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# VARIABILITY STUDIES IN $F_6$ POPULATION OF BOTTLE GOURD (*LAGENARIA SICERARIA* (MOLINA) STANDL.)

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**ABSTRACT**

The present investigation entitled "Variability studies in $F_6$ population of bottle gourd (*Lagenaria siceraria* (Molina) Standl.)" was conducted to assess the variability, heritability and genetic advance to improve yield and yield contributing characters of bottle gourd. The present experiment was conducted at DR. YSRHU, College of Horticulture, Venkataramannagudem during Summer season 2024. The experimental material used was three crosses such as cross 1 Pusa Sandesh x Arka Bahar, cross 2 Pusa x Sandesh x Punjab Bahar and cross 3 Pusa Naveen x Local Long. The experiment was performed in a Randomized Block Design consisting of three replications. A significant degree of variability was observed for all the traits under study. High PCV and GCV recorded for the traits such as fruit yield per vine in cross 1 and number of fruits per vine in cross 3. Moderate PCV and GCV was observed in fruit length and average fruit weight in all the three crosses which indicating that due to presence of significant amount of variation the selection of desirable characteristics is more effective. In all the three crosses PCV is slightly greater than GCV which implies that the particular trait is significantly influenced by environment rather than genotype itself. High heritability coupled with high genetic advance as a per cent of mean was observed for fruit yield per vine in all the 3 crosses and number of fruits per vine in cross 2 and cross 3 which indicating that these traits are governed by additive gene action and these traits are effectively selected in breeding programme.

***Keywords*:** Bottle Gourd, Genetic variability (GCV, PCV), Heritability, Genetic advance as a per cent of mean (GAM).

## Introduction

Bottle gourd (*Lagenaria siceraria* (Molina) Standl) is an important vegetable crop belonging to the Cucurbitaceae family with a chromosome number of 2n = 22. It is believed to have originated in Africa and South Asia and is widely cultivated in tropical and subtropical regions. Bottle gourd is grown in both the late kharif and summer seasons. The immature fruit is primarily used for culinary purposes and it holds significant medicinal value due to its high moisture content and dietary fiber which aid in digestion and weight management. Apart from its use as a vegetable, bottle gourd has economic significance in various industries particularly in the production of musical instruments, handicrafts and household items.

A well-structured breeding program for improving fruit size, shape and yield relies on genetic variability for effective selection. PCV and GCV are used to measure variation, where GCV reflects genetic factors, while PCV includes both genetic and environmental influences. Heritability ($h^2$) determines the genetic contribution to a trait, while Genetic Advance (GA) and GAM predict the extent of improvement achievable through selection. High heritability

combined with high GAM indicates additive gene action, making selection more effective in breeding programs.

## Materials and Methods

"The present investigation was conducted at Dr. YSRHU, College of Horticulture, Venkataramannagudem, West Godavari district, Andhra Pradesh, India during 2023-24. Seeds from the superior-performing F5 progenies of three crosses viz., cross 1 (Pusa Sandesh × Arka Bahar), cross 2 (Pusa Sandesh × Punjab Bahar) and cross 3 (Pusa Naveen × Local Long) were collected and selfed to develop the F6 generation during 2023-24. The F5 progeny seeds were sown in a Randomized Block Design (RBD) with three replications for precise evaluation. Each experimental unit consisted of pits spaced at 3.0m × 0.9m to provide optimal growth conditions. A total of 180 plants were maintained across the three crosses, with 60 plants per cross. Initially, 3-4 seeds were sown per pit, followed by thinning to retain two healthy plants per pit for further evaluation and selection. In each replication, five randomly selected superior performing progenies were selected and those selected progeny fruit seeds are selfed to raise F6 population. For the evaluation of the F6 generation 3 crosses along with five parental lines i.e., Pusa Sandesh, Arka Bahar, Punjab Bahar, Pusa Naveen and Local Long were grown separately with each parent consisting of 10 plants, to assess the superiority of the progenies over parents.

The observations were recorded in this study included the number of branches per plant, node number at which the first male flower appears, node number at which the first female flower appears, days to first male flower appearance, days to first female flower appearance, sex ratio, days to first harvest, number of fruits per vine, fruit length (cm), fruit diameter (cm), average fruit weight (kg) and fruit yield per vine (kg). The estimation of PCV and GCV was conducted following Burton (1952), while heritability and genetic advance were analyzed as per Johnson *et al*. (1955) using Indostat software. PCV and GCV were categorized based on variation ranges: Low (<10%), Moderate (10–20%), and High (>20%). Similarly, heritability and genetic advance were classified as Low (0–30%), Moderate (31–60%), and High (>60%).

## Results and Discussion

The analysis of variance revealed significant differences among the three crosses of bottle gourd for 12 traits indicating a high level of genetic variability of bottle gourd. Mean, range and genetic variability parameters are depicted in table 1,2 and 3. A broad range of variation was noted among most of the studied traits like fruit yield per vine (kg) in cross 1 and number of fruits per vine in cross 3. It suggested that due to presence of high variation it make the selection more effective and leading to faster genetic improvement of the important traits. The presence of wide variability in this crop is consistent with findings from earlier research by Deepthi *et al*., (2016), Gorpad *et al.,* (2019), Harika *et al.,* (2012), Janghel *et al.,* (2018), Sharma and Sengupta (2013). Moderate PCV and GCV was recorded in node number at which the first male flower appears, number of fruits per vine, fruit length (cm) and average fruit weight (kg) in cross 1 and number of branches per plant, node number at which the first male flower appears, number of fruits per vine, fruit length (cm), fruit diameter (cm), average fruit weight (kg) and fruit yield per vine (kg) in cross 2 and fruit length (cm), average fruit weight (kg) and fruit yield per vine (kg) in cross 3. These results are indicated that moderate GCV indicates sufficient genetic variability for selection while maintaining stability, whereas moderate PCV suggests that environmental influences are present but not dominant, making the trait more predictable across different conditions. Similar findings were reported by Damor *et al*., (2016), Gautham and Balasubramanian (2018), Husna *et al.*, (2011) and Kandasamy *et al*., (2019). An analysis of the data in Table 1,2 and 3 revealed a significant difference between PCV and GCV values for all the traits studied. This suggests that environmental factors have a strong influence on trait expression, making direct selection less effective for bottle gourd improvement. Additionally, the lower magnitude of GCV compared to PCV across all traits further indicates that direct selection may not be the most suitable approach. Instead, heterosis breeding could be a more effective strategy for achieving genetic improvement in these traits.

PCV and GCV indicate the extent of variability in a population, but they do not determine how much of this variation is inheritable. Heritability helps assess whether a trait is genetically controlled, while genetic advance predicts the potential improvement through selection. High heritability coupled with high genetic advance as a per cent of a mean observed in fruit yield per vine in cross1 and number of branches per plant, node number on which first female flower appears, number of fruits per vine, fruit length(cm), fruit diameter(cm), average fruit weight(kg) and fruit yield per vine(kg) in cross 2 and number of fruits per vine, fruit length(cm), average fruit weight(kg) and fruit yield per vine(kg) in cross 3. High heritability along with high genetic advance ensures that a trait is controlled by additive genes, making selection

effective and leading to significant genetic improvement. This combination reduces environmental influence, enhances genetic gain and ensures efficient breeding outcomes. Similar findings were reported by Ahmad *et al*., (2019), Deepa *et al*., (2018), Harshitha *et al*., (2019), Khan *et al*., (2017), Raja *et al*., (2007), Ranjan *et al*., (2015) and Varalakshmi *et al*., (2018). High heritability coupled with moderate genetic advance as a per cent of mean recorded in number of branches per plant, node number on which first male flower appears, node number on which first female flower appears, number of fruits per vine, fruit length and average fruit weight(kg) in cross 1 and node number on which first female flower appears and days to first female flower appearance in cross 2 and number of branches per plant, node number on which first male flower appears, node number on which first female flower appears, days to first male flower appearance and fruit diameter(cm) in cross 3. High heritability with moderate GAM suggests both additive and non-additive gene effects, making selection partially effective while also highlighting the potential for hybrid breeding. This balance ensures stable and gradual genetic improvement in plant breeding. These results are in align with Alekhar *et al*., (2019), Jhangel *et al*., (2018), Koppad *et al*., (2015), Rana and Pandit (2011), Rashid *et al*., (2020), Resmi and Sreelathakumary (2017), Sultana *et al*., (2015), Tomar *et al*., (2008), Usharani and Nagabhushana (2017) and Vijaykumar *et al*. (2020).

**Table 1 :** Mean, variability, heritability and genetic advance for different characters in $F_6$ generation of cross-1(Pusa Sandesh × Arka Bahar)

| Characters | Range | Mean | PCV | GCV | Heritability (%) | GA at 5% | GAM at 5% |
|---|---|---|---|---|---|---|---|
| Number of branches per plant | 7.00-8.96 | 7.93 | 6.15 | 5.75 | 87.21 | 0.88 | 11.05 |
| Node number on which first male flower appears | 2.98-4.29 | 3.71 | 10.99 | 10.22 | 86.49 | 0.73 | 19.58 |
| Node number on which first female flower appears | 4.00-5.98 | 5.17 | 10.56 | 9.00 | 72.63 | 0.82 | 15.81 |
| Days to first male flower appearance | 28.19-32.30 | 29.99 | 3.79 | 3.43 | 81.92 | 1.92 | 6.40 |
| Days to first female flower appearance | 29.00-34.00 | 31.67 | 4.61 | 3.06 | 43.84 | 1.32 | 4.17 |
| Sex ratio | 16.00-19.98 | 17.73 | 6.26 | 5.55 | 74.37 | 1.75 | 9.85 |
| Days to first harvest | 51.52-58.00 | 53.97 | 3.43 | 3.04 | 78.46 | 2.99 | 5.54 |
| Number of fruits per vine | 11.00-16.96 | 13.58 | 12.75 | 10.64 | 69.68 | 2.48 | 18.30 |
| Fruit length (cm) | 18.00-41.32 | 34.01 | 15.17 | 14.31 | 88.92 | 9.45 | 27.79 |
| Fruit diameter (cm) | 28.00-32.89 | 30.70 | 6.16 | 6.14 | 99.47 | 3.87 | 12.62 |
| Average fruit weight (kg) | 0.92-1.49 | 1.19 | 13.05 | 11.69 | 80.18 | 0.26 | 25.56 |
| Fruit yield per vine (kg) | 14.53-30.00 | 23.04 | 21.54 | 20.32 | 89.00 | 9.10 | 39.49 |

*PCV- Phenotypic coefficient of variation *GCV- Genotypic coefficient of variation
*GA- Genetic advance *GAM- Genetic advance as a per cent of mean

**Table 2 :** Mean, variability, heritability and genetic advance for different characters in $F_6$ generation of cross-2(Pusa Sandesh × Punjab Bahar)

| Characters | Range | Mean | PCV | GCV | Heritability (%) | GA at 5% | GAM at 5% |
|---|---|---|---|---|---|---|---|
| Number of branches per plant | 3.50-6.89 | 5.24 | 19.46 | 17.56 | 81.36 | 1.71 | 32.62 |
| Node number on which first male flower appears | 3.00-5.97 | 4.08 | 18.79 | 16.53 | 77.41 | 1.22 | 29.97 |
| Node number on which first female flower appears | 4.00-5.50 | 4.62 | 9.31 | 8.28 | 79.18 | 0.70 | 15.18 |
| Days to first male flower appearance | 29.75-34.59 | 32.07 | 4.43 | 3.80 | 73.66 | 2.16 | 6.72 |
| Days to first female flower appearance | 31.00-38.98 | 35.35 | 6.37 | 6.24 | 95.89 | 4.45 | 12.58 |
| Sex ratio | 14.00-20.00 | 16.55 | 6.88 | 5.72 | 69.15 | 1.62 | 9.79 |
| Days to first harvest | 51.00-56.09 | 54.11 | 2.19 | 2.06 | 88.01 | 2.15 | 3.98 |
| Number of fruits per vine | 14.28-27.00 | 19.11 | 18.95 | 18.78 | 98.20 | 7.32 | 38.33 |
| Fruit length (cm) | 9.00-21.00 | 14.62 | 20.30 | 17.61 | 75.24 | 4.60 | 31.46 |
| Fruit diameter (cm) | 18.23-33.29 | 26.71 | 14.59 | 12.91 | 78.29 | 6.28 | 23.53 |
| Average fruit weight (kg) | 0.96-1.89 | 1.43 | 19.47 | 19.29 | 98.20 | 0.56 | 39.38 |
| Fruit yield per vine (kg) | 18.00-34.00 | 23.56 | 17.36 | 16.78 | 93.46 | 7.87 | 33.42 |

*PCV- Phenotypic coefficient of variation *GCV- Genotypic coefficient of variation
*GA- Genetic advance *GAM- Genetic advance as a per cent of mean

**Table 3 :** Mean, variability, heritability and genetic advance for different characters in $F_6$ generation of cross- 3 (Pusa Naveen × Local Long)

| Characters | Range | Mean | PCV | GCV | Heritability (%) | GA at 5% | GAM at 5% |
|---|---|---|---|---|---|---|---|
| Number of branches per plant | 8.00-10.98 | 9.47 | 8.78 | 7.93 | 81.60 | 1.40 | 14.78 |
| Node number on which first male flower appears | 5.00-6.71 | 5.68 | 9.66 | 9.51 | 96.95 | 1.10 | 19.29 |
| Node number on which first female flower appears | 5.00-7.40 | 6.10 | 9.17 | 8.21 | 80.20 | 0.92 | 15.15 |
| Days to first male flower appearance | 28.94-38.92 | 35.06 | 7.20 | 6.93 | 92.64 | 4.82 | 13.74 |
| Days to first female flower appearance | 34.56-40.09 | 37.03 | 4.39 | 4.35 | 98.09 | 3.29 | 8.88 |
| Sex ratio | 15.00-17.49 | 16.18 | 5.22 | 5.03 | 92.94 | 1.62 | 9.99 |
| Days to first harvest | 52.00-59.86 | 56.54 | 3.94 | 3.87 | 96.86 | 4.44 | 7.85 |
| Number of fruits per vine | 3.56-9.00 | 6.46 | 21.81 | 21.57 | 97.80 | 2.84 | 43.94 |
| Fruit length (cm) | 28.23-42.31 | 36.37 | 12.13 | 11.69 | 92.94 | 8.44 | 23.21 |
| Fruit diameter (cm) | 25.00-35.26 | 31.53 | 8.54 | 8.39 | 96.40 | 5.35 | 16.97 |
| Average fruit weight (kg) | 1.00-1.60 | 1.44 | 11.46 | 10.78 | 88.48 | 0.31 | 20.88 |
| Fruit yield per vine (kg) | 8.64-15.98 | 11.13 | 17.44 | 17.26 | 98.00 | 3.92 | 35.20 |

*PCV- Phenotypic coefficient of variation *GCV- Genotypic coefficient of variation
*GA- Genetic advance *GAM- Genetic advance as a per cent of mean

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