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# Assessment of Variability Parameters under Moisture Stress Condition in Mungbean (*Vigna radiata* (L.) Wilczek)

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**ABSTRACT**

Mungbean is an important crop to meet the challenges of food and nutritional security due to its nature of high protein and other micronutrients. To exploit the maximum yield potential of this crop, drought is considered as one of the most important constraint. Hence, an investigation was undertaken to estimate the genetic parameters on various yield, yield contributing traits and physiological parameters with 31 mungbean genotypes under moisture stress induced during pod filling stage for fifteen days. The results indicated that, based on mean performance for yield and its contributing characters, the genotypes VG-6197A, RMG-492 and LGG 450 were found to be good under simulated moisture stress condition. In the present investigation, high heritability coupled with high genetic advance as per cent of mean was recorded for relative injury, number of pods per cluster, seed yield per plant, chlorophyll content, 100-seed weight, number of pods per plant, plant height, number of clusters per plant, number of seeds per pod, harvest index and SLA indicating that these traits may be improved through simple selection methods.

**Key words :** Genetic advance as percent of mean, Heritability, Mungbean, Physiological traits.

Mungbean (*Vigna radiata* (L.) Wilczek) is an important pulse crop and cultivated in tropical, subtropical and temperate zones of Asia. It is a short duration crop (60-75 days) and grown as sole as well as inter and multiple cropping systems and it improves the nutrient status of soil through atmospheric nitrogen fixation and adds humus to the soil. Mungbean is a source of digestible protein and average protein content in the seeds is around 24% which is three times that of cereal based diets.

Despite, its suitability to various niches and different cropping systems, the production potential of this crop is being hampered by abiotic stress like drought, which effects the yield drastically. Many breeding programmes have been initiated to develop drought tolerant/ resistant varieties in mungbean, however the progress is not significant as the drought is a complex phenomenon and always coupled with moisture and high temperature stresses. Mungbean is sensitive to moisture stress during critical stages like flowering and pod filling. Therefore systematic efforts are needed to breed the cultivars by thorough understanding of the mechanisms of drought at various developmental, physiological, biochemical and molecular levels.

Genetic variability in any crop is pre-requisite for selection of superior genotypes over the existing cultivars. The amount of genetic variation considered alone will not be of much use to the breeder unless supplemented with the information on heritability estimate, which gives a measure of the heritable portion of the total variation. The heritability estimates in conjunction with genetic advance will be more effective and reliable in predicting the response to selection (Johnson *et al*., 1955).

In order to reach this goal, this study was conducted to assess the genetic variability with the help of suitable parameters like genotypic and phenotypic coefficient of variation, heritability and genetic advance and to give an idea of the possible improvement of the character through selection.

## MATERIAL AND METHODS

The material consisted of thirty one mungbean diversed genotypes selected from various parts of the country. All these thirty one genotypes were grown at S.V. Agricultural College, Tirupathi during summer 2013 in RBD with three replications and spacing of 30 cm between rows and 15 cm between plants. Five plants were selected at random from each replication and data were recorded for plant height, number of clusters per plant, number of pods per cluster, number of

Table 1. Analysis of variance for fifteen quantitative characters in mungbean under moisture stress condition.

| Sl. No. | Characters | Mean sum of squares | | |
|---|---|---|---|---|
| | | Replications (df: 2) | Treatments (df: 30) | Error (df: 60) |
| 1. | Days to 50% flowering | 0.139 | 6.096** | 0.273 |
| 2. | Plant height (cm) | 0.677 | 7.966** | 1.199 |
| 3. | Days to maturity | 0.050 | 176.307** | 0.052 |
| 4. | No. of clusters/ plant | 0.903 | 2.548** | 0.503 |
| 5. | No. of pods/ cluster | 0.003 | 1.771** | 0.001 |
| 6. | No. of pods/ plant | 2.462 | 14.687** | 0.840 |
| 7. | No. of seeds/ pod | 0.139 | 2.404** | 0.106 |
| 8. | 100 seed weight (g) | 0.001 | 1.242** | 0.002 |
| 9. | Harvest index (%) | 0.643 | 56.109** | 0.784 |
| 10. | SCMR(SPAD Chlorophyll Meter Reading) | 1.747 | 22.032** | 2.175 |
| 11. | Relative water content (%) | 1.480 | 10.333** | 1.582 |
| 12. | Relative injury (%) | 4.185 | 81.910** | 1.488 |
| 13. | Chlorophyll content | 0.028 | 0.383** | 0.011 |
| 14. | Specific leaf area ($cm^2$ $g^{-1}$) | 20.577 | 696.081** | 21.555 |
| 15. | Seed yield (g) | 0.003 | 2.176** | 0.005 |

* Significant at 5% level; ** Significant at 1 % level

pods per plant, number of seeds per pod, hundred seed weight, harvest index, SPAD Chlorophyll Meter Reading (SCMR), Relative Water Content (RWC), Relative Injury percentage (RI), Chlorophyll Content and Specific Leaf Area (SLA). Whereas, the data on days to 50% flowering and days to maturity were recorded on plot basis. In this study, to create a moisture stress, irrigation was withhold fifteen days during pod filling stage in order to predict the effect of terminal stress on mungbean crop. The differences between 31 genotypes for different characters were tested for significance by using analysis of variance technique on the basis of the model proposed by Panse and Sukhatme (1961). The data were statistically analysed to estimate genotypic and phenotypic coefficient of variance (Burton, 1952), heritability (Lush, 1940) and the genetic advance (Johnson *et al.* 1955).

**RESULTS AND DISCUSSION**

The analysis of variance indicated significant differences among the genotypes for all the characters (Table. 1). The present study revealed that genotype VG-6197A recorded high seed yield coupled with high SCMR and Chlorophyll content values (Table. 2). Similarly, the genotype RMG-492 also recorded high yield coupled with higher RWC and low RI values when compared to other genotypes. Hence these genotypes could be exploited in the breeding programme to develop drought tolerant lines coupled with high yield.

In the present study, the estimates of PCV for all the characters were slightly higher than the estimates of GCV, which may be due to the interaction of genotypes with the environment (Table. 3). The characters, Relative injury (GCV: 35.56%; PCV: 35.89%), number of pods per cluster (GCV: 26.90%; PCV: 26.91%), seed yield per plant (GCV: 23.68%; PCV: 23.71%), Chlorophyll content (GCV: 20.83%; PCV: 21.16%), number of pods per plant (GCV: 20.84%; PCV: 21.46%) and plant height (GCV: 20.63%; PCV: 20.64%) showed higher estimates of genotypic and phenotypic coefficient of variation indicating the presence of ample variation among the genotypes for these

Table 2. Mean performance of thirty one genotypes of mungbean for fifteen quantitative characters under moisture stress condition.

| Sl. No. | Genotype | Days to 50% flowering | Days to maturity | Plant height (cm) | No. of clusters/ plant | No. of pods/ cluster | No. of pods/ plant | No. of Seeds/ pod | 100 seed weight (g) | Harvest Index (%) | SCMR | RWC (%) | Relative injury (%) | Chlorophyll content | Specific leaf area ($cm^2 g^{-1}$) | Seed yield/ plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | AKM 9904 | 42.67 | 66.67 | 34.14 | 4.67 | 2.13 | 12.33 | 7.00 | 3.39 | 22.34 | 39.64 | 73.76 | 10.03 | 1.56 | 75.05 | 3.47 |
| 2. | ASHA | 42.33 | 63.00 | 33.69 | 3.67 | 3.23 | 11.00 | 7.67 | 3.28 | 22.58 | 46.78 | 70.07 | 11.94 | 1.64 | 127.56 | 3.27 |
| 3. | COGG 974 | 43.33 | 66.00 | 40.26 | 5.33 | 2.64 | 10.67 | 8.33 | 3.15 | 18.66 | 42.23 | 72.59 | 16.58 | 2.14 | 100.43 | 3.61 |
| 4. | EC- 396117 | 39.67 | 62.00 | 30.10 | 5.67 | 2.74 | 10.00 | 10.67 | 4.56 | 25.14 | 43.94 | 75.32 | 16.43 | 2.20 | 106.89 | 4.17 |
| 5. | GVIT-203 | 41.67 | 65.00 | 51.52 | 3.67 | 4.06 | 10.33 | 9.00 | 3.06 | 33.27 | 49.13 | 76.57 | 14.26 | 1.51 | 115.65 | 3.19 |
| 6. | IPM-02-03 | 39.67 | 63.33 | 29.39 | 4.00 | 2.04 | 8.67 | 8.00 | 3.68 | 20.79 | 44.60 | 75.17 | 13.64 | 1.63 | 99.49 | 2.04 |
| 7. | IPM-02-19 | 40.33 | 63.00 | 34.37 | 4.00 | 2.58 | 11.00 | 9.00 | 3.72 | 25.41 | 44.67 | 71.32 | 19.84 | 1.33 | 107.70 | 4.07 |
| 8. | KM-8-657 | 41.33 | 64.00 | 41.44 | 5.00 | 3.85 | 8.67 | 8.00 | 3.52 | 19.58 | 48.90 | 70.95 | 8.48 | 1.07 | 109.13 | 2.11 |
| 9. | KM-122 | 40.67 | 63.67 | 37.33 | 4.00 | 2.18 | 9.67 | 9.00 | 4.25 | 21.40 | 43.27 | 72.54 | 12.18 | 1.95 | 102.76 | 2.98 |
| 10. | LGG 407 | 42.33 | 67.00 | 29.85 | 4.33 | 3.54 | 11.67 | 8.00 | 2.67 | 24.34 | 42.70 | 75.13 | 12.55 | 1.76 | 108.55 | 2.57 |
| 11. | LGG 410 | 44.00 | 66.00 | 43.35 | 5.33 | 2.38 | 10.33 | 8.00 | 3.25 | 18.81 | 41.93 | 74.57 | 18.91 | 2.19 | 124.77 | 4.05 |
| 12. | LGG 450 | 43.33 | 67.33 | 46.63 | 6.33 | 4.27 | 9.67 | 8.00 | 3.06 | 28.00 | 42.97 | 72.51 | 21.13 | 1.67 | 92.19 | 5.03 |
| 13. | LGG 460 | 44.33 | 67.00 | 39.46 | 4.67 | 2.09 | 8.33 | 9.00 | 2.62 | 23.64 | 41.27 | 72.30 | 19.36 | 2.12 | 84.13 | 3.69 |
| 14. | LGG 528 | 41.33 | 65.00 | 39.00 | 5.00 | 2.35 | 9.67 | 7.33 | 2.75 | 23.45 | 41.37 | 73.62 | 11.56 | 2.24 | 123.58 | 2.55 |
| 15. | MGG295 | 43.33 | 65.00 | 47.53 | 3.67 | 2.11 | 10.33 | 8.00 | 3.31 | 33.17 | 40.35 | 71.59 | 19.44 | 1.09 | 110.67 | 4.31 |
| 16. | MGG347 | 42.67 | 67.33 | 49.49 | 5.67 | 3.13 | 8.67 | 7.67 | 3.22 | 27.37 | 40.20 | 76.43 | 33.33 | 1.87 | 64.88 | 4.27 |
| 17. | MGG350 | 42.33 | 65.00 | 44.26 | 7.33 | 3.34 | 13.33 | 6.00 | 3.15 | 23.13 | 41.27 | 75.55 | 11.77 | 1.55 | 83.81 | 4.02 |
| 18. | MH-3-18 | 40.00 | 62.67 | 25.07 | 4.33 | 2.24 | 8.33 | 7.00 | 3.46 | 21.02 | 43.54 | 72.51 | 21.74 | 1.37 | 91.31 | 2.97 |
| 19. | MH-565 | 40.00 | 62.67 | 28.09 | 4.00 | 2.92 | 9.00 | 8.33 | 3.20 | 29.16 | 45.50 | 75.18 | 8.58 | 1.75 | 91.50 | 3.62 |
| 20. | ML145 | 40.67 | 64.67 | 24.09 | 6.00 | 3.93 | 9.33 | 7.67 | 4.16 | 26.48 | 46.00 | 75.83 | 10.87 | 2.02 | 123.22 | 3.74 |
| 21. | ML-267 | 40.67 | 64.00 | 42.41 | 3.67 | 1.81 | 7.67 | 10.00 | 2.74 | 24.05 | 39.55 | 71.39 | 11.93 | 1.93 | 109.10 | 4.52 |
| 22. | PM110 | 42.33 | 65.33 | 31.25 | 4.00 | 1.91 | 9.33 | 8.00 | 3.94 | 25.59 | 41.03 | 74.30 | 10.08 | 1.95 | 96.78 | 4.37 |
| 23. | PUSA 9531 | 43.67 | 64.33 | 38.44 | 5.67 | 1.96 | 9.67 | 8.00 | 3.14 | 15.41 | 40.77 | 70.38 | 13.94 | 1.14 | 100.99 | 2.57 |
| 24. | PUSA VISHAL | 40.00 | 62.67 | 45.51 | 5.00 | 4.36 | 12.33 | 8.00 | 3.62 | 27.17 | 37.94 | 74.77 | 9.58 | 1.70 | 86.32 | 3.06 |
| 25. | RMG 492 | 40.33 | 63.33 | 35.33 | 6.00 | 3.43 | 18.33 | 8.00 | 3.52 | 30.55 | 44.65 | 76.14 | 10.19 | 1.38 | 100.17 | 5.04 |
| 26. | TLM-7 | 42.33 | 65.67 | 27.50 | 5.67 | 2.52 | 8.00 | 8.00 | 4.26 | 25.17 | 39.75 | 73.02 | 10.45 | 1.97 | 100.25 | 3.07 |
| 27. | TM 96-2 | 41.67 | 63.67 | 32.43 | 4.33 | 3.72 | 8.33 | 8.00 | 3.58 | 18.12 | 44.84 | 75.47 | 15.23 | 1.78 | 109.82 | 2.82 |
| 28. | VG- 6197A | 43.33 | 68.00 | 36.48 | 5.67 | 2.84 | 8.33 | 9.00 | 5.31 | 25.89 | 44.84 | 73.65 | 16.52 | 2.06 | 114.32 | 5.26 |
| 29. | VG 7098A | 39.33 | 63.67 | 26.65 | 4.33 | 3.61 | 10.33 | 8.67 | 3.67 | 19.15 | 43.08 | 73.67 | 11.69 | 1.19 | 83.48 | 3.17 |
| 30. | WGG 2 | 41.00 | 64.67 | 48.37 | 4.67 | 2.16 | 11.67 | 8.67 | 4.88 | 19.84 | 40.09 | 71.58 | 18.36 | 1.09 | 89.74 | 3.13 |
| 31. | WGG-37 | 42.00 | 63.33 | 38.09 | 5.33 | 2.45 | 14.67 | 9.33 | 4.33 | 27.34 | 42.13 | 73.97 | 10.70 | 1.49 | 120.49 | 4.61 |
| | **General Mean** | **41.69** | **64.68** | **37.15** | **4.87** | **2.85** | **10.31** | **8.24** | **3.56** | **24.06** | **42.86** | **73.60** | **14.55** | **1.68** | **101.76** | **3.59** |
| | S.Ed. | 0.30 | 0.63 | 0.13 | 0.41 | 0.02 | 0.53 | 0.19 | 0.02 | 0.51 | 0.85 | 0.72 | 0.70 | 0.06 | 2.68 | 0.04 |
| | CD at 5%) | 0.85 | 1.79 | 0.37 | 1.16 | 0.05 | 1.49 | 0.53 | 0.07 | 1.44 | 2.40 | 2.05 | 1.99 | 0.17 | 7.58 | 0.12 |
| | CD at 1% | 1.14 | 2.38 | 0.49 | 1.54 | 0.06 | 1.99 | 0.70 | 0.09 | 1.92 | 3.20 | 2.73 | 2.64 | 0.24 | 10.08 | 0.16 |

Table 3. Mean coefficient of variability, heritability (broad sense) and genetic advance as per cent of mean for fifteen characters in thirty one mungbean genotypes under moisture stress condition.

| Sl. No. | Character | Mean | Range | | Variance | | Coefficient of Variation | | Heritability (Broad sense) (%) | Genetic advance (GA) | Genetic advance as percent of mean (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Max. | Genotypic | Phenotypic | Genotypic | Phenotypic | | | |
| 1. | Days to 50% flowering | **41.69** | 39.33 | 44.33 | 1.94 | 2.03 | 3.34 | 3.42 | 95.52 | 2.81 | 6.73 |
| 2. | Days to maturity | **64.67** | 62.00 | 68.00 | 2.26 | 2.65 | 2.32 | 2.52 | 84.94 | 2.85 | 4.41 |
| 3. | Plant height (cm) | **37.15** | 24.09 | 51.52 | 58.75 | 58.77 | 20.63 | 20.64 | 99.97 | 15.78 | 42.50 |
| 4. | No. of Clusters per plant | **4.87** | 3.62 | 7.33 | 0.68 | 0.85 | 16.95 | 18.92 | 80.25 | 1.52 | 31.28 |
| 5. | No. of Pods per cluster | **2.85** | 1.81 | 4.36 | 0.59 | 0.60 | 26.90 | 26.91 | 99.96 | 1.58 | 55.42 |
| 6. | No. of Pods per plant | **10.31** | 7.67 | 18.33 | 4.62 | 4.89 | 20.84 | 21.46 | 94.28 | 4.29 | 41.67 |
| 7. | No. of Seeds per pod | **8.23** | 6.00 | 10.67 | 0.76 | 0.80 | 10.63 | 10.87 | 95.57 | 1.76 | 21.40 |
| 8. | 100 seed weight (g) | **3.56** | 2.62 | 5.31 | 0.41 | 0.42 | 18.04 | 18.06 | 99.85 | 1.32 | 37.15 |
| 9. | Harvest index (%) | **24.06** | 15.41 | 33.27 | 18.44 | 18.70 | 17.85 | 17.92 | 98.60 | 8.78 | 36.50 |
| 10. | SCMR | **42.86** | 37.94 | 49.13 | 6.62 | 7.34 | 6.00 | 6.32 | 90.13 | 5.03 | 11.74 |
| 11. | Relative water content (%) | **73.06** | 70.07 | 76.57 | 2.92 | 3.44 | 2.32 | 2.52 | 84.68 | 3.23 | 4.39 |
| 12. | Relative injury (%) | **14.55** | 8.48 | 33.33 | 26.81 | 27.30 | 35.56 | 35.89 | 98.18 | 10.56 | 72.60 |
| 13. | Chlorophyll content | **1.68** | 1.07 | 2.24 | 0.12 | 0.13 | 20.83 | 21.16 | 96.87 | 0.71 | 42.23 |
| 14. | Specific leaf area ($cm^2 g^{-1}$) | **101.76** | 64.88 | 127.56 | 224.84 | 232.03 | 14.74 | 14.97 | 96.90 | 30.41 | 29.88 |
| 15. | Seed yield per plant (g) | **3.59** | 2.04 | 5.26 | 0.72 | 0.73 | 23.68 | 23.71 | 99.74 | 1.75 | 48.72 |

traits. Therefore, simple selection could be effective for further improvement of these characters. Similar results were also found with Parinya and Piyada (2011) for number of pods per plant; Suresh *et al.* (2010) for seed yield per plant; Arpita Das *et al.* (2010) for number of pods per plant and seed yield per plant and Rahim *et al.* (2010) for seed yield per plant and number of pods per plant.

Moderate estimates of PCV and GCV were observed for the traits seed weight (GCV: 18.05%; PCV: 18.06%), harvest index (GCV: 17.84%; PCV: 17.97%), number of clusters per plant (GCV: 16.95%; PCV: 18.92%), specific leaf area (GCV: 14.73%; PCV: 14.97%) and number of seeds per pod (GCV: 10.62%; PCV: 10.87%). Similar results were also observed with the findings of Srivastava and Singh (2012) for number of seeds per pod and 100-seed weight and Parinya and Piyada (2011) for number of seeds per pod and 100-seed weight.

However, low estimates of co-efficient of variation was observed for the characters SCMR (GCV: 6.00%; PCV: 6.32%), days to 50% flowering (GCV: 3.34%; PCV: 3.42%), Relative Water Content (GCV: 2.32%; PCV: 2.52%) and days to maturity (GCV: 2.32 %; PCV: 2.52 %) in the decreasing order of their magnitude indicating the low range of variation for these characters in the genotypes, thus offering little scope for further improvement of these characters through simple selection. Similar kind of findings was also reported by Srivastava and Singh (2012) for days to 50% flowering and Parinya and Piyada (2011) for days to maturity.

Heritability values along with genetic advance would be more reliable and helpful in predicting the gain under selection than heritability estimates alone. In the present investigation, high heritability coupled with high genetic advance as per cent of mean was recorded for Relative injury, number of pods per cluster, seed yield per plant, Chlorophyll content, 100-seed weight, number of pods per plant, plant height, number of clusters per plant, number of seeds per pod, harvest index and SLA indicating the preponderance of additive gene action and hence phenotypic selection would be more effective for these characters. This result was also in conformity with the findings of Swathi (2013) for harvest index, seed yield per plant, Relative injury, seed weight, specific leaf area, number of pods per plant and plant height and Srivastava and Singh (2012) for seed yield per plant.

The character SCMR exhibited high heritability and moderate genetic advance as per cent of mean indicating that this character was governed by additive gene effects and may express consistently in succeeding generations, leading to greater efficiency of breeding programme.

In contrast, low genetic advance with high heritability was reported for days to 50% flowering, days to maturity and Relative water content indicating that these characters are governed by non- additive gene effects and highly influenced by environmental effects. Hence direct selection for such characters would be ineffective. These results were also in conformity with the findings of Srivastava and Singh (2012) for days to 50% flowering and Suresh *et al.* (2010) for days to 50% flowering and days to maturity.

By and large, from present study, it is clearly evident that the characters relative injury, number of pods per cluster, chlorophyll content, plant height and number of pods per plant showed high PCV, GCV and high heritability along with high genetic advance as percent mean. Hence, emphasis should be given in the breeding programme aimed to develop desirable drought tolerant and high yielding genotypes in mungbean.

## LITERATURE CITED

**Arpita Das, Mainak Biswas and Ghosh Dastidar K K 2010** Genetic Divergence in Mungbean (*Vigna radiata* (L.)Wilczek). *Journal of Agronomy*, 9(3): 126-130

**Burton G W 1952** Quantitative inheritance in grasses. *Proceedings of 6th Grass land congress Journal,* 1: 277-278

**Johnson H W, Robinson H F and Comstock R E 1955** Estimation of genetic and environmental variability in Soybean. *Agronomy Journal*, 47(7): 314-318

**Lush J L 1940** Intra-sire correlation and regression of offspring in rams as a method of estimating heritability of characters. *Proceedings of American Society of Animal Product,* 33: 292-301

**Panse V G and Sukhatme P V 1961** *Statistical methods for agricultural workers* (2nd Edition), ICAR, New Delhi. 361

**Parinya and Piyada 2011** Relationships and variability of agronomic and physiological characters in mungbean. *African Journal of Biotechnology,* 10(49): 9992-10000

**Rahim M A, Mia A A, Mahmud F, Zeba N and Afrin K S 2010** Genetic variability, character association and genetic divergence in mungbean (*Vigna radiata* (L).Wilczek). *Plant Omics Journal,* 3(1): 1-6

**Srivastava, R L and Singh, G 2012** Genetic Variability, Correlation and Path Analysis in mungbean (*Vigna radiata* (L.) Wilczek). *Indian Journal Science,* 2 (1): 61-65, 2012

**Suresh S, Jebaraj S, Hepziba S Juliet and Theradimani M 2010** Genetic studies in mungbean (*Vigna radiata* (L).Wilczek). *Electronic Journal of Plant Breeding*, 1(6): 1480-1482

**Swathi 2013** Genetic diversity analysis using morpho- physiological and molecular markers for breeding yield and drought tolerance in mungbean (*Vigna radiata* (L) Wilczek). M.sc. (Ag.) Thesis, Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad, A.P.

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