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 percent 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 was 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], Bhutia 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) [9], Tiwari et al. (2014) [12], Bhutia et al. (2016) [11] 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 |
|-------|-------------------|--------------------|-----------------------|
| 1     | IC-39269          | 1993               | Jodhpur, Rajasthan    |
| 2     | IC-39275          | 1993               | Kherana, 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               | Nibadi, 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 |
| No. | Variety | Year | Source |
|-----|---------|------|--------|
| 18  | IC-39427 | 1993 | Harij, Patan, Gujarat |
| 19  | IC-39451 | 1988 | Lakhtatar, 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, Rajasthan, 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 | Dhub, Chittorgarh, Rajasthan |
| 48  | IC-103244 | 1986 | Bhrwas, Didwana, Nagaur, Raj. |
| 49  | IC-103245 | 1987 | Odda, Banswara, Rajasthan |
| 50  | IC-103785 | 1989 | Khemlo, Vishansa, Rajasthan |
| 51  | IC-103821 | 1989 | Nagdhin, Santrumpur, Gujarat |
| 52  | IC-103973 | 1989 | Barvalbhipor, Bhavnagar, Gujarat |
| 53  | IC-324012 | - | * |
| 54  | IC-338868 | 1990 | Sanari, Barmer, Rajasthan |

**Varieties procured from Agriculture University, Jodhpur**

| No. | Variety | Year | Source |
|-----|---------|------|--------|
| 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, Pulse Res. Station, Vadodara |
| 66  | COGG-912 |  | TNAU, Coimbatore |

**Varieties procured from RARI, Durgapura, Jaipur**

| No. | Variety | Year | Source |
|-----|---------|------|--------|
| 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**

| No. | Variety | Year | Source |
|-----|---------|------|--------|
| 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    | 8.88    | 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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