur, Rajasthan
3	IC-39279	1993	*
4	IC-39288	1993	Nimbojhai, Nagour, Rajasthan
5	IC-39293	1993	Kadampura, Nagour, Rajasthan
6	IC-39298	1993	Bambor,Jodhpur, Rajasthan
7	IC-39300	1993	Jaswasar, Bikaner, Rajasthan
8	IC-39328	1993	Lalela, Barmer, Rajasthan
9	IC-39333	1993	Dhawa, Barmer, Rajasthan
10	IC-39352	1993	Manduwa, Barmer, Rajasthan
11	IC-39368	1993	Lunawas, Jodhpur, Rajasthan
12	IC-39375	1993	Nibali, Barmer, Rajasthan
13	IC-39383	1993	Godan, Jalore, Rajasthan
14	IC-39395	1993	Aburoad, Sirohi, Rajasthan
15	IC-39399	1993	Jaspura, Palanpur, Gujarat
16	IC-39409	1993	Kapara, Banaskantha, Gujarat
17	IC-39420	1993	Nearsami, Patan, Gujarat
18	IC-39427	1993	Harij, Patan, Gujarat

19	IC-39451	1988	Lakhtarar, Surendranagar, Gujarat
20	IC-39454	1988	Surendranagar, Gujarat
21	IC-39465	1988	Kalyana, Patan, Gujarat
22	IC-39483	1988	Kalapur, Surendranagar, Gujarat
23	IC-39492	1988	Dudhai, Mahesana, Gujarat
24	IC-39495	1988	Chandrani, Kachchh, Gujarat
25	IC-39500	1988	Kishangarh, Gujarat
26	IC-39515	1988	Kauth, Gujarat
27	IC-39580	1992	Bachau, Kutch, Gujarat
28	IC-39582	1992	Chilora, Kheda, Gujarat
29	IC-39591	1992	Sevelia, Kheda, Gujarat
30	IC-39604	1992	Bholi, Rajasmand, Rajasthan
31	IC-39608	1992	Nevra, Jodhpur, Rajasthan
32	IC-39610	1992	Osian, Jodhpur, Rajasthan
33	IC-52073	1992	*
34	IC-52076	1992	*
35	IC-52078	1992	*
36	IC-52081	1992	*
37	IC-52082	1992	*
38	IC-52087	1992	*
39	IC-55069	1992	*
40	IC-102792	1986	Banar, Jodhpur, Rajasthan
41	IC-102821	1986	Gidani, Jaipur, Rajasthan
42	IC-102857	1986	Khasur, Dholpur, Rajasthan
43	IC-102963	1986	Avikanagar, Tonk, Rajasthan
44	IC-103014	1986	Alampur, Kheda, Gujarat
45	IC-103059	1986	Krakas, Amreli, Gujarat
46	IC-103204	1987	Gangawar, Chittorgarh, Raj.
47	IC-103207	1987	Dhinva, Chittorgarh, Rajasthan
48	IC-103244	1986	Bhrwasa, Didwana, Nagaur, Raj.
49	IC-103245	1987	Odda, Banswara, Rajasthan
50	IC-103785	1989	Khemlo, Vishsana, Rajasthan
51	IC-103821	1989	Nagdhan, Santrampur, Gujarat
52	IC-103973	1989	Barvalbhipor, Bhavnagar, Gujarat
53	IC-324012	-	*
54	IC-338868	1990	Sanari, Barmer, Rajasthan
Varieties procured from Agriculture University, Jodhpur			
55	Sweta		CSAVAT, Kanpur
56	IPM-02-3		ICAR-IIPR, Kanpur
57	IPM-02-14		ICAR-IIPR, Kanpur
58	Samrat (PDM-139)		ICAR-IIPR, Kanpur
59	GM-4		AAU, Pulse Res. Station, Vadodara
60	MH 2-15		CCSHAU, Hisar
61	MH-421		CCSHAU, Hisar
62	IPM-205-7		ICAR-IIPR, Kanpur
63	IPM 99-125 (Meha)		ICAR-IIPR, Kanpur
64	IPM-409-4		ICAR-IIPR, Kanpur
65	GAM-5		AAU, PulseRes. Station, Vadodara
66	COGG-912		TNAU, Coimbatore
Varieties procured from RARI, Durgapura, Jaipur			
67	RMG-62		SKRAU-ARS, Durgapura, Jaipur
68	RMG-268		SKRAU-ARS, Durgapura, Jaipur
69	RMG-344		SKRAU-ARS, Durgapura, Jaipur
70	RMG-492		SKRAU-ARS, Durgapura, Jaipur
71	Keshwanand Mung-1 (RMG-975)		SKNAU-RARI, Durgapura, Jaipur
72	Keshwanand Mung-2 (MSJ-118)		SKNAU-RARI, Durgapura, Jaipur
Varieties procured from ARS, Sriganganagar			
73	Ganga-1		SKRAU-ARS, Sriganganagar
74	Ganga-8		SKRAU-ARS, Sriganganagar
75	MUM-2		CCS Meerut University, Meerut
76	SML-668		PAU, Ludhiana
77	SML-832		PAU, Ludhiana
78	ML-683		PAU, Ludhiana
79	ML-818		PAU, Ludhiana

*Source was not mentioned by NBPGR, Regional Station, Jodhpur

Table 2: Analysis of variance for different characters of mungbean

Source of variation	D.F.	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of pods per plant	No. of seeds per pod	Pod length (cm)	100-seed weight (g)	Biological yield per plant (g)	Harvest index (%)	Seed yield per plant (g)
Replications	2	0.34	4.81	27.06	0.362**	0.76	0.46	0.48	0.001	2.04	0.98	0.63
Genotypes	78	250.90**	159.74**	1057.98**	0.635**	572.79**	2.84**	2.91**	0.580**	1252.01**	316.13**	162.12**
Error	156	0.18	1.79	12.36	0.006	1.99	0.20	0.16	0.003	6.87	3.07	0.37

*Significant at P = 0.05
** Highly significant at P = 0.01

Table 3: Estimates of genetic variability parameters for different characters of mungbean

S. No.	Characters	Range	Mean	GCV	PCV	Heritability (%)	Genetic Advance	GA as % of mean
1	Days to 50% flowering	34 - 60	47.23	19.35	19.38	99.8	18.81	39.83
2	Days to maturity	64–84	74.70	9.71	9.88	96.7	14.70	19.68
3	Plant height (cm)	40.47-126.13	77.43	24.11	24.53	96.6	37.79	48.81
4	Number of branches per plant	1.50 -3.03	2.34	19.54	19.82	97.1	0.93	39.66
5	Number of pods per plant	1.53-55.60	21.89	63.00	63.33	99.0	28.26	129.11
6	Number of seeds per pod	8-11.67	10.17	9.20	10.22	81.2	1.74	17.09
7	Pod length (cm)	2.46-10.22	7.41	12.92	14.02	84.9	1.82	24.51
8	100-seed weight (g)	2.45-5.41	3.63	12.09	12.20	98.2	0.89	24.68
9	Biological yield per plant (g)	12.20–104.33	44.04	46.26	46.64	98.4	41.62	94.52
10	Harvest Index (%)	1.10- 38.41	19.16	53.31	54.09	97.1	20.74	108.25
11	Seed yield per plant (g)	0.47-26.07	9.07	80.95	81.22	99.3	15.07	166.17

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