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Genetic variability and multivariate evaluation of mungbean genotypes for heat stress tolerance and yield stability

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Abstract

Climate change poses significant challenges for plant growth and development. Among these, heat stress has emerged as a major concern, severely affecting various physiological processes in mungbean, including disruption of flowering, reduced seed setting, and impaired pod development. These impacts ultimately lead to a substantial reduction in yield, posing a critical challenge for mungbean production under high-temperature conditions. To address this issue, the present study aimed to evaluate heat tolerance in 25 mungbean genotypes. The experiment was performed in a randomised complete block design on two sowing dates: normal sowing (39°C/26°C) and late sowing for heat treatment (47°C/30°C). Significant variations were observed among treatments, genotypes, and genotype × treatment interactions, indicating differential responses to heat stress. Genetic variability analysis showed alternations in genotypic (GV) and phenotypic (PV) variations, while high heritability (H2) and genetic advance percentage mean (GAM) were observed for yield-related traits, indicating their potential for genetic improvement. A significantly positive correlation of plant height, number of seeds per pod, and 100-seed weight with seed yield was recorded under both normal and stress conditions, respectively. Principal component analysis revealed a high contribution of seed yield, yield index, geometric mean productivity, tolerance, stress tolerance index, and mean productivity for PC1 and PC2. Cluster analysis revealed that genotypes retained in Cluster 1 and Cluster 2 could be utilised to combine yield and stress stability indices in breeding programs. Overall, genotypes NM-98, NM-108, NM-2011, NM-2225, NM-93, and NM-203 emerged as potential genotypes for heat tolerance, offering valuable genetic resources for improving mungbean cultivars under high-temperature conditions.

Keywords: Crop physiology, crop production, heat stress, multivariate analysis, mungbean

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