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# Study on the Physico-chemical Characteristics of Bael Germplasms Collected from various Location of Madhya Pradesh, India

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**ABSTRACT: Survey is very important for understanding the reasons behind physiological parameter and fruit variation in bael germplasm Survey was made for collection of different germplasm of Bael. It was studied during 2022-23 in the month May-June in various location of Jabalpur district under AICRP-AZF, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) and analysis was done for studies the physico-chemical characteristics of collected Bael germplasms. Total twelve germplasms were selected and collected fully ripe Bael fruit, the germplasm code is JB-1 to JB -12. Among the 12 germplasm, JB-8 and JB-9 germplasm were having maximum fruit size, weight and fruit volume followed by JB-1, JB-6, and JB-7 and remaining germplasm was at par. Average Fruit weight is ranged from 142 g to 1450 g, fruit volume (82 to 1290 ml), fruit length (71.2 to 137.0 mm), fruit width (61.2 to 137.9 mm), pulp weight (70.3 to 1003.0 g), number of seed (50 to 105), seed weight (17 to 38 g), rind weight (75 to 328 g), rind thickness (2.4 to 4.8). The maximum fruit weight recorded in germplasm JB-8 (1450 g), fruit volume (1290 ml), shell weight (328g), pulp weight (958 g) and seed weight (41 g). Second best germplasm was JB-9 recorded 1178 g fruit weight, 925 ml fruit volume, 748 g pulp weight, medium seed weight 17g, seed number 78 and minimum number of locules i.e. 10. Highest TSS (°Brix) was found in germplasm JB-7 (46.3), JB-1 (44), JB-8 (43) respectively. Germplasm JB-7 observed recorded minimum acidity % (0.57) while in germplasm JB-9 have maximum acidity percent.**

**Keywords:** Bael, Germplasm, survey and fruit.

## INTRODUCTION

Bael (*Aegle marmelos*) belongs to Rutaceae family is an important native fruit of India. It is drought resistance and hardy fruit plant of semi-arid and arid region belongs. *Aegle marmelos* is native across the Indian subcontinent and Southeast Asia, and is cultivated throughout Sri Lanka, Tamilnadu, Thailand, and Malesia. It occurs in dry, open forests on hills and plains at altitudes from 0–1,200 m (0–3,937 ft) with mean annual rainfall of 570–2,000 mm (22–79 in). It has a reputation in India for being able to grow in places that other trees cannot. It survive with a wide range of soil (pH range 5–10) and tolerant of water logging. Bael is a deciduous shrub or small to medium-sized tree, up to 13 meters (43 feet) tall with slender drooping branches and rather open, irregular crown.

Each and every part of this Bael fruit *i.e.* fruit, seed, trunk, bark, leaf, and root are important ingredients of several Ayurvedic prescriptions (Jauhari and Singh 1971). Bael fruit is rich in various nutrients. It is a good source of vitamins, including vitamin C, vitamin A, and niacin. It also contains minerals such as calcium, potassium, and phosphorus. The pulp of the fruit is high in dietary fiber, which aids digestion. Bael has been used in traditional medicine for its numerous health benefits. The fruit, leaves, roots, and bark of the tree are all utilized for medicinal purposes. Bael is known for its digestive properties and is used to treat various digestive disorders such as diarrhea, dysentery, and indigestion. It is also believed to have antimicrobial, antifungal, and anti-inflammatory properties. Bael fruit is also used in the preparation of jams, jellies, chutneys, and desserts. The fresh fruit is not consumed freely because of eating difficulties due to its hard shell, mucilaginous texture, numerous seeds, and fibers. Seeds are flattened oblong, about 1 cm long, bearing woolly hairs and each enclosed in a sac of adhesive, transparent mucilage that solidifies

on drying. The pulp has attractive colour and contains an excellent aroma, which is not destroyed even after processing (Singh *et al*., 2005).

Physicochemical studies demonstrate that Bael fruit is rich in nutritional value, and this is being used from several years ago. The uses of Bael fruit in aspects of food have many forms in each country. For example, the ripe fruit is consumed fresh and also prepared as nectar, squash, sherbet, jam, marmalade, and cream in India (Morton, 1987). Thus, there is immense scope of genetic improvement of Bael through selection of promising genotype from wild genetic diversity rich regions of M.P. The variation in Bael germplasm is of significant importance in plant breeding and conservation efforts. It allows researchers and breeders to select and develop improved varieties with desirable traits, such as high fruit yield, disease resistance, and enhanced medicinal properties. By studying the genetic diversity within bael germplasm, scientists can better understand the species' evolutionary history and develop strategies for its conservation and sustainable utilization.

The survey and collection of Bael germplasm serves as a valuable resource for researchers and plant breeders. It provides a broad genetic base to study various traits, such as disease resistance, yield potential, nutritional quality, and other desirable characteristics. Researchers can use the germplasm to explore new varieties, develop improved cultivars, and enhance the overall productivity and quality of Bael crops. As the global climate changes, preserving genetic diversity becomes increasingly important. Different Bael germplasm accessions may possess unique genetic traits that confer tolerance or resistance to specific environmental conditions, such as drought, heat, or pests. By systematically collecting germplasm from diverse regions, Bael breeding programs can access a wide range of genetic resources to develop climate-resilient varieties that can adapt to changing climates and ensure sustainable crop production. Keeping the above points in view survey was carried out to collect superior germplasm and evaluate the Physico-chemical parameter of Bael fruit from different location of Madhya Pradesh in order to evaluate them for their qualitative traits.

## MATERIAL AND METHODS

The Survey was conducted during the month of May 2022 in different blocks of Jabalpur (Madhya Pradesh). Jabalpur is situated at 23° 10′N latitude and 79° 59′E longitude having an altitude of 412.00 meter above the mean sea level. The climate of the region/location is characterized by long hot summer and cool winter. Total twelve germplasms were selected and collected fully ripe Bael fruit from different location of Madhya Pradesh, India for exploration and physico–chemical analysis purpose of germplasm. The germplasm code is JB-1, JB-2, JB-3, JB-4, JB-5, JB-6, JB-8, JB-9, JB-10, JB-11 and JB-12.

**Table 1: Location and Source of collected germplasm.**

| Sr. No. | Germplasm code | Location | Source |
|---|---|---|---|
| 1. | JB-1 | Adhartal Station Road | Farmers field |
| 2. | JB-2 | Premnagar Katangi | Government site |
| 3. | JB-3 | Patan | Farmers field |
| 4. | JB-4 | Medhi Udana, Jabalpur | Farmers field |
| 5. | JB-5 | Khamond | Farmers field |
| 6. | JB-6 | Khamond | Farmers field |
| 7. | JB-7 | Korja | Farmers field |
| 8. | JB-8 | Rajatola | Farmers field |
| 9. | JB-9 | Rajatola | Government site |
| 10. | JB-10 | Nayapara | Farmers field |
| 11. | JB-11 | Dhanoli | Farmers field |
| 12. | JB-12 | Mandir | Farmers field |

**Physical properties of Bael fruit.** Fruits selected for the physical characteristics. Properly ripped, healthy and uniform size, maturated fruits were selected. physical characteristics i.e. length, width, diameter, and weight were measured. Specific gravity, volume and TSS were also recorded. The flesh was extracted with knife or the spoon manually and recorded the observations. All linear measurements were taken by using Vernier caliper. Quality attributes i.e. colour, appearance, shape, uniformity were recorded visually. The weight of randomly selected three fruits was taken by electronic weighing machine. Average weight of fruit was calculated and expressed in grams. Length of five fruits. Length and diameter measured by Vernier Caliper.

**Volume.** For measuring the volume water displacement method followed.

**Specific gravity.** It calculated by applying the formula as given below:

$$\text{Specific gravity (g/cc)} = \frac{\text{Weight of fruits}}{\text{Volume of water displaced}}$$

**Pulp.** It is ratio of edible part of fruit i.e. pulp to total weight of fruit multiplied by 100. Pulp yield was calculated and expressed in percent.

$$\text{Pulp \%} = \frac{\text{Total weight of pulp}}{\text{Total weight of fruits}} \times 100$$

**Total Soluble Solids.** In each replication's five fruits were sliced into various parts and mashed to produce a homogenized sample, from which juice was extracted and collected by using muslin cloth. To record TSS, Using a hand refractometer, a little quantity of extracted juice were put on the surface of the refractometer's prism with the assistance of a clean glass rod to determine TSS in °Brix. The refractometer's cover was softly folded, and the point when the boundary time of the shaded region interacts with the unshaped area of the scale was observed through the eyepiece with the protective inlet facing light. After each usage, the specimen compartment was cleaned with amuslin cloth and repeated for all the treatments.

**Acidity.** As percent citric acid the acidity of sample was calculated by standard A.O.A.C. method (1990). Acidity was expressed as percent citric. The acidity was determined using the A.O.A.C. (1970) technique, which is a simple acid alkali titration method (1970).

## RESULT AND DISCUSSION

The physical characteristics of fruit play a crucial role for tree improvement purpose as well as processing industries. Quality of any fruit can be assessed by the important physical traits. The data on physical characteristics of ripened Bael fruits are presented in Table 1 with respect to fruit size, fruit volume, peel weight, pulp weight, seed weight, number of seed, number of locules, and biochemical characters like TSS, acidity %. The mean performance of the genotypes revealed a wide range of variability for all these traits. Among the 12 genotypes, fruit size of genotypes JB-8, JB-9, were having maximum fruit size, weight and fruit volume respectively followed by JB-1, JB-6, JB-7and remaining genotypes were exhibited at par fruit size and fruit volume. Fruit weight varies to germplasm to germplasm. It indicates that the expression of plant characters was not uniform. Average Fruit weight is ranged from 142 g to 1450 g, fruit volume (82 to 1290 ml), fruit length (71.2 to 137.0 mm), fruit width (61.2 to 137.9 mm), pulp weight (70.3 to 1003.0 g), number of seed (50 to 105), seed weight (17 to 38 g), rind weight (75 to 328 g), rind thickness (2.4 to 4.8). The maximum fruit weight of in germplasm B-8 noted to be 1450 grams, fruit volume 1290 ml, rind weight 328g, pulp weight 958 g, seed weight 41 g, maximum number of seed 105.

Second best germplasm was JB-9 recorded 1178 g fruit weight, 925 ml fruit volume, 748g pulp weight, medium seed weight 17g, seed number 78 and minimum number of locules i.e. 10.

Highest TSS (°Brix) was found in germplasm JB-7 (46.3), JB-1 (44), JB-8 (43) respectively. Germplasm JB-7 observed recorded minimum acidity % (0.57) while in germplasm JB-9 have maximum acidity percent.

Bael is a sexually reproducing plant, which means it undergoes sexual reproduction and genetic recombination. This process leads to the creation of genetic variation within the species. Bael germplasm consists of a range of genetic variations within the species. Genetic factors control traits such as fruit size, shape, color, flavor, and nutritional composition. Environmental conditions also play a significant role in shaping the physiological parameters and fruit variation in bael germplasm. Factors like temperature, humidity, rainfall, soil type, and sunlight exposure can influence the growth and development of the fruit. The physiological parameters and fruit characteristics can vary depending on the maturity stage at harvest. Bael fruits undergo changes in color, texture, flavor, and nutrient composition as they ripen. The variation in physiological parameters can be attributed to the varying levels of ripeness at which the fruits are harvested.

Bael fruits can exhibit variation in size and shape. Some varieties produce larger fruits, while others may have smaller-sized fruits. The shape of the fruit can also vary, ranging from round to slightly pear-shaped, fruits colour typically have a greenish-yellow or yellowish-green color when they are mature and ripe. However, the exact shade of color can differ among different accessions. Some varieties may have a more vibrant or deeper hue of yellow, while others may appear paler. The texture of the fruit skin and pulp can also show variation. The fruit skin is generally hard and woody, with a rough, wrinkled texture. However, the degree of roughness and texture can differ among different varieties. The pulp inside the fruit can range from soft and creamy to firm and fibrous. Mitra *et al.* (2010) reported the similar variations for fruit weight, rind thickness, number of seeds, total soluble solids, fruit acidity. Rai and Dwivedi (1992) noticed in wide variations in shape, size and fruit quality in different Bael genotypes and this variation offers a great scope for breeding of desirable traits. (Kumar *et al.*, 2008, 2009) also recorded high genetic variability in range of economically important physic-chemical traits *viz*., fruit yield, fruit weight, TSS etc. Similar variations in fruit weight, fruit length, fruit volume, fruit circumference and skin thickness in different genotypes/cultivars of bael have also been reported by a number of workers (Nath *et al.,* 2003; Pandey *et al.,* 2013). A wide variation is encountered in bael because it is a cross pollinated crop and is mainly propagated through seed (Kumar *et al*., 2008).

**Table 2: Fruit, pulp, peel weight, fruit volume and peel thickness of different germplasms.**

| Sr. No. | Germplasm code | Fruit weight (g) | Pulp weight (g)/ fruit | Fruit volume (ml) | Shell weight (g) | Shell thickness (mm) |
|---|---|---|---|---|---|---|
| 1. | JB-1 | 657.3 | 414.4 | 360 | 212.6 | 2.6 |
| 2. | JB-2 | 450.7 | 214.5 | 198.33 | 203.5 | 2.8 |
| 3. | JB-3 | 179.83 | 121.3 | 120 | 38.63 | 3.1 |
| 4. | JB-4 | 421.83 | 285.54 | 310 | 116.99 | 2.6 |
| 5. | JB-5 | 527.0 | 407.8 | 396.6 | 103.9 | 3.0 |
| 6. | JB-6 | 777.8 | 450.12 | 550 | 280.36 | 3.2 |
| 7. | JB-7 | 652.2 | 455.3 | 545 | 161.33 | 3.3 |
| 8. | JB-8 | 1450 | 1003.0 | 1290 | 405.54 | 2.8 |
| 9. | JB-9 | 1178 | 849.55 | 925 | 303.01 | 2.4 |
| 10. | JB-10 | 444.5 | 225.5 | 285 | 193.5 | 4.8 |
| 11. | JB-11 | *211* | *130.5* | *145* | 60.8 | 2.5 |
| 12. | JB-12 | 142 | 70.3 | 82.5 | 39.5 | 4.2 |

**Table 3: Number of locules, seed, seed weight, TSS and acidity of different germplasms.**

| Sr. No. | Germplasm code | Number of locules | Number of seeds | Seed weight (g)/ fruit | TSS ($^0$Brix) | Acidity (%) |
|---|---|---|---|---|---|---|
| 1. | JB-1 | 16 | 66 | 30.2 | 44 | 1.08 |
| 2. | JB-2 | 13 | 104 | 39.7 | 41 | 0.85 |
| 3. | JB-3 | 14 | 57 | 19.9 | 36 | 1.30 |
| 4. | JB-4 | 14 | 58 | 19.3 | 42 | 1.10 |
| 5. | JB-5 | 12 | 50 | 17.2 | 40 | 1.04 |
| 6. | JB-6 | 14 | 88 | 38.6 | 38 | 1.02 |
| 7. | JB-7 | 15 | 70 | 35.6 | 46.5 | 0.57 |
| 8. | JB-8 | 16 | 105 | 41.5 | 43 | 1.15 |
| 9. | JB-9 | 10 | 78 | 27.5 | 36 | 1.40 |
| 10. | JB-10 | 13 | 80 | 25.5 | 43 | 0.89 |
| 11. | JB-11 | 11 | 38 | 19.5 | 40 | 1.21 |
| 12. | JB-12 | 10 | 86 | 32.1 | 41 | 1.15 |

## CONCLUSIONS

Survey is very important for understanding the reasons behind physiological parameter and fruit variation in bael germplasm is crucial for selecting and breeding improved varieties, optimizing cultivation practices, and ensuring post-harvest quality. By studying and manipulating these factors, researchers and farmers can work towards developing bael cultivars with desirable physiological parameters, improved fruit quality, and increased yield.

Among the 12 germplasm, the range of fruit weight from 142 g to 1450 g, fruit volume (82 to 1290 ml), fruit length (71.2 to 137.0 mm), fruit width (61.2 to 137.9 mm), pulp weight (70.3 to1003.0 g), number of seed (50 to 105), seed weight (17 to 38 g), rind weight (75 to 328 g), rind thickness (2.4 to 4.8). The maximum fruit weight, fruit volume, shell weight, pulp weight and seed weight was recorded in germplasm JB-8 followed by germplasm was JB-9 recorded. Highest TSS (°Brix) was found in germplasm JB-7. Germplasm B-7 observed recorded minimum acidity % (0.57) while in germplasm B-9 have maximum acidity percent.

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**Conflict of Interest**. None.

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