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STUDIES ON PHYSICAL ATTRIBUTES OF BAEL (*AEGLE MARMELOS* L. *CORR.*) GENOTYPES UNDER CENTRAL UTTAR PRADESH REGION OF INDIA

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ABSTRACT

Bael (*Aegle marmelos* (L)*Corr*.) occupies an important place among indigenous fruits of India due to its nutritional, pesticidal and medicinal values. Expected growth in production of this crop has not been accomplished yet. Identification of suitable genotypes, therefore, becomes imperative for increasing its production, productivity and quality. A wide range of variation is encountered in Bael (Rai.etal.2005). The present investigation was conducted during summer season. The detail study of selected varieties/genotypes was carried out in relation to growth and physical traits of fruits. Genotypic and phenotypic variation in the vast population have a greater chance of producing a desirable type of variety, with this view keeping in mind 14 varieties/genotype were taken for the study of various parameters and the results in mind are discussed in the light research work done in India and abroad.

***Keywords* :** Bael, nutritional, genotype, phenotype and qualitative traits.

Introduction

One of India's most significant underutilized indigenous fruit crops for medicine is Bael (*Aegle marmelos* (L)*Corr*.) which belongs to the Rutaceae family. It can be found all over India which includes Madhya Pradesh, Uttaranchal West Bengal, Rajasthan, Uttar Pradesh, Bihar, Madhya Pradesh, Uttaranchal, Chhattisgarh, and Odisha, which are all extensively scattered throughout the nation. On a smaller scale, it is also grown internationally in places like Bangladesh, Pakistan, southern Nepal, Cambodia, Sri Lanka, the northern Malay Peninsula, Java, the Philippines, Vietnam, Laos, Cambodia, Thailand etc. Due to its mythical importance, it is mostly planted close to the temples and is only farmed on a modest scale across an area of nearly 800hectares, producing just 2000 MetricTons.Sandy loam soils with adequate drainage are best for its growth. It demands a subtropical environment with dry, hot summers and mild winters as it can cultivate Even at a height of 1200 meters. Although it is grown in all the states of India, there aren't many systematic plantations dedicated to this fruit crop. Due to its hardiness, Bael trees may thrive in a variety of challenging soil and climatic conditions, even in places where other crops cannot It is from the Rutaceae family. It is referred to locally by a variety of names in several languages, including holy fruit, Bael fruit, Bael Giri, Bengal quince, Baelpatra, Bela, Siri-phal, Indian Bael, golden apple, elephant apple and Indian quince stone. Literature from 300 BC onwards refers that it originated in the Eastern Ghats and central India andis indigenous to India. Dry woodlands in plain and hilly location sare good places for Bael to flourish. It is cultivable all over the world and can adapt to a broad variety of habitats. Bael cultivation is best suited to sandy loam soils that are moderately rich and well drained, as well as sunny, warm, and humid weather. Although it was discovered to be appropriate in a variety of soils, including sandy, clay, stony, acidic, alkaline, salt affected soils, wastelands, etc., due to its hardiness. Above data and analysis suggest that

Bael is an ecosystem-friendly tree species that can thrive in a variety of soil types (pH range 5-10) in challenging circumstances, such as hot and dry regions. It can also sustain in a harsh environment of -7 ºC temperature. There are two to three species of Bael, also known as *Aegle marmelos* Correa, which belongs to the Rutaceae family. While the species name, marmelosis, is of Portuguese provenance, the genus name, Aegle, is of Greek origin. Chromosomes X=9 and 2n=36 make up Bael. The tree has fragrant, trifoliate leaves and a whitish/gray trunk that can reach heights of 6 to 8 metres. The petals are typically five thick, oblong, oval, blunt, pale greenish white, and glandularly spotted. It is a deciduous tree. The calyx is shallow, has five thin, board-shaped teeth, and is externally hairy. It has long, shallowly wrinkled, corky, thorny branches. Bael's blooms are 2 cm in diameter, greenish white in colour, bisexual, and sweetly perfumed. They are produced in clusters. The pulp of the Bael fruit encompasses a wide range of bioactive beneficial substances, like coumarins, flavonoids, carotenoids, antioxidants that may guard against long-term illnesses, terpenoids, and phenolic alkaloids. By delivering exceptional fruits for human consumption and animal feed, it may guarantee the security of food and nutrition, leading to stability in the production of all biomass. The therapeutic application of Bael fruit is in demand. In the summer, drinks are made because of their calming and cooling properties. In addition, it also contains many vitamins and minerals, including vitamin C, vitamin A, thiamine, riboflavin, calcium, and phosphorus. In the 1500s, British colonists and Portuguese used this fruit as a remedy to treat diarrhoea and dysentery. Bael is used to treat stomach ailments and enhance digestion as it can transformed into a variety of drinks and jams. There are no well-organized Bael orchards known in the nation, despite the Bael's Indian origin and use for its high medicinal and nutritional benefits. Fat, minerals like Ca and Fe, Proteins, and vitamins, including Vitamin C, riboflavin, beta-carotene, and, are all abundant in Bael fruit. It can be encouraged for the development of waste and under utilised areas since it can adapt to unfavourable environmental circumstances and thrive where other fruit trees cannot. The processing potential of Bael fruit is tremendous, and it may be used to make a variety of goods for export markets, including jam, candies, syrups, and squash. Seed locules may be used to extract gum, which has use in coatings for oil emulsions, water proofing, and adhesives. Its bark is used to treat diabetes, while the Bael tree's root extract possesses anti-inflammatory and wound-healing effects. Compared to plants produced vegetatively, seedling plants begin to yield fruit in 6 to 7 years and 12 to 15 years, full output is achieved. After the litter has fallen, the fruits are often collected at a yellowish-green stage and stored for a week while they lose their green tinge. During this time, the fruits' stems easily split from them. When managed properly, a mature budded bael tree that is 10–12 years old can produce 100–150 fruits, whereas seedling trees will yield 300–400 smaller fruits. The age of the tree, the cultivar, and care techniques all affect fruit output, though. Bael cultivation has several difficulties in spite of its many advantages. Fruit fly, wilt, and leaf spot are just a few of the diseases and pests that are likely to affect the tree. Reduced yields and poor-quality fruit are frequently the result of farmers' lack of expertise and resources to control these pests and illnesses. Bael is also up against competition from more well-known and better-marketed fruit crops like mango, guava, and banana. The development of the bael sector in India is further hampered by a lack of market connections and infrastructure. Examining both the morphological and fruit traits is crucial for differentiating the many bael varieties. But because there isn't a good genotype, the desired growth, blooming, and fruit set haven't happened. To increase productivity, output, and fruit quality in humid sub-tropical environments, it is necessary to choose a genotype that is appropriate for the area. In several parts of India, including GBPUAT, Pantnagar, CISH, Lucknow, NDUA&T, Faizabad and Regional Station numerous land races have recently been established for commercial farming. It has not been investigated if they can adapt to the humid sub-tropical environments in Lucknow. Due to their lack of familiarity with the traits of many bael types, farmers in this area have trouble recognising the cultivars. Desirable growth, blooming, and fruit set have not taken place in the absence of an appropriate genotype. To increase the yield, productivity, and fruit quality of the region's fruit trees in humid sub- tropical circumstances, it is required to identify the genotype that is most suited for the area and suggest the best cultivars which can suitable for commercial cultivation

Materials and Methods

The present investigation was conducted during summer season with an objective to identify the superior genotypes of Bael. The present investigation was the collection of different varieties of Bael in ANDUA & T, Ayodhya than carried out in the laboratory Department of Horticulture Babasaheb Bhimrao Ambedkar University Lucknow. Fourteen varieties of Bael were selected to see their growth and quality attributes. Which were planted at Acharya Narendra Dev University of Agriculture and Technology Ayodhya UP. Collection of twenty-eight healthy, uniform sized fruit free from diseases, pests and blushes randomly selected from the trees of each cultivar from each direction. When the fruits are nearly matured, then it was picked up and taken for experiment in the month of April. The present study assessed fourteen guava genotypes: T1 (NB-3), T2 (NB-4), T3 (NB-5), T4 (NB- 7),T5 (NB-9),T6 (NB-14),T7 (NB-15),T8 (NB-16),T9 (NB-17),T10 (CISHB-1),T11 (CISHB-2), T12 (Pant Sujata), T13 (Pant Aparna) and T14 (Pant Shivani). Measurements were taken for fruit shape, fruit length (cm), fruit breadth (cm), volume (ml), weight (gm), colour, no. of seeds per fruit, pulp weight per fruit, shell weight per fruit, pulp: shell ratio. The collected data underwent statistical analysis.

Plant height (m) the height of each replication was measured from the ground up to the top of the tallest shoot. With the use of the graduated measuring bar, the plant height was measured. The three plants' average heights were calculated together and represented in meter (m). Plant spread (m) during the active growth stage, plant spread was calculated as the canopy diameter (average of East-West and North-South dimensions). Three randomly chosen plants were chosen from the field, and using a graduated measuring bar, the spread of each plant was measured from both directions, that is, from north to south and from east to west. Calculated and represented in meters (m), the average spread of replicates from both sides. Stem girth (cm) was measured at a height of 25 cm, and in the case of grafted/budded plants, 15 cm above the graft union. Three plants were chosen at random, and the average stem diameter, measured in centimeters (cm), was computed. Thorn were visualized thoroughly with the naked eye and observed the short or medium thorn. Fruit Shape: From each replication, three fruits were chosen at random, and the observation was made based on how they looked. Fruit girth (cm) by use of a vernier caliper, the length of the fruits was measured, and their average was taken for consideration. The fruit's circumference was measured in centimeters (cm). Fruit length (cm): With the aid of a Vernier calliper, the fruit length of three randomly chosen fruits per tree was measured, and their average was taken into consideration as a duplicate. The fruit's measurement was given in centimeters (cm). Fruit weight (kg): Picked and weighed on an electric digital balance were three randomly chosen fruits that grew in opposite directions on the tree. By dividing the total fruit weight by the total number of fruits consumed and then expressing the result in kilograms (kg), the average weight was determined. Fruit volume (cm^3): By using the water displacement technique, fruit volume was calculated. A measuring cylinder was used to calculate the amount of water that was lost. The cubic centimeter (cm^3) unit was used to indicate the typical volume. Fruit color: Fruit color was identified by using a color chart. Number of seeds per fruit: Each fruit's total quantity of seeds was carefully counted. Numbers were used to determine and represent the average value. Pulp weight per fruit (g): Selected fruits from each replication's pulp were removed, and the pulp was then weighed on a computerized electric balance. The determined average value was converted to grams (g) and expressed. Shell weight per fruit (g): Separately from each replication's randomly chosen fruits, the shell and pulp were removed. The weight of the shell was measured using an electric digital balance. Calculated and presented in grams, the average value. Pulp-shell ratio: For the pulp shell ratio, the average value of pulp weight was divided by the average value of shell weight. The calculation's outcome was the pulp-to-shell ratio.

Results and Discussion

Physical standards of fruit

The physical parameters of fruits of different varieties/genotypes have been evaluated in term of weight of fruits, length of fruits, width of fruits, shape of fruit, volume of fruit, No. of seed per fruits, colour of fruits. Pulp weight, shell weight, pulp shell ratio and various variability has been observed regarding the fruit weight that varied from 0.51kg (NB-3) to 3.71kg (NB-7) Such variation in this character of different varieties/genotypes may be due to genetic makeup of genotype. Patel *et al.* (1977) reported that increase in fruit weight of some germplasm might be due to more uptake of water, nutrients and also due to fertility states of soil, microclimate. Pandey *et al.* (2013) carried a survey of Bael germplasm in different areas of UP and Bihar and observed variation in fruit weight. Sharma and Dubey (2013) also reported the variability in fruits weight of different genotypes. Pandey et.al (2008) and Nath *et al*. (2003) have also reported average fruits as large as 2.2kg and 2.6kg which is similar to the finding int he present experiment.

The fruit length was found maximum in NB-7(14.86cm) while minimum was found in Pant Sujata (11.19cm) and width of fruit sare noted was which ranged from 29.29 cm to 36.49cm whereas, maximum width NB-7(36.49cm) and minimum width was noted in genotype Pant Shivani (29.29cm). The length of fruits showing marked variation in different selected genotypes.This variation is due to genetically characteristics of varieties and rate of enlargement of mesocarp cells of fruits as well as micro-climatic factors. Pandey *at.al*(2006) noted the variation in seventeen cultivars of Bael fruit width varied from 29.66 cm to 48.33 cm is in different districts of Bihar and Jharkhand. Further Pandey *et al.* (2013) carried a survey of Bael germplasm in different areas of UP and reported variation in fruit circumference from 29.0cm to 61.0cm. Sarkar *et al.* (2015) also studied variation in fruit width ranging from 7.44 cm to15.0 cm in different Bael cultivars under Bangladesh conditions. Among the 14 genotypes evaluated, the fruit volume was recorded maximum (817cm^3) inNB-7and minimum (512.29cm^3) inNB-3. Kumar *et al.* (2009) also reported the variation in fruit volume and the same trend of variation was reported by Kumar *at.al* (2008) under under Meerut condition.The fruit volume is more or less correlated with the fruits weight. The pulp weight varied in different varieties/genotypes of Bael and it ranged from 330.59 to 700.66 gm, while variety NB-7 had maximum pulp weight (700.66gm), whereas minimum pulp weight was noted in variety NB-3 (330.59gm). More pulp weight in NB-7 be due to its more fruit weight and fruit volume. Shell weight per fruit was minimum (147.91gm) in NB-15 and maximum in NB-7(250.29gm). The pulp: Shell ratio in different cultivars/genotypes of Bael ranged from 2.05% to 2.87%. But variety NB-5 had maximum Pulp:Shell ratio (2.87%). whereas, minimum Pulp: Shell ratio (2.05%) was noted in variety NB-3. Number of seeds per fruit exhibited significant variation among the selected Bael germplasm. Highest no. of seeds per fruit (154.35) was observed in NB-15 and minimum (65.99) in NB-5. Rai *et al.* (1991) noticed 46-108 seeds per fruit in different bael collections identified from Eastern Uttar Pradesh. Pandey *et al.* (2013) found higher no. of seeds per fruit (>100) in different collection of Bael genotypes. The fruit shape is usually round, elliptical, obovate, slightly flat, and colour of mature fruit is greenish yellow to yellowish green. Variation in morphological characters of fruits has been reported by Singh *et al.* (2016) in germplasm collected from central-East India,they also noticed that variation in fruit shape and colour.

Table 1 : Physical attributes of Bael (*Aegle marmelos* L. *Corr*.) genotypes

S. No.	Treatments	Genotypes	Plant height	Plant spread (e-w)	Plant spread (n-s)	Stem girth (cm)	Width of fruit	Length of fruit
1	T1	NB-3	5.4	4.57	5.02	54.22	29.30	12.49
2	T2	NB-4	6.3	5.49	3.32	66.45	30.49	12.89
3	T3	NB-5	4.82	4.77	5.09	65.38	35.56	11.82
4	T4	NB-7	5.2	5.29	3.19	50.32	36.49	14.86
5	T5	NB-9	4.98	4.64	4.39	97.71	30.66	12.59
6	T6	NB-14	5.67	3.39	2.59	61.46	28.22	13.49
7	T7	NB-15	4.87	4.39	3.62	54.27	30.39	12.29
8	T8	NB-16	5.43	4.49	5.05	74.99	30.54	12.99
9	T9	NB-17	5.23	6.06	5.82	56.99	29.96	13.19
10	T10	CISHB-1	5.16	5.99	5.45	56.76	28.46	12.87
11	T11	CISHB-2	4.92	5.37	5.31	52.34	32.98	13.80
12	T12	PANT SUJATA	4.77	4.89	4.32	48.65	36.01	11.19
13	T13	PANT APARNA	5.17	4.29	4.75	47.45	33.46	11.36
14	T14	PANT SHIVANI	5.19	3.44	2.59	46.41	29.29	12.19
	C.D.		0.19	0.27	0.17	17.96	1.18	0.52
	SE(M)		0.06	0.09	0.05	6.17	0.40	0.17

Table 1 continued

S. No.	Treatments	Genotypes	Weight of fruits	Volume of Fruits	No. of seeds/ fruit	Weight of pulp	Shell weight	Pulp: shell ratio
1	T1	NB-3	0.51	512.29	66.99	330.59	160.29	2.05
2	T2	NB-4	0.74	517.19	75	430.69	170.19	2.52
3	T3	NB-5	1.50	761.99	65.99	625.99	217.89	2.87
4	T4	NB-7	3.71	817.99	94.99	700.66	250.29	2.78
5	T5	NB-9	2.22	557.69	90	427.69	164.19	2.64
6	T6	NB-14	1.69	670.19	141.03	600.29	220.19	2.71
7	T7	NB-15	2.36	548.29	154.95	530.19	147.19	2.51
8	T8	NB-16	1.62	626.29	111.99	469.89	183.99	2.55

9	T9	NB-17	1.76	545.39	89.99	420.89	167.99	2.50
10	T10	CISHB-1	0.52	515.29	72.99	373.09	163.99	2.28
11	T11	CISHB-2	0.73	719.99	74.99	538.79	207.39	2.67
12	T12	PANT SUJATA	1.59	782.09	93.66	603.39	232.19	2.69
13	T13	PANT APARNA	1.39	648.89	86.99	668.79	200.99	2.42
14	T14	PANT SHIVANI	1.36	655.49	114.99	450.29	190.19	2.35
	C.D.		0.09	23.92	19.26	20.33	50.0	0.09
	SE(m)		0.03	8.21	6.61	6.98	17.17	0.03

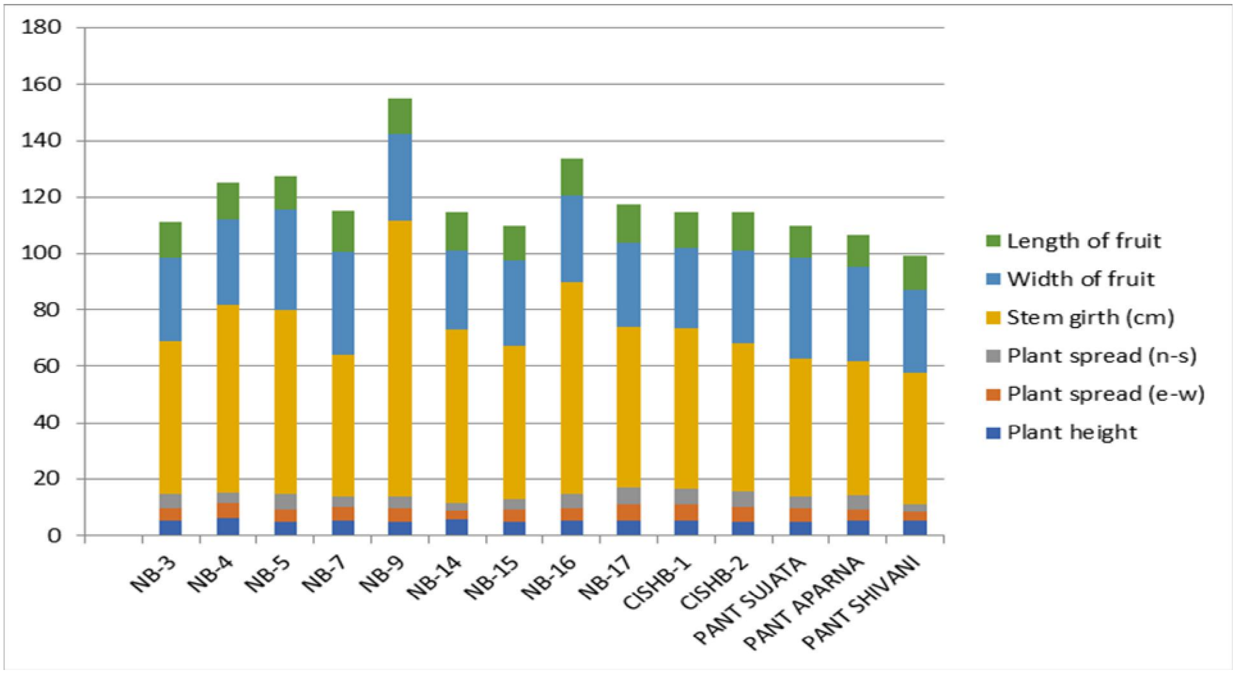

Fig. 1 : Physical attributes of Bael (*Aegle marmelos* L. *Corr*.) genotypes

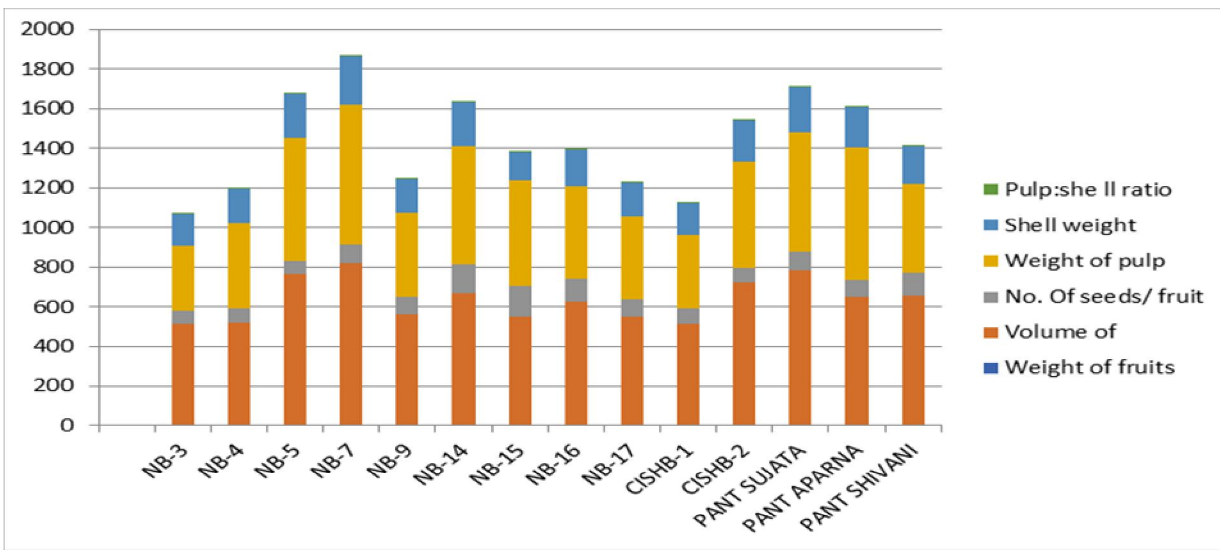

Fig. 2 : Physical attributes of Bael (*Aegle marmelos* L. *Corr*.) genotypes

Conclusion

There results on evaluation of physical attributes of Bael genotypes revealed that the NB-7 genotype proven its superiority over weight of fruit, length of fruit, volume of fruit, weight of pulp and shell. While variety NB-5 was found superior to the genotypes as regard to, minimum no. of seed sand maximum Pulp: Shell ratio. So, on the basis of data, I was observed that the best variety for suitable commercial cultivation and processing industries is NB-5 and NB-7 in central UP.

Plate 1: Estimation of different physical characters in laboratory

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