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Stability Analysis for Agro-morphological and Physio-biochemical Traits in Mungbean [*Vigna radiata* (L.) Wilzeck] under Arid Environment

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ABSTRACT

Background: Mungbean is an ancient pulse crop widely cultivated under different agro-ecological situations in India. It is the potential source of protein, essential minerals and vitamin-B (vitamin-C in sprouting grains). Pulses offer an alternative for diversification of agricultural system but poor yield renders them poor competitors of cereals, oilseeds and cash crops. So it is necessary to screen and identify phenotypically stable genotypes which could perform more or less uniformly under different conditions. The current study aimed to identify the high potential stable genotype and appropriate sowing time for mungbean cultivation in hot arid zone of Rajasthan.

Methods: A field experiment was conducted with 35 mungbean genotypes over four environments created by four different dates of sowing in RBD with three replications at SKRAU, Bikaner during summer-2019 and *Kharif*-2019 using the model of Eberhart and Russell (1966).

Result: Stability parameters revealed that genotype IC-39269 exhibited stable performance for number of seeds per pod, biological yield per plant and harvest index across the environments; whereas, IPM 02-3, MH 2-15 and RMG-344 exhibited stable performance for seed yield under favourable environment *i.e. Kharif* season and genotype IC 103059 for stressed environment *i.e.* summer season.

Key words: Component traits, Environment, Genotype, Mungbean, Seed yield, Stability parameters.

INTRODUCTION

Mungbean/green gram is an ancient pulse crop widely cultivated under different agro-ecological situations in India mainly during *Kharif* and summer seasons. It is a diploid species having chromosome number (2n=22) belongs to family Leguminosae (Fabaceae), sub-family Papilionaceae and is botanically recognized as *Vigna radiata* (L.) Wilczek. Mungbean is a native of South Asia (India). *Vigna radiata* var. *sublobata* is the probable progenitor of mungbean. It is essentially a self-pollinated crop (Singh *et al*., 2015).

Mungbean is largely cultivated in arid and semi-arid areas. It is drought tolerant and has ability to grow under harsh climate and medium to poor rainfall situations. It is tolerant to moisture stress and heat as well. It has ability to cultivate under low input conditions. It is grown on a variety of soil including black, red lateritic, gravelly and sandy soils. Well-drained fertile sandy loam soil with a pH between 6.2-7.2 is the best for mungbean cultivation (Sharma, 2016).

Mungbean is an important dietary component for vegetarians of the country. It is the potential source of protein (about 24 per cent), essential minerals and vitamin-B (vitamin-C in sprouting grains). It is an economical source of protein and provides nutritional safety to vegetarians. Mungbean is eaten in the form of *Dal*, sprouts and green pods as a vegetable. It is also used in the preparation of several food products like *Papad, Namkeen, Mangori, Dal vada*, *etc*. *Mung Ki Dal Ki Khichadi* made with mungbean *Dal* and rice is easily digestible and therefore, always recommended by doctors for sick people. *Mung Ki Dal Ka Halwa* is a very famous sweet prepared from mungbean in India (Sharma, 2016).

Genotype and its interaction with the prevailing environment is the basic factor determining the final yield. The genotype × environment interaction is particularly important in the expression of quantitative characters, which are controlled by polygenes and are greatly modified by environmental influences. Thus, in order to have unbiased estimates of various genetic components, it is imperative that the experiment must be repeated over different environments. The evaluation of genotype × environment interaction gives

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an idea of the stability or buffering ability of the population under study. Genotype x environment interaction is of common occurrence and often creates manifold difficulties in interpreting results and thus hampers the progress of breeding programme aiming at the further genetic improvement of crop plants. Hence, the knowledge of magnitude and nature of genotype x environment interaction is very useful to a breeder for proper understanding and assessment of his material (Sprague, 1966). The present investigation was therefore, undertaken to identify the stable genotype and appropriate sowing time of mungbean.

MATERIALS AND METHODS

The experimental material consisting of thirty five genotypes (including 21 germplasm and 14 released varieties) were procured from NBPGR, Regional Station, Jodhpur; Rajasthan Agricultural Research Institute, Durgapura, Jaipur; Agricultural Research Station, Sriganganagar and Agricultural Research Station, Mandor, Jodhpur is given in Table 1. A field experiment was conducted at Swami Keshwanand Rajasthan Agricultural University, Bikaner during summer-2019 and *Kharif*-2019. The experimental material consisted of 35 genotypes of mungbean was

Table 1: Details of mungbean genotypes used in investigation.

Name of genotype	Year of collection	Source of procurement
Germplasm procured from NBPGR, Regional Station, Jodhpur		
IC-39269	1993	Jodhpur, Rajasthan
IC-39300	1993	Jaswasar, Bikaner,Rajasthan
IC-39328	1993	Lalela, Barmer, Rajasthan
IC-39352	1993	Manduwa, Barmer, Rajasthan
IC-39399	1993	Jaspura, Palanpur, Gujarat
IC-39409	1993	Kapara, Banaskantha, Gujarat
IC-39454	1988	Surendranagar, Gujarat
IC-39492	1988	Dudhai, Mahesana, Gujarat
IC-39608	1992	Nevra, Jodhpur, Rajasthan
IC-39610	1992	Osian, Jodhpur, Rajasthan
IC-52076	1992	*
IC-52081	1992	*
IC-52082	1992	*
IC-52087	1992	*
IC-102792	1986	Banar, Jodhpur, Rajasthan
IC-102821	1986	Gidani, Jaipur, Rajasthan
IC-102857	1986	Khasur, Dholpur, Rajasthan
IC-103014	1986	Alampur, Kheda, Gujarat
IC-103059	1986	Krakas, Amreli, Gujarat
IC-103244	1986	Bhrwasa, Didwana, Nagaur, Raj.
IC-338868	1990	Sanari, Barmer, Rajasthan
Varieties/ genotypes procured from Agriculture University, Jodhpur		
Sweta		CSAUAT, Kanpur
IPM-02-3		ICAR-IIPR, Kanpur
IPM-02-14		ICAR-IIPR, Kanpur
Samrat (PDM-139)		ICAR-IIPR, Kanpur
GM-4		AAU, Pulse Res.Station,Vadodara
MH 2-15		CCSHAU, Hisar
MH-421		CCSHAU, Hisar
Varieties/genotypes procured from RARI, Durgapura, Jaipur		
RMG-62		SKRAU-ARS, Durgapura, Jaipur
RMG-344		SKRAU-ARS, Durgapura, Jaipur
Keshwanand Mung-1 (RMG-975)		SKNAU-RARI, Durgapura, Jaipur
Varieties/ genotypes procured from ARS, Sriganganagar		
SML-668		PAU, Ludhiana
SML-832		PAU, Ludhiana
Ganga-1		SKRAU-ARS, Sriganganagar
MUM-2		CCS Meerut University, Meerut

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

evaluated in randomized block design with three replications accommodating 3 meter long two rows per replication at 30 cm spacing under sprinkler irrigated situation in four different environments created by four different dates of sowing *viz*., (i) summer season: (A) early sowing (06, March) and (B) late sowing (20, March); (ii) *Kharif* season: (C) early sowing (06, July) and (D) late sowing (20, July). Observations were recorded for seventeen characters *viz*., days to 50 per cent flowering, days to maturity, plant height, number of pods per plant, number of seeds per pod, pod length, 100-seed weight, biological yield per plant, harvest index, chlorophyll-a, chlorophyll-b, total chlorophyll content, membrane stability index, relative water content, proline content, protein content and seed yield per plant to study the stability parameters of mungbean genotypes. The observations were recorded on individual plant basis on five randomly selected plants from each genotype of each replication for all traits except day to 50 per cent flowering and days to maturity. Day to 50 per cent flowering and days to maturity were recorded on whole plot basis. The mean values of different genotypes for all the characters were subjected to analysis of variance separately for individual environment as well as for pooled data to determine the significance of differences among genotypes, environments and genotype × environment interaction described by Panse and Sukhatme (1985). Stability parameters were estimated according to the model of Eberhart and Russell (1966).

RESULTS AND DISCUSSION

The analysis of variance indicated significant difference among genotypes in each environment for all seventeen traits studied (Table 2). Pooled analysis of variance also exhibited significant differences among genotypes and environments for all characters under study (Table 3) which indicate the high degree of variability among genotypes as well as in environments. Significant G × E interactions revealed the varying performance of genotypes in different environments for all characters except pod length. Similar findings were earlier reported by Lal *et al*. (2013), Win *et al*. (2018), Wankhede and Najan (2019), Baraki *et al*. (2020) and Singh *et al*. (2020) in mungbean.

The mean squares due to E+ (G × E) were found to be significant for all the traits except days to flowering, days to maturity, 100-seed weight and total chlorophyll content. Environments (linear) were found significant for all characters representing the presence of variability among environments; thereby, indicating the effect of environment on performance of genotypes. Linear component of G × E interaction was found significant for plant height, number of pods per plant, number of seeds per pod, biological yield per plant, chlorophyll-a, proline content and protein content indicated that the performance of genotypes with reference to seed yield and above mentioned component characters is predictable. Pooled deviation (non-linear) was found non-significant for all traits indicated that the performance of genotypes can be predicted on the basis of these traits (Table 4).

Table 2: Analysis of variance of mungbean genotypes for agro-morphological and physio-biochemical characters of individual environment.

Source of variation	d.f.	Env.	DF	DM	PH (cm)	Number of pods per plant	Number of seeds per pod	PL (cm)	100-SW (g)	BY (g)	HI (%)	Chl.-a (mg/g f. w.)	Chl.-b (mg/g f. w.)	Total Chl. (mg/g f. w.)	MSI (%)	RWC (%)	Proline content (mg/g f. w.)	Protein content (%)	Seed yield per plant (g)
Replications	2	E-1	1.181	1.181	23.582	3.971	0.932	0.159	0.249	1.012	18.965	0.027	0.000	0.002	0.847	2.842	0.038	0.081	0.451
		E-2	0.924	0.124	53.779	2.888	0.035	0.001	0.042	5.808	2.747	0.025	0.007	0.085	13.99	29.825	0.122	0.226	2.571
		E-3	0.257	1.324	99.459	17.152	0.067	0.097	0.001	33.731	9.576	0.001	0.007	0.057	17.176	25.926	0.008	0.088	1.619
		E-4	0.01	6.695	34.483	1.783	0.115	0.29	0.0003	8.75	1.911	0.011	0.001	0.073	6.117	44.204	0.043	0.009	0.371
Genotypes	34	E-1	39.002**	36.923**	55.523**	64.146**	2.886**	0.474*	0.464**	65.363**	41.908**	0.087**	0.041**	0.210**	272.093**	106.126**	5.593**	5.286**	8.090**
		E-2	13.760**	14.806**	66.624**	72.707**	0.987**	0.521**	0.651**	39.154**	386.206**	0.115**	0.052**	0.280**	429.956**	69.357**	3.371**	3.115**	17.662**
		E-3	76.080**	73.500**	458.224**	133.081**	1.315**	0.645**	0.474**	254.376**	489.003**	0.116**	0.034**	0.253**	407.701**	107.400**	2.179**	6.805**	28.018**
		E-4	54.296**	54.010**	609.821**	81.301**	1.004**	0.935**	0.486**	670.210**	195.672**	0.108**	0.021**	0.207**	308.498**	175.314**	1.862**	8.044**	14.775**
Error	68	E-1	0.397	1.201	8.73	5.028	0.4	0.292	0.111	2.477	10.375	0.024	0.005	0.039	18.268	4.502	0.101	0.172	0.471
		E-2	0.296	0.82	24.346	9.638	0.461	0.257	0.013	5.705	29.539	0.033	0.008	0.048	27.577	32.539	0.1	0.119	0.886
		E-3	0.277	1.079	52.774	13.584	0.655	0.378	0.001	12.76	21.107	0.049	0.007	0.036	24.234	37.441	0.048	0.04	1.691
		E-4	0.225	1.019	56.752	11.492	0.51	0.379	0.0002	31.51	9.286	0.038	0.004	0.037	35.535	54.65	0.054	0.067	0.84

* and ** represents significant at 5 per cent and 1 per cent level of significance, respectively.

DF= Days to 50 per cent flowering; DM= Days to maturity; PH= Plant height; PL= Pod length; 100-SW = 100-seed weight; BY= Biological yield per plant; HI= Harvest Index; Chl.-a = Chlorophyll-a; Chl.-b = Chlorophyll-b; Total Chl. = Total Chlorophyll content; MSI = Membrane stability index; RWC = Relative water content.

Table 3: Pooled analysis of variance of mungbean genotypes over the environments for agro-morphological and physio-biochemical characters.

Sources of variance	d.f.	Mean sum of squares															
		DF	DM	PH (cm)	Number of pods per plant	Number of seeds per pod	PL (cm)	100-SW (g)	BY (g)	HI (%)	Chl.-a (mg/g f.w.)	Chl.-b (mg/g f.w.)	Total Chl.(mg/g f. w.)	MSI (%)	RWC (%)	Proline content (mg/g f. w.)	Protein content (%)	Seed yield per plant (g)
Replication	8	0.59	2.33*	52.83	6.45	0.29	0.14	0.07*	12.33	8.3	0.02	0.0038	0.05	9.53	25.7	0.05	0.1	1.25
Environment	3	67.63**	53.37**	19506.85**	929.64**	128.92**	11.57**	1.85**	19896.85**	9899.41**	1.28**	0.78**	3.4**	4681.36**	4463.69**	103.6**	89.36**	549.38**
Genotypes	34	93.14**	94.73**	716.84**	120.82**	1.81**	1.67**	1.57**	476.61**	621.74**	0.26**	0.06**	0.53**	513.37**	126.64**	10.23**	20.09**	22.39**
G × E	102	30**	28.17**	157.78**	76.8**	1.46**	0.3	0.17**	184.16**	163.68**	0.06**	0.03**	0.14**	301.63**	110.52**	0.93**	1.05**	15.38**
Error	272	0.32	1.1	37.2	10.13	0.51	0.33	0.03	13.48	17.82	0.04	0.01	0.04	26.68	33.04	0.08	0.1	1.01
SEm (g) +		0.16	0.3	1.76	0.92	0.21	0.17	0.05	1.06	1.22	0.06	0.03	0.06	1.49	1.66	0.08	0.09	0.29
CD (5 %)		0.45	0.84	4.9	2.56	0.57	0.46	0.14	2.95	3.39	0.16	0.08	0.16	4.15	4.62	0.23	0.25	0.81
SEm (gxe) +		0.33	0.61	3.52	1.84	0.41	0.33	0.1	2.12	2.44	0.12	0.06	0.12	2.98	3.32	0.16	0.18	0.58
CD (5 %)		0.91	1.69	9.8	5.12	1.15	0.92	0.28	5.9	6.79	0.32	0.16	0.32	8.3	9.24	0.45	0.51	1.62
CV		1.32	1.44	12.07	12.75	7.6	7.7	4.15	12.34	11.82	9.75	15.52	7.43	9.47	7.95	9.23	1.34	10.76
GM		42.88	72.98	50.54	24.96	9.4	7.46	4.17	29.76	35.73	2.05	0.64	2.69	54.55	72.27	3.07	23.52	9.34

* and ** represents significant at 5 per cent and 1 per cent level of significance, respectively.

DF= Days to 50 per cent flowering; DM= Days to maturity; PH= Plant height; PL= Pod length; 100-SW= 100-seed weight; BY= Biological yield per plant; HI= Harvest index; Chl.-a= Chlorophyll-a; Chl.-b= Chlorophyll-b; Total Chl.= Total chlorophyll content; MSI= Membrane stability index; RWC= Relative water content.

Table 4: Analysis of variance for phenotypic stability in mungbean genotypes for agro-morphological and physio-biochemical characters.

Sources of variance	d.f.	Mean sum of squares																
		DF	DM	PH (cm)	No. of pods per plant	No. of seeds per pod	PL (cm)	100-SW (g)	BY (g)	HI (%)	Chl.-a (mg/g)	Chl.-b (mg/g)	Total Chl. (mg/g)	MSI (%)	RWC (%)	Proline content (mg/g f. w.)	Protein content (%)	Seed yield per plant (g)
Genotypes	34	31.05**	31.58**	238.95**	40.27*	0.6	0.56**	0.52**	158.87**	207.2472**	0.09**	0.02**	0.18**	171.12**	42.21	3.41**	6.7**	7.46*
Environment	3	22.54	17.79	6502.28**	309.88**	42.97**	3.86**	0.62**	6632.28**	3299.8**	0.43**	0.26**	1.13**	1560.45**	1487.9**	34.53**	29.79**	183.13**
Env. + (G × E)	105	10.36	9.63	236.87**	33.72**	1.7**	0.21**	0.07	249.13**	147.28**	0.03**	0.02**	0.08	142.25*	78.3**	1.29**	1.19**	10.21**
Env. (linear)	1	67.63*	53.37*	19506.85**	929.64**	128.92**	11.57**	1.86**	19896.85**	9899.4**	1.29**	0.77**	3.4**	4681.36**	4463.69**	103.6**	89.36**	549.38**
G × E (linear)	34	5.85	5.34	127.37**	38.5**	0.71*	0.1	0.037	139.49**	49.2196	0.03**	0	0.03	107.46	35.61	0.49**	0.64**	6.08
Pooled deviations	70	11.73	11.09	14.77	18.6	0.37	0.1	0.0636	21.7	55.6	0.01	0.01	0.06	94.31	36.39	0.21	0.2	4.52
Pooled error	280	0.11	0.37	12.4	3.38	0.17	0.11	0.01	4.49	5.94	0.01	0.0033	0.01	8.89	11.01	0.03	0.03	0.34

* and ** represents significant at 5 per cent and 1 per cent level of significance, respectively.

DF= Days to 50 per cent flowering; DM= Days to maturity; PH= Plant height; PL= Pod length; 100-SW = 100-seed weight; BY= Biological yield per plant; HI= Harvest Index; Chl.-a = Chlorophyll-a; Chl.-b = Chlorophyll-b; Total Chl. = Total Chlorophyll content; MSI = Membrane stability index; RWC = Relative water content.

These results are accordance with the earlier finding of Singh *et al*. (2009), Kuchanur *et al*. (2018) and Baraki *et al*. (2020) in mungbean.

On the basis of mean performance over environments, highest seed yield was observed in GM 4 followed by RMG 344, RMG 62, IC 39492, SML 832, Keshwanand Mung 1, MUM 2, IC 39269, IC 102821, IC 102857, MH 2-15, Samrat, IC 103059 and IC 39328 (Table 5). 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 arid zone as well as in future breeding programme to develop superior varieties. Similar findings were earlier reported by Kuchanur *et al*. (2018); Baraki *et al*. (2020) and Samyuktha *et al*. (2020) in mungbean.

In current study, genotype IC-39269 exhibited stable performance for number of seeds per pod, biological yield and harvest index in all four environments; whereas, IPM 02-3, MH 2-15 and RMG-344 were found stable for seed yield under favourable environment *i.e*. *Kharif* season; and genotype IC 103059 for stressed environment *i.e*. summer season (Table 6). None of the genotype was found stable for wider adaptability for seed yield; whereas, genotype IC-39269 was found stable for number of seeds per pod, biological yield and harvest index. All these traits were also positively correlated and directly contributed towards seed

Table 5: Mean performance of mungbean genotypes for seed yield per plant over environments.

Name of genotype	Seed yield per plant (g)				
	Env.-A	Env.-B	Env.-C	Env.-D	Pooled
IC-39269	5.47	7.70	14.94	13.65	10.44
IC-39300	4.00	6.67	11.17	9.60	7.86
IC-39328	5.47	8.28	13.96	9.73	9.36
IC-39352	6.20	5.87	13.30	8.53	8.47
IC-39399	5.80	7.60	9.91	10.77	8.52
IC-39409	5.67	7.63	10.11	9.87	8.32
IC-39454	5.73	6.13	10.91	10.67	8.36
IC-39492	9.93	6.13	13.27	16.10	11.36
IC-39608	7.73	5.73	7.16	11.00	7.91
IC-39610	8.07	5.73	8.21	10.00	8.00
IC-52076	5.40	8.67	7.52	8.00	7.40
IC-52081	6.07	9.36	8.69	8.00	8.03
IC-52082	7.00	8.80	7.73	11.00	8.63
IC-52087	8.67	8.53	8.06	10.13	8.85
IC-102792	7.47	6.67	9.83	10.00	8.49
IC-102821	4.67	10.26	11.17	15.00	10.28
IC-102857	7.27	9.86	9.33	14.00	10.11
IC-103014	6.87	10.33	9.85	10.00	9.26
IC-103059	9.33	8.40	9.97	10.00	9.43
IC-103244	6.40	6.27	8.37	6.93	6.99
IC-338868	11.67	6.27	8.43	10.00	9.09
Sweta	6.20	8.80	7.06	11.00	8.26
IPM-02-3	4.60	9.59	12.37	11.00	9.39
IPM-02-14	4.53	10.46	12.54	8.00	8.88
Samrat (PDM-139)	4.87	9.66	15.21	9.07	9.70
GM-4	5.47	13.89	19.22	14.00	13.15
MH 2-15	5.60	9.41	12.87	11.00	9.72
MH-421	4.67	11.42	10.98	8.93	9.00
RMG-62	6.53	14.59	12.72	11.73	11.39
RMG-344	6.40	11.13	15.76	15.00	12.07
Keshwanand Mung-1	6.93	6.67	17.44	11.73	10.69
SML-668	5.07	9.32	10.87	9.33	8.65
SML-832	5.87	14.61	14.44	9.60	11.13
Ganga-1	6.73	5.47	15.11	9.20	9.13
MUM-2	5.13	9.39	13.23	14.00	10.44
Overall mean	6.38	8.72	11.48	10.76	9.34
Range	4.00-11.67	5.47-14.61	7.06-19.22	6.93-16.10	6.99-13.15

Table 6: Adaptability of mungbean genotypes for different environmental situation (ranked on the basis of mean).

Name of character	Genotypes suitable for different environments		
	High mean, average response (bi=1), suitable for wide adaptation for all environments	High mean, above average response (bi>1), suitable for better environment	High mean, below average response (bi<1), suitable for poor environment
Days to 50 per cent flowering	-	-	-
Days to maturity	-	Sweta, IC-39492	RMG-344
Plant height (cm)	IC-103014, IC-39409 and Keshwanand Mung-1	IC-39269, IC-338868, IC-39399, IC-102821, IC-39300, IC-102857, IC-103059, IC-39608, IC-102792, IC103244, IC-39454, IC-39610, IC-52082 and IC-39328	IC-39492
Number of pods per plant	-	RMG-344, IC-39328, GM-4 and MH 2-15,	-
Number of seeds per pod	IC-102792, SML-832, IC-39269, GM-4 and IC-39610	Keshwanand Mung-1, IC-103014 and IC-39608	IC-39409, IC-52082, SML-668, RMG-62 and MH- 2-15
Pod length (cm)	SML-832 and IC-52081	GM-4, IPM-02-14, Samrat, IC-103244 and IC-39492	IC-39409, MH-421, IC-52087, SML-668 and IC-39610
100-seed weight (g)	-	SML-668, SML-832 and IC-103059	IC-39492 and IC-39409
Biological yield per plant (g)	RMG-344, IC-103244 and IC-39269	IC-102792, IC-39399, IC-102857, IC-39454 and IC-39409	-
Harvest index (%)	IC-39269	-	-
Chlorophyll-a (mg/g f. w.)	IC-102821, IC-39300, IC-39328, SML-668 and IC-52076,	IC-103059, IC-39409, MH-421, IC-39492, MH 2-15, IC-39399 and IC-39608	Samrat , IC-103244, IC-52082 and Ganga-1
Chlorophyll-b (mg/g f. w.)	Ganga-1, IC-39300, IC-39328, Samrat, IC-52076, IC-52081, MH-421, IC-39492, IC-103244, SML-668, IC-39352 and IC-39399	-	-
Total chlorophyll (mg/g f. w.)	MH-421, IC-39300, IC-39328, Samrat, IC-103244, IC-52076, SML-668 and Ganga-1	IC-39492	IC-102821
Membrane stability index (%)	IC-39492 and IC-39610	IC-39328, IC-103014 IPM-02-3 and IC-39409	Sweta , IPM-02-14, IC-338868, IC-39454 and IC-103059

Table 6: Continue...

Table 6: Continue...

Relative water content (%)	IC-52082, IC-102792, IC-102821, RMG-62, IC-39328, IC-52081 and RMG-344	SML-832, IC-52076, Keshwanand Mung-1 and MUM-2	GM-4, MH-421, IC-39300 and IC-39352
Proline content (mg/g)	GM-4 and IPM-02-14	SML-668	
Crude protein content (%)	-	IC-52076, IC-52082, IC-102857, Ganga-1, IC-103244, IC-52081, IC-103014, IC-39608, IC-39610, IPM-02-14 and IC-102792	-
Seed yield per plant (g)	-	RMG-344, MH 2-15 and IPM-02-3	IC-103059

yield. Therefore, genotype IC-39269 may indirectly be considered as stable genotype for wider adaptability for seed yield also. The genotypes exhibited stable performance under favourable environment *i.e*. *Kharif* season were Sweta and IC-39492 for days to maturity; RMG-344, IC-39328, GM-4 and MH 2-15 for number of pods per plant; IC-102792, IC-39399, IC-102857, IC-39454 and IC-39409 for biological yield; whereas, variety RMG-344 for days to maturity; SML-668 for number of seed per pod and pod length; IC-39409 for number of seed per pod and 100-seed weight were found stable for stressed environment *i.e*. summer season. Seed yield potential obtained under different environments indicate that early sowing in *Kharif i.e*. July 6th was most appropriate sowing time to achieve the highest seed yield of mungbean. The results confirmed the findings of Raje and Rao (2004), Nath (2012), Win *et al*. (2018), Wankhede and Najan (2019) and Samyuktha *et al*. (2020) in mungbean.

CONCLUSION

Pulses are an integral part of human diet part to fulfill the nutritional significance of vegetarians. Looking the significance and increasing demand of pulses for human consumption, International Pulse Day is celebrated on 10th February ever year to invite attention of researchers, policy planners, consumers and industry towards pulses. Mungbean is one of the widely adapted and high potential pulse crop largely cultivated in arid and semi-arid areas. Results revealed that Mungbean genotypes used in the investigation are of diverse nature. On the basis of mean performance over environments, genotypes namely; GM 4, RMG 344, RMG 62, IC 39492, SML 832, Keshwanand Mung 1, MUM 2, IC 39269, IC 102821, IC 102857, MH 2-15, Samrat, IC 103059 and IC 39328 performed relatively better and provided higher seed yield. Therefore, the potential of these genotypes may be explored for mungbean improvement programme besides their commercial cultivation. Seed yield potential obtained under different environments indicates that first week of July was most appropriate sowing time to achieve the highest seed yield of mungbean.

Conflict of interest

All authors declared that there is no conflict of interest.

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