

# CROP IMPROVEMENT OF GUAVA (*PSIDIUM GUAJAVA*) THROUGH IT'S GENETIC RESOURCES

## Abstract

Guava, frequently referred to as the "tropical apple," is a significant crop of fruit in India. Guava is valued for its hardiness, vitamin C, and export potential. Its versatility extends to culinary uses and potential health benefits. In 2021-2022, India, led by Uttar Pradesh, produced 5.59 million metric tons of guava, showcasing genetic diversity with unique cultivars globally. Crop improvement targets high-yield dwarfs, seedless varieties, adjusted pectin, uniform ripening, and prolonged shelf life. Guava became available to India in the 17th century after being introduced to Tropical America, resulting in a variety of Indian varieties. Essential rootstocks like *Pisidium cujavillis*, *Psidium mole*, and Chinese guava are pivotal. Noteworthy Indian guava cultivars include Pant Prabhat, HAPSI-35, and Allahabad Safeda. Global cultivation in countries like Australia, Brazil, and the USA brings forth varied guava varieties. Breeding methods encompass selection, hybridization, and mutation, yielding popular varieties like Sardar and Arka Mridula. Recent guava research advancements, including genomics and biotechnology, promise enhanced cultivation and quality.

**Keywords:** Breeding, Genetic diversity, Mutation

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## I. INTRODUCTION

Guava, being part of the Myrtaceae family, is one of India's most important fruits. Guava is a different designation for this fruit "tropical apple." It originated in tropical America, ranging from Mexico to Peru, (Landrum, 2017).it developed into a crop of significant commercial value in a number of nations due to its hardiness, ample bearing, and high vitamin C (260–300 mg/100g) concentration. The guava also has the most significant fiber content. Due to the fragrance and sweetness of the fruit, guava is prized for eating when fresh. However, plenty of its byproducts, things about the potential for export, like jelly or pulp concentrate. When the last few decades, new germplasm and raw materials have been generated because to the utilization of the technique of transformation as a reliable source of genetic variety (Van Harten, 1998; Sharma *et al.*, 2020, Sanada and Amano, 1998). While spontaneous variations have led to the creation of numerous cultivars in fruit crops, these changes are rare in nature. This rate has been artificially accelerated using various physical and chemical contaminants (Mba *et al.*, 2010); Forster and Shu, 2012) any mutagenesis agent's ability to cause a sizable proportion of beneficial improvements compared to unfavorable ones determines how effective it becomes in a breeding project (Oladosu *et al.*, 2016).

In 2021-2022, it was estimated that India would produce 5.59 million metric tons of guava, covering approximately 359 thousand hectares of cultivable land. India's highest guava producing state is Uttar Pradesh.

## II. USES

Guavas are tropical trees, and their fruits are oval in shape with light green or yellow skin, containing edible seeds (Smith *et al.*, 2021). Furthermore, guava leaf extract is consumed as a supplement, and the leaves are used for preparing a herbal tea also use in diarrhea (Birdi *et al.*, 2011). Guava may help you better regulate your blood sugar, according to some data (Gupta *et al.*, 2020). The extract of guava leaves has been demonstrated to have anticancer effects, can increase immunity, and can aid in the treatment of constipation (Santos *et al.*, 2018).

Guava is frequently used to make the infamous drink agua fresca. It is sometimes dipped in chamoy likewise. In these areas, pulque de guayaba, also known as Spanish for "guava," is a well-liked alcoholic beverage (Rodriguez *et al.*, 2020). Guavas are often used to manufacture confections, jams, jellies, preserves, and marmalades (Tiwari *et al.*, 2013). The fruit is rich in minerals, pectin, vitamins, carbohydrates, protein, and fiber (Sushmith *et al.*, 2018).

## III. OBJECTIVES OF CROP IMPROVEMENT

- To create superior, high-yielding dwarf cultivars
- Even shape, decent size, appealing skin and pulp colour, and few and soft seeds
- Creation of seedless varieties
- Less pectin content when used for food.
- Uniform ripening
- Long extends the shelf life and suitable for tables

1. **Center of diversity:** Tropical America is the center of origin of guava (Hayes, 1953). Guava come in India at a 17<sup>th</sup> century.

**Table 1: Distribution around the entire country**

Species	Common name	Specific Feature
<i>Psidium guineense</i>	Brazilian Guinea or Brazilian guava	Small fruit with poor quality
<i>Psidium cattleianum</i>	Cattley guava or Strawberry guava	Purplish red colour small fruit
<i>Psidium montanum</i>	Mountain guava	Fruits are small, globose in form and vibrant crimson in colour
<i>Psidium friedrichsthalianum</i>	China guava	Small fruit, wilt resistance
<i>Psidium cujavillus</i>	Lemon guava	Fruit a globose berry, 2-3 cm diameter. Golden yellow when ripe
<i>Acca sellowiana</i>	Pineapple guava	Lime-green fruits Chicken-eggs, with waxy skin

**Table 2: India encounters guava species available**

<i>Psidium pumilum</i>	HETC, Basti and Saharanpur
<i>Psidium montanum</i>	IIHR, Bangalore
<i>Psidium acutangulam</i>	IIHR, Bangalore
<i>Psidium guineense</i>	HETC, Basti and NDUA & T, Faizabad
<i>Psidium friedrichsthalianum</i>	HETC, Basti and NDUA & T, Faizabad.
<i>Psidium cujavillus</i>	HETC, Basti and NDUA & T, Faizabad.
<i>Psidium chinensis</i>	HETC, Basti and NDUA & T, Faizabad.
<i>Psidium cattleianum</i>	HETC, Basti and NDUA & T, Faizabad.
<i>Psidium oraca</i>	HETC, Basti

**Table 3: Rootstocks of Guava**

Rootstocks	Feature
<i>Psidium cujavillis</i>	Non-uniform and rough-skinned fruits
<i>Psidium mole</i>	Resistant to wilt
Crioula	Tolerant to pests and diseases, Rust
Chinese guava	Dwarf and compatible rootstock, resistant to wilt and nematode.
Pusa Srijan	Tolerance to wilt

**Table 4: Guava Cultivar**

<b>Cultivar</b>	<b>Description</b>	<b>Use / purpose</b>
Pant Prabhat	Red skin and flesh, from G.B.P.U.A.S.T., Pantnagar	Jelly making (Blitch)
HAPSI-35, 46	Red skin and flesh, suitable for Nectar making	Nectar making
HAPSI-16	Red skin and flesh, high in vitamins, long shelf life	Longer shelf life
Bangkok Gold Apple	Newly released variety, supreme mild flesh, rich in pectin	Jelly making
Allahabad Safeda	Vigorous tree, medium size, smooth skin, cold tolerant	Important in Uttar Pradesh
Chittidar	Tall tree, small yellow fruits with red dots, good keeping quality	Good keeping quality
Apple Colour	Medium-sized tree, small sweet pink fruits, good keeping quality	Good keeping quality
Sardar Guava	Semi-dwarf tree, large yellow fruit,	Drought-tolerant

**Table 5: World's Most Important Guava Varieties**

<b>Country</b>	<b>Variety</b>
Australia	Beaumont, Sardar, Ka Hua Kula
Bangladesh	Baromasi, also known as the "Barahmasi" guava, Swarupkathi
Brazil	Pedro Sato, Século XXI (21st Century) ,Douradinha ,Paluma ,Costa Rica
Cuba	Cuba Enana Roja Cubana; EEA 1–23
Egypt	Bassateen El Sabahia, Bassateen Edûna.
Hong Kong	Pink, Jambu Kapri Putih, Maha 65, Bentong Seedless.
India	Apple Colour, Sardar, Karela, Seedless, Red Fleshed, Lalit, Lalima, Sardar, Arka Mridula, Arka Amulya, Baruipur
South Africa	Fan Retief, Frank Malherbe.
Taiwan	Tai-kuo-ba, Corozal Mixta, Corriente, Seedling 57-6-79
USA (Hawaii)	Beaumont, Pink Acid, Ka Hua Kul

2. **Genetic diversity:** The evaluated qualitative elements such as fruit size, shape, texture of pulp, color of pulp and peel, and fruit. Dots, pulp flavor, etc., are crucial for obtaining the best results. farmers and consumers are accepted (Nayan *et al.*, 2022). Like the qualitative data, characteristic that comprises fruit length, weight, and pulp thickness, antioxidant, total soluble solids, ascorbic acid, and pulp weigh capacity, amongst other things, is

important for export and processing manufacturing as also for farmers (Nayan *et al.* 2022).

#### IV. METHOD OF BREEDING

- Selection
- Hybridization
- Mutation

**1. Selection:** The Ganeshkhind Fruit Experiment Station in Pune, India, initiated guava improvement in 1907 by collecting diverse guava seeds to identify superior cultivars. A pool of 600 seedlings that had been thoroughly inspected over fruit quality as well as yield (Cheema and Deshmukh, 1927). Lucknow-49 (originating in Lucknow from Allahabad Safeda seeds) turned well-known for its widespread cultivation; Because of its low seed number and medium quality, this prolific bearer, which is greenish yellow with milky white sweet pulp, is used for table purposes and yields 25 t/ha. it eventually received the name Sardar (Cheema *et al.*, 1954).

Saharanpur Fruit Research Station, led by (Singh in 1953) and (Rangacharlu, 1954) developed S-1, known for its desirable fruit shape, reduced seed count, pleasing taste, and prolific yield. Marathwada produced promising strains, including ABD 3, BHR 3, and BHR 5. Karnataka selected sixteen high-performing guava seedlings from the Navalur variety.

Faizabad revealed two promising seedlings (FS 1, FS 2) and three Allahabad Safeda seedlings (AS 1, AS 2, AS 3) for exceptional fruit quality and productivity (Pathak and Dwivedi, 1988). Arka Mridula, from IIHR in Bangalore, resulted from 200 Allahabad Safeda seedlings and featured compact, high-yield plants with medium-sized fruits, minimal soft seeds, high sugar content, T.S.S., and extended shelf life. Allahabad Surkha, distinguished by large pink fruits with deep pink flesh, originated in the Allahabad region (Nand *et al.*, 1991). CISH-G-3, named Lalit, emerged from 631 red guava seedlings at CISH in Lucknow, featuring saffron-colored fruits, firm pink flesh, balanced sugar and acid content, and storage stability, yielding 24 percent more than Allahabad Safeda (Anon., 1998-99).

The Pant Prabhat variety, with abundant yield and small, rounded fruits with soft seeds, was introduced at GBPUA Dhareedar, from Kuthulia, Rewa's Fruit Research Station, featured fruits around medium as well as large with flavorful pulp.

Beyond India, global guava improvement efforts thrived. In Brazil, Canizares conducted an extensive study with over Canizares (1981) 3000 seedlings, recognizing five plants with fruits weighing over 400g each. Rensburg and Preeze (1985) selected six Nelspriut guava varieties for South Africa, with selection No.1 excelling in ascorbic acid concentration and selection No. 6 displaying the maximum fruit weight. In Cuba, four varieties (Enana Roja Cubana, N6, Suprema Roja, and Belic L-207) were chosen from a seedling screening project in (Rodríguez *et al.*, 2010). Varieties with vibrant red fruit command higher prices and exhibit superior quality and shelf life.

2. **Hybridization:** Guava hybridization has been actively investigated by research institutions all over the world, however there are few global hybrids available. In India, H1 and H6 hybrids showed potential for fruit quality and early bearing Horticulture R&D Training Centre, Basti, U.P. while 55 hybrids at the Fruit Research Station in Anantharajupet, Andhra Pradesh, showed no such promise. In Sangareddy, intervarietal hybridization produced the superior Safed Jam and Kohir Safeda hybrids (Andhra Pradesh) and are currently commercially grown in semi-arid regions (Shanmugavelu *et al.* 1987, Mitra and Bose, 1985). The 600 F1 hybrids created by IIHR in Bangalore included the high-yield Arka Amulya. Pink-pulp variations Arka Kiran and Arka Rashmi have been rendered available by ICAR-IIHR. High-lycopene, low-seed guava hybrids with a variety of fruit traits were the main focus of ICAR-CISH (Lucknow). In Bihar, Rajendra Agricultural University created an outstanding cross between Sardar and Apple Colour. The Agricultural Research Institute of Taiwan developed wilt-resistant crosses that have potential for commercial use. To this advancement, (Rodriguez *et al.* 2010) made a contribution. (Rajan *et al.* 2007) explored genetic divergence and recommended hybridization between populations that did not appear closely related with the objective to improve seed attributes.
3. **Mutation:** In contrast to genetic isolation or recombination, mutations are abrupt, inheritable modifications to an organism's genetic makeup (De Vries, 1901). De Vries created the term "sudden" for these changes. They come from stochastic plant mutations and variances in the wild and in cultivation. "Mutation breeding" is intentional selection for crop improvement that uses mutagens to cause changes and molecular or phenotypic approaches to identify mutants (Van Harten, 1998).

Recent advances in genomics have significantly contributed to guava's genetic enhancement and biotechnological applications.

- **Functional Markers Across the Genome:** The genome of guava cultivar Allahabad Safeda revealed 14,115 genes, shedding light on the genetic makeup of this important fruit (Thakur *et al.*, 2021). Comparative transcriptomics suggested trait-based breeding possibilities and unveiled the strong resemblance to eucalyptus.
- **Somatic Embryogenesis:** This technique for consistent plant reproduction from individual cells was explored, potentially revolutionizing guava propagation (P. K. *et al.*, 2010 somatic embryogenesis research). Factors affecting it were studied, and applications included clonal propagation, genetic modification, and synthetic seed production.
- **Novel g-SSR Markers:** Over 10,000 genomic simple sequence repeat (g-SSR) markers were discovered via next-generation sequencing, proving valuable for characterizing genetic variation in guava (Ma, *Zet al.*, 2020).
- **Biotechnological Achievements:** A review highlighted guava's biotechnological progress, covering regeneration, genetic modification, markers, and genomics (Manoj *et al.*, 2010). Challenges like regeneration efficiency and gene silencing were discussed, offering avenues for improvement in guava research and breeding.

## V. CONCLUSION

Guava is a vital fruit in India, celebrated for its resilience and culinary versatility. Its high vitamin C content and diverse uses, from jelly to herbal tea, highlight its importance. India's significant guava production, especially in Uttar Pradesh, underscores its agricultural value. Crop improvement aims to enhance commercial viability with high-yield dwarfs and seedless varieties. Guava's origin in Tropical America led to diverse Indian species, and essential rootstocks and cultivars are pivotal. Various breeding methods have produced desirable varieties globally, and recent genomic and biotechnological advancements promise further enhancement in cultivation and quality.

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