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Assessment of Genetic Variability for Agro-economic Traits in Green Gram

Devendra Chandel, Sundar Anchra*, Anil Kumar, Ravindra Kumar, Hukam Singh Kothyari and N.K.Sharma

College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan), 334006

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Abstract: Eighty three genotypes of mung bean were assessed for genetic variability and agro-economic traits during summer-2018. These genotypes exhibited significant differences for all the 11 characters studied. Six genotypes namely ML-818, Keshwanand Mung-1, GM-4, MH-2-15, IPM-02-3 and COGG-912 were identified to possess the desirable traits. Highest values of GCV and PCV was recorded for number of branches per plant whereas their lowest values were recorded for pod length, number of seeds per pod and days to maturity. A high degree of genetic variability along with high heritability and high genetic advance as percentage of mean were recorded for days to 50% flowering, number of pods per plant, 100-seed weight and biological yield per plant. This indicates that these characters are controlled by additive gene action and can therefore serve as a basis for selection in improvement programs. The presence of ample genetic diversity in the germplasm suggests that these varieties can be used in recombination breeding programs to develop high-yielding varieties for the arid zone.

Key words: Genetic variability, green gram, gene action, germplasm, heritability.

Correspondence
Sundar Anchra
sundaranchra@gmail.com

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Green gram (*Vigna radiata* L.) is a typically warm season crop requiring 60 to 65 days from sowing to maturity (depending on the variety). The optimum temperature range for growth is between 27°C and 40°C. However, this crop can tolerate still higher temperatures and thus can successfully be grown during summer. It is considered to be heat and drought tolerant. Green gram is responsive to day length. Short days result in early flowering, while long days result in late flowering. Different green gram varieties vary in their photoperiod response. Green gram does best on fertile sandy loam soils with good internal drainage and a pH in the range of 6.3 and 7.2. It requires slightly acidic soil for best growth. It does not tolerate salinity and can show severe iron chlorosis symptoms and certain micronutrient deficiencies on more alkaline soils. Root growth can be restricted to heavy clays (Gupta and Pratap *et al.*, 2016). It is an ancient crop cultivated in Rajasthan, which covers the largest area (>21 lakh hectare) under green gram cultivation in India. In the Rajasthan state, the total area sown under green gram crop is 21.20 lakh hectare with the grain production of 10.49 lakh tons and the average productivity of 495 kg

ha^{-1}. The major green gram growing districts of Rajasthan are Nagaur, Pali, Jodhpur, Jalor, Ajmer, Jaipur and Tonk (Anonymous, 2017-18). Green gram is grown in arid and semi-arid regions. It is drought tolerant and has ability to grow under harsh climate and medium to low rainfall situation. It is tolerant to moisture stress and heat as well. It has ability to grow 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 best for green gram cultivation. Water logged and saline soils are not suitable for green gram cultivation (Sharma, 2016).

Genetic variability and their quantification for qualitative and quantitative characters of economic importance are prerequisites for any crop improvement program. Hence, the knowledge of variability, heritability and genetic advance become important for an efficient plant breeding program. The knowledge of heritability coupled with genetic advance is useful in selecting breeding program to find out guidelines for a better selection of quantitative traits in green gram. Being highly self-pollinated crop, natural variability for yield and yield related traits is very narrow in green gram 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 the better genotypes for improvement. 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 (Degafa *et al.*, 2014). The present research study was conducted to evaluate the degree of genetic variability in green gram genotypes for developing high yielding varieties in breeding program.

Materials and Methods

The present investigation was conducted during the summer of 2018 in sandy soils of the Landscape Cell Nursery at Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan. The experimental site is located at 28.010°N latitude and 73.220°E longitude, with an altitude of 234.70 meters. The climate was hot arid with average annual rainfall of about 265 mm. During summer, the maximum temperature may go as high as 48°C; while in winter it may fall as low as 0°C. The experimental material consisting of 83 genotypes procured from NBPGR, Regional Station, Jodhpur; Rajasthan Agricultural Research Institute, Durgapura, Jaipur; Agricultural Research Station, Sriganganagar and Agricultural Research Station, Mandor, Jodhpur. The genotypes were evaluated in randomized block design with three replications consisting of two 3-meter-long rows spaced 30 cm apart per replication under sprinkler irrigated situation. Pre-sowing sprinkler irrigation was done on March 12, 2018. The seed of green gram genotypes was sown @ 15 kg seed ha^{-1} at the depth of about 2-3 cm on March 13, 2018 manually in the furrows opened by hand drawn seed drill. After sowing one light irrigation was applied through sprinkler to ensure proper germination. Hand weeding was done at 20 and 40 days after sowing (DAS) with the help of hand hoe to keep the field weed free. Crop was managed under irrigated situation to ensure crop survival and seed set. Foliar sprays of imidachloprid @ 20 ml 15 L^{-1} was applied for pest management and copper oxychloride @ 2-3 gL^{-1} was used against bacterial disease. The observations were recorded on individual plant basis on five randomly selected plants from each genotype of each replication for 11 characters viz., days to 50% flowering, days to maturity, plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, pod length, 100-seed weight, biological yield $plant^{-1}$, seed yield $plant^{-1}$and harvest index were recorded during period of research study. Analysis of variance was carried out as per Panse and Sukhatme (1985) and heritability in broad sense was calculated according to the following formula suggested by Burton and Devane (1953).

Result and Discussion

The values of different traits are presented in Table 1 and 2. The data showed significant differences for all characters under study among the 83 genotypes both at 1% and 5% level of significance indicating the presence of sufficient variability among different genotype. The seed yield is the most important economic trait which is directly and indirectly governed by the number of other component traits of the plant. The differences among genotypes of green gram for seed yield per plant were

Table 1. Analysis of variance for different characters of green gram

Source of variation	DF	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)
Replication	2	4.16	2.94	5.17	0.09	2.20	0.13	0.23	0.02	3.67	5.24	0.46
Genotypes	82	90.63**	98.26**	33.02**	0.56**	17.13**	1.60**	0.48*	0.87**	7.29**	43.54**	4.52**
Error	164	1.56	1.30	7.41	0.08	1.40	0.38	0.32	0.01	1.31	22.70	1.44

*Significant at P = 0.05; ** Significant at P = 0.01.

Table 2. Estimates of genetic variability parameters for different characters of green gram

Characters	Range	Mean	GCV	PCV	Heritability (%)	Genetic advance	GA as per cent of mean
Days to 50% flowering	23 – 38	32.31	16.87	17.31	95.0	10.94	33.88
Days to maturity	64 – 80	73.69	7.71	7.86	96.1	11.48	15.58
Plant height (cm)	17 – 33	26.75	10.92	14.92	53.5	4.40	16.46
Number of branches per plant	1.20 - 2.80	1.90	21.02	25.99	65.4	0.66	35.02
Number of pods per plant	15.27 - 26.44	19.06	12.01	13.53	78.9	4.18	21.98
Number of seeds per pod	7.77- 11.37	9.67	6.60	9.20	51.4	0.94	9.75
Pod length (cm)	5.72- 8.09	7.01	3.20	8.77	14.0	0.17	2.52
100-seed weight (g)	2.42 - 4.95	3.51	15.20	15.71	93.7	1.06	30.32
Biological yield per plant (g)	9.42 - 15.59	11.90	11.85	15.28	60.2	2.25	18.95
Harvest Index (%)	27.54 - 48.62	36.99	7.12	14.72	23.4	2.62	7.10
Seed yield per plant (g)	5.10 - 11.44	7.02	14.43	22.39	41.5	1.34	19.15

found statistically significant. Seed yield per plant ranged from 5.10 to 11.99 g with the overall mean of 9.07 g. Coefficient of variance for this trait was found to be 17.12%. The highest seed yield per plant was recorded in genotype Ganga-1 followed by MUM-2, COGG-912, Keshwanand Mung-1, RMG-268, GM-4, MH 2-15, RMG-492, RMG-344 and SML-832 while the lowest seed yield per plant was found in IC-39515. The highest genotypic coefficient of variation in green gram germplasm was recorded for number of branches plant^{-1} (21.02) followed by days to 50% flowering (16.87), 100-seed weight (15.20), seed yield plant^{-1} (14.43), number of pods plant^{-1} (12.01), biological yield plant^{-1} (11.85), plant height (10.92), days to maturity (7.71), harvest index (7.12) and number of seeds pod^{-1} (6.60) whereas the lowest genotypic coefficient of variation was recorded for pod length (3.20). The highest phenotypic coefficient of variation was also recorded for number of branches plant^{-1} (25.99) followed by seed yield plant^{-1} (22.39), days to 50% flowering (17.31), 100-seed weight (15.71), biological yield plant^{-1} (15.28), plant height (14.92), harvest index (14.72), number of pods plant^{-1} (13.53), number of seeds pod^{-1} (9.20) and pod length (8.77); while the lowest phenotypic coefficient of variation was recorded for days to maturity (7.86). The highest value of heritability was observed for days to maturity (96.1%) followed by days to 50% flowering (95.0%), 100-seed weight (93.7%), number of pod plant^{-1} (78.9%), number of branches plant^{-1} (65.4%), biological yield plant^{-1} (60.2%), plant height (53.5%), number of seed pod^{-1} (51.4%), seed yield plant^{-1} (41.5%) and harvest index (23.4%); whereas the lowest value of heritability was observed for number of pod length (14.0%). The highest genetic advance as per cent of mean was recorded for number of branches per plant (35.02%) followed by days to 50% flowering (33.88%), 100-seed weight (30.25%), number of pods plant^{-1} (21.98%), seed yield per plant (19.15%), number of pods plant^{-1} (18.95%), plant height (16.46%), days to maturity (15.58%), number of seed per pod (9.75%) and harvest index (7.10 %); while pod length (2.52%) exhibited the lowest genetic advance as per cent of mean.

Reddy *et al.* (2003) studied thirty-six genotypes of green gram for genetic variability in seed yield and its contributing characters. High magnitude of variability was observed for pods per plant, grain yield per plant; while moderate variability was recorded for pods per cluster, clusters per plant, plant height and days to 50% flowering suggesting the possibility of their improvement by selection. Eswari and Rao (2006) evaluated thirteen

green gram varieties selected from different locations in Andra Pradesh for seed yield and its component traits during Kharif, 2000-01 to 2002-03.

Considerable amount of phenotypic and genotypic variability was observed for seed yield per plant and pods per plant. Kumhar and Chaudhary (2007) evaluated fifty two genotypes of green gram [*Vigna radiata* (L.) Wilczek)] during rainy season of 2005 at Agricultural Research Station, Mandor, Jodhpur for eight characters to estimate variability, heritability and genetic advance as percentage of mean in which characters like seed yield plant^{-1}, pods plant^{-1}, primary branches plant^{-1}, 100-seed weight and pod length exhibited high variability. Jyothsna and Anuradha (2013) studied genetic variability, heritability, genetic advance, correlation, path analysis in 50 genotypes of green gram during Rabi 2012-2013.

The genotypic coefficients of variation for all the characters were lesser than the phenotypic coefficients of variation indicating the modifying effects of environment on the expression of the characters. High PCV and GCV estimates were observed for number of pods per plant and seed yield per plant. Bisht *et al.* (2014) studied the PCV, GCV, heritability, genetic advance and correlation coefficient analysis for eight quantitative characters in 20 green gram genotypes and one black gram genotypes of intra and inter-specific origin. The genotypes differed significantly for all the characters studied. Phenotypic coefficients of variation were higher than genotypic coefficients of variation for all the characters studied. Higher GCV and PCV values were obtained for seed yield per plant, 100-seed weight and number of pods per plant. Pulagampalli and Lavanya (2017) evaluated 22 green gram genotypes along with one check (SAMRAT). Analysis of variance showed highly significant differences among 22 green gram genotypes for 12 quantitative characters studied. Maximum genotypic and phenotypic variance was recorded for pods per plant and harvest index. Rasal and Parhe (2017) studied 50 green gram genotypes for genetic variability and reported high magnitude of GCV and PCV were recorded for number of clusters per plant plant, seed yield per plant plant and number of pods per plant; while moderate amount was found for plant height and 100-seed weight. Sharma *et al.* (2017) validated eight green gram varieties under rainfed and irrigated situations at farmer's fields in the arid zone of Rajasthan. A wide range of variation among green gram varieties for seed yield has been observed under both rainfed (292 to 515 q ha^{-1}) and irrigated (591 to 885 q ha^{-1}) situations. Varieties GM-4, MH-421, SML-668, RMG-492 and IPM 2-3 performed relatively better in both the situations.

Conclusion

The research data obtained from this investigation revealed that the ML-818, Keshwanand Mung-1, GM-4, MH-2-15, IPM-02-3 and COGG-912 were found as desirable genotypes for higher yield and other desirable traits, the maximum GCV and PCV was recorded for number of branches per plant whereas the low GCV and PCV values of variances were recorded for pod length, number of seeds per pod and days to maturity, respectively in green gram germplasm. The maximum magnitude of heritability has been observed for days to 50% flowering followed by number of branches per plant and days to maturity. Thus, these varieties could be used for summer season cultivation under irrigated situation as well as in green gram recombination breeding program to develop high yielding varieties for the arid zone.

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