Stability Analysis for Yield and Its Component Characters in Blackgram [Vigna mungo (L.) Hepper]

C. Shobanadevi, R. Elangaimannan, K. Vadivel

ABSTRACT
Background: Blackgram [Vigna mungo (L.) Hepper] is an important pulse crop occupying a unique position in Indian agriculture. Blackgram provides a major share of the protein requirement of the vegetarian population of the country. The crop is resistant to adverse climatic conditions and improves the soil fertility by fixing atmospheric nitrogen in the soil. Phenotypically stable genotypes are of great importance because the environmental conditions vary from season to season and year to year. Stable performance of blackgram genotypes across contrasting environments is essential for the successful selection of stable and high yielding varieties. Methods: A total of seven genotypes of blackgram were evaluated one season (Rabi - 2019) in three environments to study the G×E interaction for three traits. Result: Based on the stability analysis of Eberhart and Russell model, two genotypes viz., MDU 1 and NRIB 002 were found to be stable across the environments for seed yield. These genotypes had high seed yield with a unity regression coefficient and deviation from regression equal to zero. Key words: Blackgram, G×E interaction, Genotypes, Seed yield, Stability.

INTRODUCTION
Blackgram [Vigna mungo (L.) Hepper] is an important pulse crop occupying a unique position in Indian agriculture. Blackgram provides a major share of the protein requirement of the vegetarian population of the country. The crop is resistant to adverse climatic conditions and improves the soil fertility by fixing atmospheric nitrogen in the soil. Phenotypically stable genotypes are of great importance because the environmental conditions vary from season to season and year to year. Stable performance of blackgram genotypes across contrasting environments is essential for the successful selection of stable and high yielding varieties (Yousaf and Sarwar, 2008). The combination of genotypes stability with high yield is an important criteria for selecting high yielding and stable genotypes (Yihunie et al., 2018). An understanding of the genotype and environmental interactions in blackgram is important both for crop improvement and to ascertain the performance of genotypes to variations in the environmental factors. An analysis of adaptability and stability is essential to identify varieties with predictable performance and that are responsive to environmental variations in specific or wide conditions, making more reliable the recommendation of cultivars (Cruz et al., 2012). The main purpose of a breeding program is to identify superior genotypes replace than to the existing varieties. Thus, the genotypes are intensively evaluated for seed yield. However, the relative ranking of the genotypes, in most cases, is not consistent, since variations may occur because of the interactions between genotype and environment. Therefore, this interaction takes a leading role in the process of cultivar recommendation. In this way, the genotype with high yielding potential and good stability could be recommended for cultivation. There are few studies about the adaptability and stability of blackgram genotypes. Therefore, the study aimed to evaluate selected blackgram genotypes for the adaptability of seed yield using Eberhart and Russell model (1966) to recommend stable genotypes for cultivation and for their utilization in breeding programmes for improvement of grain yield in blackgram. In this technique, response of genotypes to a given environment is considered. G×E cannot be avoided. In fact, it is an important limiting factor for testing the efficiency of any breeding programme. The occurrence of large genotypes x environment (G×E) interaction affects the recommendations of the breeders in selecting genotypes for a specific environment. Genotype x environment analysis is used to provide unbiased estimated of yield and agronomic characteristics and to determine yield stability or the ability to withstand both predictable and unpredictable environmental variation (Om Vir Singh et al., 2020).

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MATERIALS AND METHODS
The experimental material for the present investigation consisted of 7 genotypes viz., NIRMAL 7, MDU 1, VBN 8, NRIBO02, NUL 7 VISWAS, LBG 648 and VBN 7. The experiment was conducted during rabi (December-February, 2019) by adopting a randomized block design with three replications in three environments namely, (1) Plant Breeding Farm, Annamalai University, (2) Aadur village and (3) Kovilpatti. The experiment was conducted with a single row of two meter length per replication with a spacing of 30 × 10 cm² (i.e. between rows and between plants within the row). All the recommended package of practices were provided for good crop growth and development. Data was recorded on number of pods per plant, 100 seed weight and seed yield / per plant over environments was analyzed using TNAUSTAT Package (Manivannan, 2014). The stability model proposed by Eberhart and Russell (1966) was used to estimate stability parameters for seed yield. Eberhart and Russell (1966) model for stability analysis provides regression indices (b values) and mean square for deviation from regression minus pooled error (S_d) as indices of a stable genotype. The stable genotypes will be those having mean yield higher than the average yield of all the genotypes under test, the regression coefficient of unity and deviation from regression equal to zero. Pooled error was obtained by averaging the error mean squares from the analysis of variance of individual environments and dividing by the number of replications. The significance of mean squares was tested against the pooled error. For testing the significance of mean values; Least Significant Difference (LSD) was computed by using the pooled error. The t-test based on the standard error of regression value was used to test significant deviation from 1.0. To determine whether deviation from regression was significantly different from zero, the F-test was employed i.e. comparing the mean square due to deviation from regression with pooled error.

RESULTS AND DISCUSSION
The pooled analysis of variance (Table 1) revealed significant differences among the genotypes for the seed yield per plant. The environment + (genotype x environment) was significant for seed yield per plant indicating the distinct nature of environments and genotype x environment interactions in phenotypic expression. The environment (linear) was found significant for the number of pods per plant, 100 seed weight and seed yield per plant indicating differences between environments and their influence on genotypes for expression of the character. The genotype x environment (linear) interaction component showed significance for number of pods per plant, 100 seed weight and seed yield per plant. This indicated significant differences among the genotypes for linear response to environments (bi) behavior of the genotypes could be predicted over environments. The mean square due to pooled deviation from regression was significant showing that the performances of some of the genotypes were not stable over environments. Similar results were obtained by Thiyagarajan and Rajasekaran (1989), Sarvamangala et al. (2010), Nunes et al. (2014) and EI-Shaieny et al. (2015). Grain yield is the most important trait in the development of blackgram varieties and dentifying a genotype with high seed yield, stability and average response are of immense value. The stability parameters (mean, bi and S_d) of the individual genotypes are illustrated in Table 2.

Table 1: Pooled analysis of variance for stability for three characters in blackgram genotypes.

| Sources                        | Df | Number of pods per plant | 100-seed weight (g) | Seed yield per plant (g) |
|--------------------------------|----|--------------------------|---------------------|--------------------------|
| Genotypes                      | 6  | 8.22**                   | 5.23**              | 0.94**                   |
| G × E                          | 12 | 0.24**                   | 0.17**              | 0.06**                   |
| Environment + (G × E)          | 14 | 0.29**                   | 0.15**              | 0.07**                   |
| Environment (Linear)           | 1  | 1.25**                   | 0.06**              | 0.22**                   |
| Genotype × Environment(Linear) | 6  | 0.32**                   | 0.19**              | 0.09**                   |
| Pooled Deviation               | 7  | 0.13**                   | 0.12**              | 0.02**                   |
| Pooled Error                   | 36 | 0.03                     | 0.01                | 0.0003                   |

*, ** Significant at 5 and 1% respectively.
It is concluded from the present study that the two genotypes MDU 1 and NRIB 002 were found stable with high mean yield and had average responses to the environmental conditions and recorded statistically on high yield. Hence these genotypes can be recommended for cultivation in the rabi season.

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**Table 2: Mean and stability parameters for three characters in blackgram.**

| Genotypes  | Number of pods per plant | 100-seed weight (g) | Seed yield per plant (g) |
|------------|--------------------------|--------------------|-------------------------|
|            | Mean b_i S^2d_i         | Mean b_i S^2d_i    | Mean b_i S^2d_i         |
| Nirmal 7   | 7.19** -0.06 0.10**     | 4.56 -1.68 0.03**  | 3.20** 0.99 0.01**      |
| MDU 1      | 8.60** 1.21 -0.01      | 5.43** 6.47 0.01   | 3.15** 1.09 0.001        |
| VBN 8      | 4.31 0.37 0.14**       | 4.60 -2.47 0.11**  | 1.95 0.10 0.01**         |
| NRIB 002   | 8.06** 0.45 0.0001     | 7.42** -4.35 0.01  | 3.63* 0.84 0.001         |
| NUL 7 VISWAS | 6.69 -0.55 -0.01     | 3.92 0.28 0.04**   | 2.57 -0.34 0.0004        |
| LBG 648    | 6.13 2.91 0.59**       | 3.94 1.13 0.02**   | 2.46 2.47 0.007**        |
| VBN 7      | 4.46 2.67 0.03*        | 3.69 7.61 0.008    | 2.65 4.04 0.06**         |
| Grand Mean | 6.49                     | 4.79                  | 2.80                     |

*,** Significant at 5 and 1% respectively.