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Genetic variability and heritability studies in brinjal (*Solanum melongena* L.)

Bhavesh Verma, Dhananjay Sharma and Jitendra Trivedi

Abstract
In the latest research, 24 diverse brinjal genotypes were thoroughly examined to evaluate their genetic diversity. The results highlighted a significant and remarkable amount of variation among the genotypes, evident in various crucial characteristics such as plant height, flowering time, fruit dimensions, average fruit weight, and fruit yield per plant. Interestingly, the phenotypic coefficient of variation (PCV) surpassed the equivalent genotypic coefficient of variation (GCV) for all traits, indicating a strong influence of environmental factors on these features. Among all attributes, the number of fruits per plant and per cluster exhibited the most substantial estimates of both phenotypic and genotypic variation. Additionally, key features like average fruit weight, fruit yield per plant, cluster size, fruit length, and girth demonstrated robust heritability estimates, suggesting that simple selection based on observable traits would be highly effective in enhancing these characteristics through additive gene action.

Keywords: Variability**,** GCV, PCV, traits

Introduction
Brinjal, also called eggplant (Solanum melongena L.), is a widely cultivated vegetable in tropical regions, notably in India, except at higher altitudes. Its year-round growth and adaptability to diverse agro-climatic conditions make it a prominent crop. Leveraging the plant's rich genetic diversity, breeding endeavors hold great potential for further enhancement (Hassanzadeh Khankahdani *et al*., 2022) [4].
Globally, China takes the lead in brinjal production, closely followed by India. In India, brinjal is cultivated across 7.49 lakh hectares, yielding approximately 128.74 lakh metric tonnes annually. In Gujarat state alone, brinjal covers an extensive area of 77.55 thousand hectares, resulting in a substantial yield of 1533.67 thousand metric tonnes each year (Anonymous, 2021) [1]. In the context of crop development, comprehending the extent of variability and identifying heritable and desirable traits is crucial. Hence, this study focuses on assessing genetic advance (GA) and variability indices related to significant yield and yield-contributing traits. For this purpose, 24 diverse brinjal genotypes were carefully examined to gain insights into the existing diversity (Anonymous, 2021) [1].

Materials and Methods
In the rabi season of 2019-20, a comprehensive experiment was conducted at the Horticultural Research-cum-instructional Farm, Department of Vegetable Science, College of Agriculture, IGKV, Raipur (C.G.). The study was meticulously designed using a three-replication Randomised Block Design (RCBD) in the field, known locally as "Dorsa," characterized by clay-loam textured soil with moderate fertility. Thirty-day-old seedlings were transplanted, maintaining a spacing of 60 cm x 45 cm to ensure optimal crop growth. Throughout the cultivation period, the recommended agronomic practices were diligently followed to promote a healthy crop. During different developmental stages of the crop, five randomly selected plants from each plot were closely monitored. The statistical analysis followed the Panse and Sukhatme (1967) [8] approach, with the GCV and PCV expressed as percentages, calculated using the Burton and De Vane (1953) [3] formula. Moreover, the heritability (%) in the broad sense and the genetic progress for each characteristic were determined using the method proposed by Johnson *et al.* (1955) [5].

Result and Discussion
Analysis of variance
The analysis of variance revealed significant differences across almost all attributes, pointing

to a substantial degree of genetic diversity in the material under investigation. Notably, plant height, days to 50% flowering, fruit length, fruit girth, average fruit weight, and number of fruits per plant exhibited wide variations, offering ample opportunities for selecting superior genotypes to optimize brinjal yield (Table 1). The observed broad range of variation in plant height, fruit yield per plant, days to 50% flowering, and number of fruits per plant aligns with findings from previous studies by Barik *et al*. (2021) [2] and Sujin *et al*. (2017) [9], further corroborating the significance of these traits in brinjal improvement efforts.

Genotypic and phenotypic coefficient of variation

Consistently, the phenotypic coefficient of variance (PCV) surpassed the equivalent genotypic coefficient of variation (GCV) for all traits, indicating the potential effectiveness of selection based on these features with reduced influence from environmental factors. Among the characteristics studied, average fruit weight displayed the highest PCV (93.00%) and GCV (92.60%), followed by the number of fruits per plant (68.02% and 65.68%), number of fruits per cluster (57.12% and 54.11%), number of flowers per cluster (49.30% and 47.12%), fruit girth (44.16% and 43.32%), and fruit length (40.21% and 39.63%). Traits such as days to first flower (18.26% and 17.59%), days to maturity (18.25% and 17.44%), days to 50% flowering (16.18% and 15.80%), and fruit stalk length (14.13% and 13.19%) exhibited moderate GCV and PCV values (Table 1). In line with these findings, similar results were reported by Thomas *et al*. (2022) [10], and Muniappan *et al*. (2010) [6] for average fruit weight and quantity of fruits per plant.

Heritability and genetic advance as percent of mean

All of the characteristics, with the exception of the number of main branches per plant, had high heritabilities.

Among the studied traits, all except the number of primary branches per plant exhibited high heritability, signifying a strong genetic influence. The traits with the highest heritability were average fruit weight (98.52%), followed by fruit length (96.21%), and fruit girth (95.30%). Moreover, all traits displayed substantial genetic advance as a percentage of the mean, indicating their potential for improvement through selective breeding. Notably, the characters showing the highest genetic advance were average fruit weight (99.11%), number of fruits per cluster (98.19%), and number of fruits per plant (90.44%) (Table 1). The combination of high heritability and significant genetic advance was particularly notable in traits like average fruit weight, number of fruits per plant, number of fruits per cluster, fruit length, and fruit girth. These findings are consistent with similar studies by Thomas *et al*. (2022) [10], Barik *et al*. (2021) [2], Sujin *et al*. (2017) [9], and Muniappan *et al*. (2010) [6] concerning average fruit weight and quantity of fruits per plant. To increase yield, simple selection based on plant parameters such as plant height, spread, fruit girth, and fruit quantity per plant can be effective. The high heritability coupled with genetic advancement underscores the significance of additive gene effects, offering promising avenues for enhancing brinjal yields through targeted breeding efforts.

Conclusions

Ensuring the presence of variability among materials is vital for effective trait selection in breeding programs. The utilization of this genetic diversity is essential for making informed choices in the breeding process. Opting for simple character selection based on phenotypic performance can be advantageous in identifying improved genotypes of the crop. With this in mind, special consideration should be given to traits such as average fruit weight, number of fruits per cluster, and number of fruits per plant to enhance eggplant yield through targeted selection efforts.

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