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# MORPHOLOGICAL AND BIOCHEMICAL PERFORMANCE OF PROGENIES OVER THE PARENTS IN GUAVA (*PSIDIUM GUAJAVA*)

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**ABSTRACT**

Guava (*Psidium guajava* L.) is one of the important fruit crops grown in the tropics and subtropics, belonging to the family Myrtaceae. One of the normal methods of crop improvement in guava is through exploitation of hybrid vigour. This investigation was carried out at fruit science block, Dr.YSRHU-College of Horticulture, Anantharajupeta, Annamayya district, Andhra Pradesh. A total of 36 F1 progenies were developed by crossing 2 parents. Progenies were evaluated along with their parents for morphological and leaf biochemical parameters. Characters like leaf area, fruit weight and number of fruits per plant showed positive heterosis and positive heterobeltiosis.

***Key words :*** *Psidium guajava*, Morphological, Progenies, Heterosis, Heterobeltiosis, Hybrid vigour.

## Introduction

Guava (*Psidium guajava* L.) commonly known as "Apple of Tropics", is one of the most widely grown fruits in India. It ranks fifth in terms of cultivation area and production, following mango, citrus, banana and apple. Guava is a hardy, prolific bearer and highly remunerative fruit. Guava is a perennial, evergreen shrub or small tree, the tree can grow up to 10 meters in height, with spreading branches (Hayes, 1970) The majority of guava cultivars are diploid (2n=22) that are commercially available (Shukla *et al* 2012), while the seedless cultivar is triploid in nature and a shy bearer. Guava can be eaten fresh or processed into juice, jam, jelly, canned segments, nectar, R.T.S., drinks etc. It is rich in vitamin C, carbohydrates, fibre and protein (Pradhan *et al*., 2021). Understanding the genetic basis of heterosis offers valuable guidance in selecting suitable parent lines for hybridization, which is essential for producing offspring with enhanced and desirable traits. Heterosis refers to the improved performance observed in hybrid offspring resulting from the cross between genetically diverse parental lines. These hybrids often exhibit superior agronomic traits such as greater biomass production, accelerated growth rates and enhanced reproductive ability or fertility when compared to both parental genotypes. Heterosis breeding provides an opportunity for improvement in earliness, uniformity, quality, productivity, and development of resistance to pests and diseases (Riggs, 1988). Guava, being cross pollinated crop, exploitation of hybrid vigour is an important aspect towards its improvement.

## Materials and Methods

The experimental material consisted of 2 parents and 36 $F_1$ hybrids maintained at fruit science block, Dr.YSRHU-College of Horticulture, Anantharajupeta, Annamayya district, Andhra Pradesh which is situated at an altitude of 162 metres (531 feet) above mean sea level and at 13.99$^0$ North latitude and 79.33$^0$ East longitude, which falls under the tropical zone with a normal rainfall of 966.1 mm. These hybrids were evaluated along with their parents. All cultural practices like fertilizer

application, spraying of pesticides and fungicides and irrigation were uniformly practised in the experimental site as per the package of practices of guava published by Dr.YSRHU. Observations on guava genotypes were made for plant, fruit and leaf biochemical characters.

**Plant height (m)**

The tree height was recorded by placing a marked bamboo pole on the soil surface near the base to the top of plant and measured in meters

**Trunk girth (cm)**

The trunk girth was measured at 15 cm above ground level with the help of measuring tape and expressed in centimeters.

**Number of primary branches**

The primary branches were physically counted and the number were recorded.

**Leaf area ($cm^2$)**

Average leaf area of 10 leaves from five shoots taken from 3rd and 4th positions from the tip of bearing shoots was measured with the help of leaf area meter (HAISERRS-1) WINDIAS software and their mean values expressed in $cm^2$.

**Leaf chlorophyll content**

The chlorophyll content of fourth leaf from the top of matured shoot at growing stage was recorded with SPAD meter and the average was calculated.

**Fruit weight (g)**

The weight of individual fruits was measured with the help of an electronic weighing balance and expressed in grams.

**Fruit length (mm)**

The length of the fruit was measured from stem end to calyx end with the help of a digital vernier calipers. The means were computed and expressed in millimetres.

**Fruit width (mm)**

The width was measured at the centre of the fruit with the help of a digital vernier calipers. The mean fruit width was computed and expressed in millimetres.

**Seed hardiness ($kg/cm^2$)**

Seed hardness was measured by means of a pocket penetrometer (FR-5120 Digital Fruit Firmness Tester) using a 3 mm probe and expressed as kg $cm^2$. The maximum fraction force required to crack a seed was recorded on 10 seeds per fruit.

**Fruit firmness ($kg/cm^2$)**

The firmness of the fruit was tested by means of a pocket penetrometer (FR-5120 Digital Fruit Firmness Tester). The penetrometer reading was adjusted to zero and the probe was pierced through the fruit surface. The pressure required to penetrate the fruit was recorded in $kg/cm^2$, which was provided on the circular disc of the pocket penetrometer.

**Number of fruits per plant**

The number of fruits per plant was counted plant wise at harvest.

**Leaf biochemical parameters**

**Total anthocyanin (mg 100 $g^{-1}$)**

The total anthocyanin content present in the leaf sample was estimated using spectrophotometric method given by Ranganna (1986). The procedure involved the extraction of anthocyanin by using ethanolic HCl. One gram of sample was placed in a beaker and 100ml of ethanolic HCl was added to it. Then the sample was kept in the refrigerator for overnight at 4°C. The pigment was then filtered using Whatman Filter Paper No.1. The filtrate was taken and the colour was measured at a wavelength of 535 nm against a blank of ethanolic HCl using UV spectrophotometer.

**Total phenols (mg GAE/ 100 g)**

The phenol content was estimated based on the method developed by Singleton *et al*. (1965). As per the outlined procedure, one gram of sample was homogenized with 20 ml of methanol (80%) in a mortar and pestle for 2-3 times. The extracts were pooled and the volume was made up to 50 ml. An aliquot of 0.5 ml of the above extract was taken in test tubes and 0.2 ml of Folin Ciocalteau's phenol reagent was added followed by 3.3 ml distilled water and mixed well. After 2 min., 1 ml of sodium carbonate (20%) solution was added, mixed and allowed to stand at room temperature for 30 minutes. Then, the blue colour developed was read in spectrophotometer at 700 nm. After that, a standard curve for phenols using gallic acid (GA) as standard was prepared and total phenol content was recorded and expressed as mg gallic acid equivalents/100g (mg 100 $g^{-1}$).

**Total flavonoids (mg 100 $g^{-1}$)**

The flavonoid content was estimated based on the method developed by Chang *et al.* (2003). Two grams of sample was homogenized with 20 ml of methanol (80%) in a motor and pestle for 2-3 times. The extract was pooled and made the volume to 50 ml and 1.0 ml of above extract was taken in test tubes and 0.3 ml of 5% $NaNO_2$ followed by 0.3 ml of 10% $AlCl_3$ were added. Subsequently, 3.4 ml of 0.1N NaOH was added after 2

min. and was allowed to stand at room temperature for 10 minutes. Then read the absorbance in spectrophotometer at 510 nm against blank and total flavonoid content was expressed as mg catechin equivalents $100g^{-1}$.

Heterosis is expressed as percent increase or decrease in the performance of $F_1$ hybrid over the mid parent (relative or mid parent heterosis) and better parent (heterobeltiosis) was computed for each character using standard formulas (Shull, 1952). The superiority of $F_1$ hybrid over the mid parental value (i.e., mean value of two parents involved in the cross is known as mid-parent or relative heterosis. The superiority of $F_1$ hybrid over the better parent out of the two parents involved in the cross is referred to as better-parent heterosis or heterobeltiosis (Rai *et al*., 2017).

Estimation of heterosis i.e. average heterosis and heterobeltiosis was also worked out following standard methods.

$$\text{Average heterosis} = \frac{F_1 - MP}{MP} \times 100$$ (MP = Mid parent)

Here, $F_1$-Mean of $F_1$ individuals

$$\text{Heterobeltiosis} = \frac{F_1 - BP}{BP} \times 100$$ (BP = Better parent)

Here, $F_1$-Mean of $F_1$ individual

## Results and Discussion

The Percent heterosis and heterobeltiosis data for vegetative characters were recorded and presented in Tabe 1 and Figs. 1 & 2. The data showed that negative heterosis recorded for all the vegetative characters except leaf area showed positive heterosis (13.94%) and negative heterosis for plant height (-4.68%), trunk girth (-3.97%), number of primary branches (-0.28%) and leaf chlorophyll content (-5.43%). Similarly, positive heterobeltiosis recorded only for leaf area (10.85%) parameter among the vegetative characters and negative heterobeltiosis plant height (-6.63%), trunk girth (-5.67%), number of primary branches (-10.85%) and leaf chlorophyll content (-9.20%). Negative heterosis and negative heterobeltiosis recorded for plant height are considered because they indicate the development of shorter, more compact plants, which can be advantangeous for wind resistance and possibly easier management. Similarly, Positive heterosis and positive heterobeltiosis for leaf area reported by Jain *et al*. (2025). Larger leaf area often correlates with increased photosynthetic capacity and fruit yield. Pourdad and sachan (2003) reported negative heterosis for plant height in Brassica napus. Negative heterobeltiosis also obtained for plant height by Nassimi *et al*. (2006).

The percent heterosis and heterobeltiosis data on physical fruits were recorded and presented in Tabe 2 and Figs. 1 & 2. The data showed that positive heterosis recorded for fruit weight (33.14%), number of fruits per plant (18.90%) fruit width (2.54%) and fruit length (0.37%) and negative heterosis recorded for the characters such as seed hardiness (-2.79%) and fruit firmness- (3.96%). For heterobeltiosis, positive heterobeltiosis recorded for fruit weight (28.24%), seed hardiness (2.74%) and number of fruits per plant

**Table 1 :** Percent heterosis and heterobeltiosis on different vegetative characters in guava progenies.

| Hybrid | Plant height (m) | Trunk girth (cm) | Number of primary branches | Leaf area ($cm^2$) | Leaf chlorophyll content (SPAD) |
|---|---|---|---|---|---|
| Hybrid Mean (P1 × P2) | 2.60 | 47.68 | 4.20 | 93.70 | 42.33 |
| Parent-1 ARP Selection | 2.79 | 50.54 | 4.71 | 84.53 | 46.62 |
| Parent-2 Lalit | 2.67 | 48.76 | 3.71 | 79.95 | 42.90 |
| Heterosis | -4.68 | -3.97 | -0.28 | 13.94 | -5.43 |
| Heterobeltiosis | -6.63 | -5.67 | -10.85 | 10.85 | -9.20 |

**Table 2 :** Percent heterosis and heterobeltiosis on physical fruit characters in guava progenies.

| Hybrid | Fruit weight (g) | Fruit length (mm) | Fruit width (mm) | Seed hardiness ($kg/cm^2$) | Fruit firmness ($kg/cm^2$) | No of fruit per plant |
|---|---|---|---|---|---|---|
| Hybrid Mean (P1 × P2) | 250.73 | 71.83 | 71.47 | 10.18 | 3.54 | 27.77 |
| Parent-1 ARP Selection | 195.52 | 73.58 | 71.86 | 11.04 | 3.62 | 23.14 |
| Parent-2 Lalit | 181.12 | 69.55 | 67.55 | 9.91 | 3.75 | 23.57 |
| Heterosis | 33.14 | 0.37 | 2.54 | -2.79 | -3.96 | 18.90 |
| Heterobeltiosis | 28.24 | -2.38 | -0.54 | 2.74 | -5.59 | 17.82 |

**Table 3 :** Percent heterosis and heterobeltiosis on leaf biochemical parameters at vegetative and flowering phase in guava progenies.

| Hybrid | Total anthocyanin (mg/100 g) | | Total phenols (mg GAE/ 100 g) | | Total flavonoids (mg/100 g) | |
|---|---|---|---|---|---|---|
| | Vegetative | Flowering | Vegetative | Flowering | Vegetative | Flowering |
| Hybrid Mean (P1 P2) | 37.01 | 35.25 | 2,199.97 | 2,211.82 | 1228.17 | 1237.06 |
| Parent-1 ARP Selection | 38.11 | 36.00 | 2,245.01 | 2,257.71 | 1249.41 | 1,227.92 |
| Parent-2 Lalit | 38.85 | 36.79 | 2,243.83 | 2,248.42 | 1289.80 | 1255.22 |
| Heterosis | -3.82 | -3.16 | -1.98 | -1.83 | -3.26 | -0.36 |
| Heterobeltiosis | -4.74 | -4.20 | -2.01 | -2.03 | -4.78 | -1.45 |

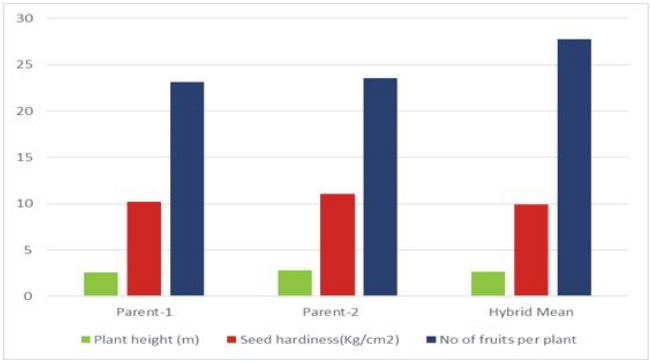


**Fig. 1 :** Comparison of parents and hybrid means for plant height (m), seed hardiness (kg/cm$^2$) and number of fruits per plant.

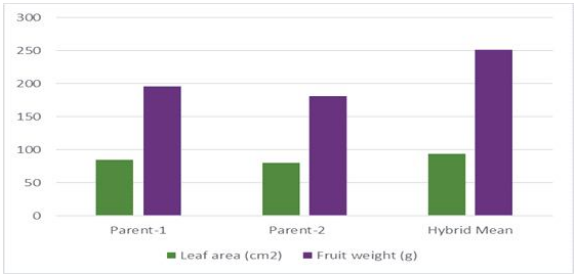


**Fig. 2 :** Comparison of parents and hybrid means for leaf area (cm$^2$) and fruit weight (g).

(17.82%) and the remaining fruit characters like fruit length (-2.38%), fruit width (- 0.54%) and fruit firmness (-5.59%) showed negative heterobeltiosis. Similar, results of fruit weight of lalit reported by Tiwari *et al*. (2016) and findings of fruit length and fruit width of lalit reported by Ahir *et al*. (2023).

The percent heterosis and heterobeltiosis data on leaf biochemical parameters were recorded at vegetative and flowering phase and presented in Tabe 3. The data showed that all the leaf parameters at vegetative and flowering phase showed negative heterosis and negative heterobeltiosis. For heterosis total anthocyanin at vegetative (-3.82%), at flowering (-3.16%), total phenols at vegetative (-1.98%), at flowering (-1.83%), total flavonoids at vegetative (-3.26%), at flowering (-0.36%) and for heterobeltiosis total anthocyanin at vegetative (-4.74%), at flowering (-4.20%), total phenols at vegetative (-2.01%), at flowering (-2.03%), total flavonoids at vegetative (-4.78%), at flowering (-1.45%). Similar results of total phenols, total flavonoids at vegetative and flowering phase of lalit reported by Singh *et al*. (2019). Similarly, total anthocyanin at vegetative and flowering phase reported by Nikumbhe *et al*.(2021).

## Conclusion

Estimation of heterosis and heterobeltiosis helpful to identify hybrids in the terms of morphological and biochemical parameters and help in increasing production and productivity of guava with better quality fruits. Heterosis is manifested through greater vigour of $F_1$ over their parents resulting into better results on desirable economic traits. A positive heterosis value indicates that the hybrid exhibits superior trait expression. The exploitation of heterosis has transformed crop improvement, leading to the development of superior progenies.

## References

Ahir, M., Kumar K., Thakur D.K., Chopra M.L. and Dangi G. (2023). Fruit morpho-physical and biochemical characteristics of some guava (*Psidium guajava* L.) cultivars and hybrids under subtropical conditions of Himachal Pradesh. *Indian J. Ecol*., **50(1)**, 124-128.

Chang, C., Yang M., Wen H. and Chern J. (2003). Estimation of total flavonoid content in propolis by two complementary colorimetric methods. *J. Food Drug Anal.*, **10**, 178-82.

Hayes, W.B. (1970). *Fruit Growing in India*. Kitabistan. Allahabad, India; 1970. Page: 72.

Jain, S., Kumar R., Singh V.P., Chand S. and Singh N.K. (2025). Assessment of hybrid vigour in guava (*Psidium guajava*). *Int. J. Adv. Biochem. Res*., **9(1)**, 935-940.

Nassimi, A.W., Raziuddin S.A. and Naushad A. (2006). Study on heterosis in agronomic characters of rapeseed (*Brassica napus* L.) using diallel. *J. Agronomy*, **5**, 505-508.

Nikumbhe, P.H., Ucho J. and Singh V.K. (2021). Morpho-physiological studies associated with flowering in high-density planted guava (*Psidium guajava*). *Indian J.*

*Agricult. Sci*., **91(12)**, 1709-1712.

Pourdad, S.S. and Sachan J.N. (2003). Study on heterosis and inbreeding depression in agronomic and oil quality characters of rapeseed (*Brassica napus* L.). *Seed and Plant*, **19**, 29-33.

Pradhan, N., Rani R. and David J. (2021). A review on utility of an astonishing fruit: *Psidium guajava* L. (Guava). *J. Sci. Technol*., **6(1)**, 60-72.

Rai, S.K., Sandhu R., Jat L., Kumar A., Kiran U., Mukhtar S., Kohli S. and Rai G.K. (2017). Study of heterosis and combining ability for yield and its component traits in *Brassica juncea* L. *Int. J. Curr. Microbiol. Appl. Sci*., **6(12)**, 2570-2579

Ranganna, S. (1986). *Handbook of analysis and quality control for fruits and vegetable products*. 2th Edition. Tata McGraw-Hill publishing company limited, New Delhi. 9-10.

Riggs, T.J. (1988). Breeding F1 hybrid varieties of vegetables. *Int. J. Horticult. Sci*., **63**, 362-369.

Shukla, A.K., Sarolia D.K., Mahawer L.N., Bairwa H.L., Kaushik R.A. and Sharma R. (2012). Genetic variability of guava (*Psidium guajava* L.) and its prospects for crop improvement. *Indian J. Plant Gen. Resources*, **25(2)**, 157-160.

Shull, G.H. (1952). Begginings of the heterosis concept. In: Heterosis J.W. Gowen (ed.), pp. 14-48. Lowa State University. Press, Ames, IA.

Singh, G., Deepak, Sahare H.A. and Kumar V. (2019). Evaluation of guava (*Psidium guajava* L.) leaves of various varieties for preparing leaf tea. *Think India J*., **22(30)**, 392-99.

Singleton, V.I., Joseph A. and Rossi (1965). Colorimetry of total phenolics with phosphomolybdic - phosphotungstic acid reagents. *Amer. J. Enol. Viticult*., **16**, 144-158.

Tiwari, A., Pal A.K., Singh S., Singh S.P. and Patidar V.L. (2016). Physico-chemical attributes and organoleptic assessment of guava (*Psidium guajava* L.) cultivars grown in Eastern Uttar Pradesh. *J. Appl. Nat. Sci*., **8(4)**, 1731-34.