**Estimation of genetic variability for grain yield and its contributing traits in black gram [*Vigna mungo* (L.) Hepper]**

**Abstract**

The present investigation was carried out on twelve black gram genotypes during *Kharif-* 2024 at Organic Research Farm (HRF), Karguanji, Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.), to study about genetic variability, heritability and genetic advance. ANOVA showed highly significant genetic variability and for all twelve black gram varieties for 13 characters studied indicating that significant amount of genetic variability present in the material. The analysis of variance inferred that the twelve genotypes differed significantly for all the thirteen characters taken under study, representing existence of abundant variability among the varieties. The widest range of variation was found in the characters, number of pods per plant (19.27 - 54.73) followed by harvest index (15.47% - 42.60%) and plant height (24.41 cm - 44.50 cm). The genotypes, viz. T-65, Shekhar -1, KU-321, IPU-09-16, Azad Urd-1 and KU-99-22 have emerged out as best performing genotypes in respect of seed yield per plant. The best performing genotypes can be utilized in developing new improved varieties as well as in hybridization programmes.

**Key words:** genetic variability, heritability, genetic advance

**Introduction**

Black gram [Vigna mungo (L.) Hepper] is a self-pollinated, annual, short- duration dicotyledonous legume crop with chromosome number 2n=22, and belongs to family fabaceae sub-family papilionaceae. Black gram cultivation on marginal lands under rainfed conditions with low inputs has been an age-old practice in Asian countries. India is the primary center of origin of black gram (Vavilov, 1926). Black gram is basically a tropical crop but it is grown in all the three kharif, rabi and zaid seasons. Like other pulses, it also enriches the soil fertility, improves the soil structure and used as green fodder for cattle (Parveen et al., 2011). Black gram seed contains about 24 per cent protein, 1.4 per cent fat, 3.2 per cent minerals, 59.6 per cent carbohydrates, calorific value 347 Kcal, 10.9 per cent moisture, and it has the highest content of phosphoric acid among all the pulses. The crop is grown in cropping systems as a mixed crop, catch crop, sequential crop besides as sole crop under residual moisture conditions after the harvest of rice and also before and after the harvest of other crops under semi irrigated and dry land conditions (Yashoda et al., 2016).

The major constraints in black gram genetic improvement are lack of exploitable genetic variability, absence of suitable ideotype for different cropping systems, poor harvest index and susceptibility to biotic and abiotic stresses and non- availability of quality seeds of improved varieties (Priya et al., 2018). It is mainly due to the repeated usage of few parents with high degree of relatedness in crossing programmes. One of the factors responsible for the poor productivity of black gram is lack of stable cultivars (Gowsalya et al., 2016). Further, it has been the least studied crop among the pulses and no international system under the CGIAR has this as a mandate crop (Ghafoor et al., 2000).

**Materials and Methods**

The experimental material for present investigation was carried out during *Kharif,* 2024 at Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.). Experimental material consists of 12 black gram genotypes were sown in RBD in 3 replications, 5 rows of each genotype in each replication with 1m length. Row to row and plant to plant distance was kept at 30 cm and 10 cm, respectively. All the recommended package of practices was followed to raise a healthy crop.

Data was recorded on thirteen different quantitative characters and their mean values were used for statistical analysis, except for days to 50 per cent flowering and days to 75 per cent maturity as they will be recorded on plot basis in each replication for each entry. The mean values of five plants were used for biometrical analysis.

The various genetic parameters *viz*., GCV and PCV were calculated by adopting the formulae suggested by Burton (1952), while heritability, GA as % mean were calculated by adopting the formulae given by Johnson *et.al.,* (1955).

**Result and Discussion**

The mean performance of twelve black gram genotypes are presented in Table 1. The perusal data revealed that the range is considerably high for most of characters. The analysis of variance inferred that the twelve genotypes differed significantly for all the thirteen characters taken under study, representing existence of abundant variability among the varieties. The widest range of variation was found in the characters, number of pods per plant (19.27 - 54.73) followed by harvest index (15.47% - 42.60%) and plant height (24.41 cm - 44.50 cm). Similar findings were also reported by **Ravikumar et al. (2020)** and **Patel et al. (2021)**, confirming the presence of significant genetic variability in black gram germplasm.

The genotypes, viz. T-65, Shekhar -1, KU-321, IPU-09-16, Azad Urd-1 and KU-99-22 have emerged out as best performing genotypes in respect of seed yield per plant. The best performing genotypes can be utilized in developing new improved varieties as well as in hybridization programmes. These promising genotypes may be utilized in future breeding and hybridization programs. Similar utilization of elite genotypes was recommended by Sharma et al. (2020) and Raj et al. (2019).

The extent of variability was high for all the characters among the test genotypes. The mean squares due to genotypes were attained significant for all the thirteen characters under study. These outcomes were comparable with that of Suguna et al. (2017), Mohanlal et al. (2018). It denotes existence of abundant variability in the test material i.e. the 46 genotypes of black gram, and there is bounteous scope available to advance the varying characters involving seed yield with the means of prudent selection. Mean sum of squares due to genotypes was significant for all characters, which aligns with the findings of Choudhary et al. (2018) and Kumar and Meena (2022), indicating ample variability for selection and improvement.

The estimates of PCV were somewhat higher than the corresponding estimates of GCV for all the traits considered under study, expressing the existence of interplay between genotypes and environment. It has also been supported by Jyothsana et al. (2016), Gowsalya et al. (2016), and Thamodharan et al. (2017).The PCV was found high for seed yield per plant, number of pods per plant and number of clusters per plant. These findings are supported by Natarajan et al. (2019) and Singh and Yadav (2021). High PCV was recorded for seed yield per plant, number of pods per plant, and number of clusters per plant, which is consistent with Kumari et al. (2020) and Chakraborty et al. (2021). The outcomes for high PCV were in agreement with Sowmini and Jayamani (2013), for seed yield per plant and number of pods per plant with Babu et al. (2016), Suguna et al. (2017) and Mohanlal et al. (2018), for seed yield per plant with Tank et al. (2018).

The PCV was moderate for 100-seed weight, number of seeds per pod, number of primary branches per plant, plant height, biological yield per plant, number of pods per cluster, harvest index. The similar outcomes were reported by Sowmini and Jayamani (2013) for plant height and number of primary branches per plant, Hemalatha et al. (2017) for 100-seed weight and plant height, Tank et al. (2018) for 100-seed weight, number of seeds per pod, plant height, biological yield per plant, number of pods per cluster and harvest index.

Table 1. Mean values of genotypes for thirteen different characters

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.**  **No.** | | **Genotype** | **Days to 50 per cent flowering** | **Days to 75 per cent maturity** | **Plant height (cm)** | | **Number of Pb per plant** | | | **Number of clusters per plant** | | | **Number of pods per cluster** | | **Number of pods per plant** | | | **Pod length (cm)** | | | **Number of seeds per pod** | **100-seed weight (gm)** | | **Biological yield per plant**  **(gm)** | | | **Seed yield per plant**  **(gm)** | | **Harvest index (%)** |
| 1. | | Vallabh Urd-1 | 37.67 | 68.67 | 41.00 | | 2.75 | | | 11.47 | | | 2.73 | | 31.87 | | | 4.30 | | | 6.00 | 4.98 | | 21.83 | | | 6.93 | | 31.88 |
| 2. | | Azad Urd-1 | 36.67 | 69.33 | 38.18 | | 3.25 | | | 7.87 | | | 2.43 | | 19.73 | | | 4.43 | | | 7.00 | 5.41 | | 18.93 | | | 4.90 | | 26.04 |
| 3. | | IPU-131 | 39.33 | 70.33 | 31.94 | | 3.18 | | | 7.51 | | | 2.93 | | 22.37 | | | 4.33 | | | 5.67 | 4.90 | | 20.30 | | | 6.63 | | 32.68 |
| 4. | | KU-321 | 37.67 | 70.00 | 44.50 | | 2.77 | | | 10.67 | | | 3.40 | | 36.07 | | | 4.27 | | | 6.33 | 4.49 | | 20.39 | | | 5.73 | | 28.65 |
| 5. | | KU-99-22 | 39.45 | 71.00 | 43.47 | | 3.11 | | | 13.40 | | | 2.83 | | 38.33 | | | 4.33 | | | 6.33 | 4.42 | | 26.13 | | | 6.70 | | 25.58 |
| 6. | | KU-010-1 | 38.00 | 72.00 | 30.15 | | 2.54 | | | 9.20 | | | 3.25 | | 29.73 | | | 4.33 | | | 6.33 | 3.96 | | 17.52 | | | 4.57 | | 26.14 |
| 7. | | Shekhar-1 | 39.33 | 77.33 | 39.42 | | 2.77 | | | 8.01 | | | 2.87 | | 21.73 | | | 4.24 | | | 5.67 | 3.97 | | 15.17 | | | 3.11 | | 20.78 |
| 8. | | Shikha-1 | 37.67 | 72.00 | 33.36 | | 3.49 | | | 11.60 | | | 3.50 | | 43.93 | | | 4.31 | | | 6.33 | 4.57 | | 19.69 | | | 6.03 | | 30.77 |
| 9. | | T-9 | 35.33 | 69.67 | 39.52 | | 2.77 | | | 9.80 | | | 3.60 | | 33.57 | | | 4.52 | | | 6.33 | 4.70 | | 22.50 | | | 6.53 | | 29.01 |
| 10. | | IPU-09-16 | 36.00 | 68.00 | 33.53 | | 3.56 | | | 11.14 | | | 2.92 | | 32.87 | | | 4.38 | | | 6.00 | 4.39 | | 19.53 | | | 5.13 | | 26.27 |
| 11. | | KU-96-3 | 34.33 | 66.00 | 30.26 | | 3.25 | | | 9.68 | | | 3.87 | | 36.20 | | | 4.00 | | | 6.00 | 4.73 | | 20.50 | | | 5.87 | | 27.41 |
| 12. | | T-65 | 39.67 | 76.33 | 32.21 | | 2.53 | | | 9.27 | | | 2.69 | | 25.02 | | | 3.90 | | | 5.33 | 3.90 | | 18.77 | | | 4.43 | | 23.83 |
|  | | GM | 37.86 | 70.98 | 35.76 | | 3.05 | | | 10.33 | | | 3.11 | | 32.23 | | | 4.32 | | | 6.50 | 4.26 | 19.70 | | | | 5.24 | | 26.31 |
|  | | SE | 0.59 | 1.12 | 1.19 | 0.10 | | | | 0.52 | | | 0.20 | | 1.65 | | | 0.06 | | | 0.29 | 0.13 | 0.94 | | | | 0.35 | | 1.64 |
|  | | CD at 5% | 1.65 | 3.16 | 3.34 | 0.27 | | | 1.45 | | | | 0.57 | | 4.63 | | | 0.16 | | | 0.82 | 0.35 | 2.63 | | | | 0.99 | | 4.60 |
|  | CD at 1% | | 2.18 | 4.18 | 4.43 | 0.35 | | 1.93 | | | | 0.75 | | | 6.13 | | 0.22 | | | 1.09 | | 0.47 | 3.48 | | | 1.31 | | 6.09 | |
|  | CV (%) | | 2.68 | 2.74 | 5.77 | 5.41 | | 8.68 | | | 11.24 | | | 8.85 | | 2.33 | | | 7.81 | | | 5.12 | 8.23 | | 11.64 | | | | 10.78 |

Table 2. Analysis of variance for different characters in black gram

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.** | **Characters** | **Replication** | **Varieties** | **Error** |
| **[2]** | **[11]** | **[22]** |
| 1. | Days to 50 per cent flowering | 0.20 | 5.93\*\* | 1.03 |
| 2. | Days to 75 per cent maturity | 1.37 | 23.32\*\* | 3.78 |
| 3. | Plant height | 0.48 | 87.28\*\* | 4.25 |
| 4. | Number of primary branches per plant | 0.01 | 0.39\*\* | 0.03 |
| 5. | Number of clusters per plant | 0.25 | 17.79\*\* | 0.80 |
| 6. | Number of pods per cluster | 0.02 | 0.58\*\* | 0.12 |
| 7. | Number of pods per plant | 1.37 | 255.88\*\* | 8.13 |
| 8. | Pod length | 0.01 | 0.15\*\* | 0.01 |
| 9. | Number of seeds per pod | 0.41 | 1.34\*\* | 0.26 |
| 10. | 100-seed weight | 0.02 | 0.52\*\* | 0.05 |
| 11. | Biological yield per plant | 1.11 | 27.01\*\* | 2.63 |
| 12. | Seed yield per plant | 0.13 | 6.54\*\* | 0.37 |
| 13. | Harvest index | 1.84 | 54.84\*\* | 8.04 |

\*, \*\* Significant at 5 and 1 per cent respectively

Table 3. Variability parameters for different characters in black gram

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S. No.** | **Characters** | **GCV (%)** | **PCV (%)** | **h2 (%)** | **GG%** |
| 1. | Days to 50 per cent flowering | 3.38 | 4.31 | 61.28 | 5.44 |
| 2. | Days to 75 per cent maturity | 3.60 | 4.52 | 63.25 | 5.89 |
| 3. | Plant height | 14.71 | 15.80 | 86.68 | 28.22 |
| 4. | Number of primary branches per plant | 11.37 | 12.59 | 81.54 | 21.15 |
| 5. | Number of clusters per plant | 23.02 | 24.60 | 87.57 | 44.38 |
| 6. | Number of pods per cluster | 12.54 | 16.84 | 55.48 | 19.25 |
| 7. | Number of pods per plant | 28.20 | 29.56 | 91.03 | 55.43 |
| 8. | Pod length | 5.01 | 5.52 | 82.26 | 9.36 |
| 9. | Number of seeds per pod | 9.26 | 12.11 | 58.46 | 14.59 |
| 10. | 100-seed weight | 9.36 | 10.66 | 76.97 | 16.91 |
| 11. | Biological yield per plant | 14.47 | 16.65 | 75.58 | 25.92 |
| 12. | Seed yield per plant | 27.38 | 29.75 | 84.69 | 51.91 |
| 13. | Harvest index | 15.01 | 18.48 | 65.98 | 25.12 |

**Conclusion**

The findings attained from the concurrent assessment of variability parameters disclosed that the characters, viz. number of pods per plant, biological yield per plant, number of clusters per plant and plant height should be given due consideration as the major components in determining yield in a selection programme aimed at improving genetic potential of black gram.

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