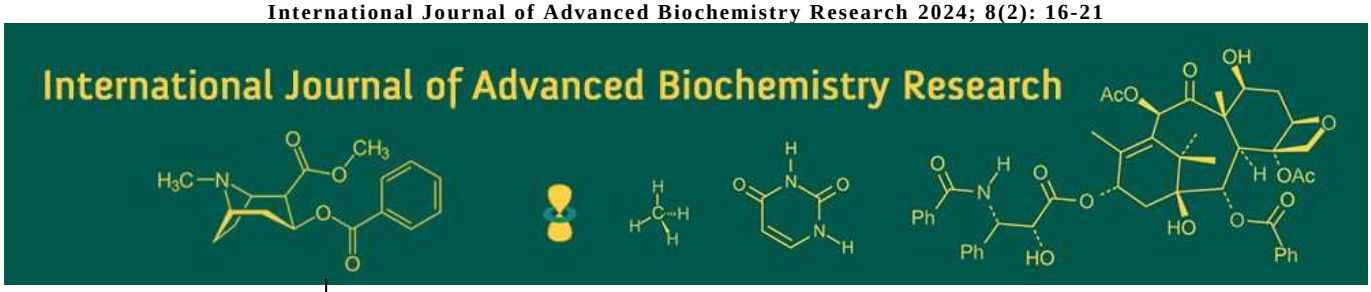

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Studied the effect of physical and yield attributes on bael (*Aegle marmelos* Correa) fruits in sodic soil condition

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Abstract
The present investigation entitled "Studied the effect of Physical and yield attributes on bael (*Aegle marmelos Correa*) fruits in sodic soil condition." was carried out at the Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the years 2016-2017. The experiment was conducted in Randomized Block Design with twelve genotypes and replicated three times, considering one plant as a unit.

On the basis of Physico-chemical attributes of bael fruit *viz.* maximum fruit length (27.35 cm), pulp weight (2.094 kg), Specific gravity (1.01 g/cc) and Minimum acidity (0.29%) found in ND/AH-25, fruit width (25.57 cm) and total soluble solids(39.00) in ND/AH-10, fruit yield (224.06 Q/ha), fruit weight (2.51 kg) are found is best in ND/AH-8. The maximum (415.67 g) shell weight was recorded in the genotype ND/AH-11 followed by (412.67 g) shell weight was recorded with the genotype ND/AH-25. The minimum (344.67 g) shell weight was recorded in the genotype ND/AH-21 followed by (356.33 g) shell weight was recorded as the genotype ND/AH-27. Maximum (3.21 mm) shell thickness was noted in genotype NB-21 followed by (2.94 mm) in genotype ND/AH-12 whereas Shell thickness was found minimum (2.19 mm) in genotype ND/AH-26. Maximum (39.00^0Brix) total soluble solid was noted in genotype ND/AH-10 followed by genotype ND/AH-8 (38.67^0Brix).

Keywords: Physical, yield attributes, *Aegle marmelos* Correa, fruits, sodic soil

Introduction
Bael fruit (*Aegle marmelos Correa*) is a tropical fruit native to south-east Asia and belongs to family Rutaceae. It is an important indigenous fruit of India. It is also known as 'Bengal Quince'. Aegle, the genous of bael is monotypic. It is a midsized, slender, aromatic, armed, gum-bearing tree growing up to 18 meter tall. It has a compound leaf with three leaflets. It has been known in India from prehistoric times and is more prized for its medicinal virtues than its edible quality. In Hinduism the tree is considered sacred. It is used for worship of lord Shiva, Who is said to favour the leaves. The trifoliate leaves symbolize the trident the Shiva holds in his right hand. The fruit were used in place of Coconuts before large-scale rail transportation become available. The fruit is said to resemble a skull with a white, bone-like outer shell and a soft inner part. The tree grows wild in dry forests on hills and plains of central and southern India, Burma, Pakistan, Bangladesh, Sri Lanka, Northern Malaya, Java, and Philippine Islands. However there was no organized orcharding of bael in India but now a day organized orchard are having planted it grows mainly wild and in temple gardens in early years. The fruit is available in almost all states of India, but most abundantly available in Uttar Pradesh, Bihar, West Bengal and Odisha, In Odisha the fruit is predominantly present in forests of Dhenkanal, Angul, Bolangir and Rayagada districts. It has a reputation in India for being able to grow in places where other trees cannot grow. The fruit is very hardy and can grow even under adverse agro-climatic conditions. Most of the tropical and subtropical condition fruits have a poor keeping quality but this let fruit can be kept for a longer period because of its hard outer shell and as, it can easily withstand transport and marketing hazards. It copes with a wide range of soil pH of 5-10 and a wide temperature tolerance from 7 degree to 48 degree C. It requires a pronounced dry season to give fruit.

The importance of bael lies in its curative properties, which make one of the important medicinal plants of India. All the parts of the tree (Stem, bark, leaves, roots, and fruits) at some stages of maturity and ripening, has some important use in many Ayurveda and Unani patented drugs in India for treatment of a variety of diseases. The fruits and roots of bael possess antiamoebic and hypoglycemic activity. Research has found the essential oil of the bael tree to be effective against 21 types of bacteria. It is prescribed for smooth bowel movement of patients suffering from constipation and other gastrointestinal problems. Unripe Bael fruit is also said to be effective in combating giardia and rotavirus. For medicinal use, the young fruits, while still tender, are commonly sliced horizontally and sun-dried and sold in local markets. Because of the astringency, especially of the wild fruits the unripe bael is most prized as a means of halting diarrhea and dysentery, which are prevalent in India in the summer months.

In India, some types have been named According to fruit shape and quality. Singh (1961) [37] described six varieties from Uttar Pradesh and considered Mirjapuri as the most promising followed by Dagogaji, Ojha, Ranpure, Asamati and rhamaria. Teaotia *et al.,* (1963) [39] listed five promising varieties and reported that the Kagzi Gonda was the most promising with thin rind, soft yellow pulp and excellent flavor. Jauhari *et al.* (1969) [40] presented the morphological and physic-chemical characteristics from the extensive survey in Uttar Pradesh and Bihar. They found that Etawah kagzi, sewan large, Mirzapuri and deoria were excellent in taste and quality. In West Bengal, working with five types of bael fruits, Majumder (1975) [14] found that the spherical flattened once were usually the best on the basis of fruit weight and chemical composition. In India, various size of bael having good quality are available which are known after the locality. Ripe fruit is available mainly during the February to May. But immature fruit are sold in the month of August to mid-January, which are consumed after boiling or roasting. Dried chips of unripe fruit are also sold in the market. Considering the importance of bael fruits in there is need to evaluate the quality attributes of bael genotypes, keeping in view the present investigater has been work out to "Studied the effect of Physical and yield attributes on bael (*Aegle marmelos Correa*) fruits in sodic soil condition."With the objective:

- To find out the physical & yield characteristics of bael genotypes

Material & Methods

The present investigation entitled "Studied the effect of Physical and yield attributes on bael (*Aegle marmelos Correa*) fruits in sodic soil condition" was carried out at Main Experimental Station and P.G. Laboratory of the Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during the year 2016-17. The experiment was conducted in Randomized Block Design with twelve genotypes and replicated three times, considering one plant as a unit.

Results and Discussion

Physical characters of bael fruit

1. Fruit length (cm)

A significant variation in fruit length was observed in all the genotypes. The fruit length varied between 27.35 cm to 17.67 cm. Among genotypes, ND/AH-25 produced longest fruit and closely followed by NB-21 and ND/AH-11. The value was found lowest in ND/AH-12. The findings are similar to that of Singh *et al.,* (2000) [34]. Pandey *et al.* (2008) [18] found that a wide range of variability in fruit characters *viz*., fruit length (7.93-18.60 cm), fruit circumference (28.20-61.67 cm), number of seed/fruit (33.95), number of seed sacs/fruit (10.00-19.00), skull weight/fruit (0.10.0-0.69 kg), skull thickness (1.25-3.32 mm), seed weight (3.74-10.48 g) and pulp weight (1.16-1.76 kg) were identified in different genotype of bael fruits. Lal (2002) [13] reported that in different parameters of twelve genotypes of bael. The maximum fruit weight (1600 g), volume (2000 ml), diameter (15.30 cm), polar diameter (14.95 cm) and pulp content (76.29%) were recorded in JB-1 in 1997-98, while the lowest values for these parameters (480 g, 350 ml, 9.87 cm, 10.49 cm and 62.12%, respectively) were in JB-7. In the following year, the highest values for these traits were found in BS-5 (around 1540 g, 2090 ml, 15.53 cm, 14.72 cm and 76.05%) and lowest in BS-5 (around 640 g, 890 ml, 10 cm, 10.12 cm and 68.70%, respectively).

Table 1: Estimates of length of fruits in bael genotype

Bael genotypes	Fruit length(cm)
ND/AH-8	23.50
ND/AH-9	22.60
ND/AH-10	25.93
ND/AH-11	26.30
ND/AH-12	17.67
ND/AH-16	25.53
ND/AH-17	25.65
ND/AH-21	19.18
ND/AH-25	27.35
ND/AH-26	25.38
ND/AH-27	21.53
NB-21	26.40
S. Em ±	0.92
CD at 5%	2.71

2. Fruit width (cm)

A significant variation in fruit width was observed in all the genotypes. The fruit width varied between 25.57 cm to 14.63 cm. Among genotypes, ND/AH-10 was found maximum fruit width (25.57 cm) followed by NB-21 (25.43 cm). The value was found lowest in genotype ND/AH-12 (14.63 cm)

followed by ND/AH-21 (18.27 cm). Lal (2002) [13] reported that the different parameters of twelve of bael genotypes. The maximum fruit weight (1600 g), volume (2000 ml), diameter (15.30 cm), polar diameter (14.95 cm) and pulp content (76.29%) were recorded in JB-1 in 1997-98, while the lowest values for these parameters (480 g, 350 ml, 9.87 cm, 10.49 cm and 62.12%, respectively) was in JB-7. In the following year, the highest values for these traits were found in BS-5 (around 1540 g, 2090 ml, 15.53 cm, 14.72 cm and 76.05%) and lowest in BS-5 (Around 640 g, 890 ml, 10 cm, 10.12 cm and 68.70%, respectively).

Table 2: Estimates of width of fruits in bael genotype

Bael genotypes	Fruit width (c.m.)
ND/AH-8	22.37
ND/AH-9	22.18
ND/AH-10	25.57
ND/AH-11	24.93
ND/AH-12	14.63
ND/AH-16	24.60
ND/AH-17	25.03
ND/AH-21	18.27
ND/AH-25	25.33
ND/AH-26	24.07
ND/AH-27	22.47
NB-21	25.43
S. Em ±	00.66
CD at 5%	1.93

3. Fruit weight (kg)

The fruit weight varied between 1.40 kg to 2.51 kg. Among the genotype ND/AH-25 recorded maximum fruit weight closely followed by ND/AH-11, whereas, minimum fruit weight was noted in ND/AH-21, it might be because of varietal effect. Pandey *et al.* (2008) [18] found that the considerable variations in morphological and physico-chemical traits of different genotypes of bael fruits. The number of fruits / tree from 56-695, weight of fruit (0.38-2.84 kg) and fruit yield (75.74 to 450.08 kg/tree) were varied among the different accessions collected. Lal (2002) [13] reported that the different parameters of twelve strain of bael genotypes. The maximum fruit weight (1600 g), volume (2000 ml), diameter (15.30 cm), polar diameter (14.95 cm) and pulp content (76.29%) were recorded in JB-1 in 1997-98, while the lowest values for these parameters (480 g, 350 ml, 9.87 cm, 10.49 cm and 62.12%, respectively) was in JB-7. In the following year, the highest values for these traits were found in BS-5 (around 1540 g, 2090 ml, 15.53 cm, 14.72 cm and 76.05%) and lowest in BS-5 (around 640 g, 890 ml, 10 cm, 10.12 cm and 68.70%, respectively).

Table 3: Estimates of weight of fruits in bael genotype

Bael genotypes	Fruit weight (kg.)
ND/AH-8	1.52
ND/AH-9	1.48
ND/AH-10	1.73
ND/AH-11	2.16
ND/AH-12	1.42
ND/AH-16	1.94
ND/AH-17	1.94
ND/AH-21	1.40
ND/AH-25	2.51
ND/AH-26	1.64
ND/AH-27	1.44
NB-21	2.01
S. Em ±	0.12
CD at 5%	0.34

4. Specific gravity (g/cc)

A significant variation in specific gravity of bael fruit was observed in all the genotypes. The specific gravity of bael fruit varied between 1.01 to 0.90 g/cc. Among genotypes, the highest (1.01) specific gravity was obtained in genotype ND/AH-25 followed by ND/AH-11(1.00). However, the lowest (0.90) specific gravity was noted with the genotype ND/AH- 27 followed by ND/AH-21(0.91). Singh *et al.* (2000) [34] observed that physico-chemical characteristics of 8 cultivars of ripe bael fruits. Significant variation in fruit characters *viz.* shape, size, weight, volume and rind thickness, fibre, mucilage, peel, pulp, seed, TSS and acidity content were recorded among the cultivars, while fruit specific gravity, TSS: acid ratio, ascorbic acid in fruits did not differ significantly.

Table 4: Estimates of specific gravity of fruits in bael genotype

Bael genotypes	Specific gravity(g/cc)
ND/AH-8	0.95
ND/AH-9	0.93
ND/AH-10	0.96
ND/AH-11	1.00
ND/AH-12	0.92
ND/AH-16	0.98
ND/AH-17	0.97
ND/AH-21	0.91
ND/AH-25	1.01
ND/AH-26	0.94
ND/AH-27	0.90
NB-21	0.97
S. Em ±	0.01
CD at 5%	0.04

5. Pulp weight (kg)

A significant variation in pulp weight of bael fruit was observed in all the genotypes. The pulp weight of bael fruit was varied between 1.046 kg to 2.094 kg. Among genotypes, the maximum pulp weight (2.094) was recorded with the genotype ND/AH-25 followed by ND/AH-11 (1.748 kg). The value was found lowest in ND/AH-12 (1.046) followed by ND/AH-21.

Tarsem *et al*. (2007) [41] observed that the an average weight 629 g, pulp and peel weight 683 and 307 g/kg of fruits, respectively had a moisture content 56%, T.S.S. 36.3%, total sugars 15.5%, reducing sugars 6.3%, acidity 0.46% and pH 4.5 in bael fruits. Nidhi and Gehlot (2007) [16] reported the bael and Guava fruits had fruit weights of 618 and 72 g, pulp weights 663 and 927 g/kg fruit, peel weight of 302 g/kg fruit, pulp: peel ratio of 2.19 and seed percentage of 3.38 and 2.76%, respectively.

Table 5: Estimates of pulp weight of fruits in bael genotype.

Bael genotypes	Pulp weight(kg)
ND/AH-8	1.132
ND/AH-9	1.090
ND/AH-10	1.344
ND/AH-11	1.748
ND/AH-12	1.046
ND/AH-16	1.554
ND/AH-17	1.554
ND/AH-21	1.052
ND/AH-25	2.094
ND/AH-26	1.312
ND/AH-27	1.080
NB-21	1.609
S. Em ±	1.07
CD at 5%	3.16

6. Number of seeds/fruit

A significant variation in number of seeds/fruit was observed in bael genotypes. The number of seeds/fruit varied between185.67 to 98.00. Among genotypes, the number of seed were found maximum (185.67) in genotype ND/AH-17 followed by genotype ND/AH-11(180.67). The minimum (98.00) number of seed/fruit was recorded with the genotype NB-21followed by ND/AH-27. Pandey *et al.* (2006) [19] noted the great variability were showed in morphological characters of bael fruit, i.e. fruit weight (0.859-1.964 kg), fruit length (7.63-19.86 cm), fruit circumference (29.66-48.33 cm), number of seed per fruit (8.66-22.66), skull weight (0.177-0.487 kg) and skull thickness (1.83-3.33 mm) in among the collected genotypes. Islam *et al.* (2012) [8] observed that greater variability in morphological and fruit character in collected bael genotypes from different location. Among the fruit characteristics, pulp percent (50.0-76.0), rind percent (17.0-41.1), percent of fibre (1.1-7.1) and percent of seed (0.7-6.4) were found.

Table 6: Estimates of number of seed/fruits in bael genotype.

Bael genotypes	Number of seed/fruit
ND/AH-8	120.67
ND/AH-9	116.00
ND/AH-10	139.33
ND/AH-11	180.67
ND/AH-12	151.00
ND/AH-16	162.67
ND/AH-17	185.67
ND/AH-21	127.00
ND/AH-25	119.67
ND/AH-26	108.67
ND/AH-27	106.33
NB-21	98.00
S. Em ±	11.64
CD at 5%	34.14

7. Shell weight (gm.)

The shell weight varied between 415.67 gm.to344.67 gm. Among the genotype ND/AH-11(415.67 gm.) recorded maximum shell weight closely followed by ND/AH-25(412.67 gm.), whereas, minimum shell weight was found in ND/AH-21, it might be because of varietal effect. Pandey *et al*. (2008) [18] found that a wide range of variability in fruit characters *viz*., fruit length (7.93-18.60 cm), fruit circumference (28.20-61.67 cm), number of seed/fruit (33.95), number of seed sacs/fruit (10.00-19.00), skull weight/fruit (0.10.0-0.69 kg), skull thickness (1.25-3.32 mm), seed weight (3.74-10.48 g) and pulp weight (1.16-1.76 kg) were identified in different genotype of bael fruits.

Pandey *et al.* (2006) [19] found that the great variability in morphological characters of bael fruit, i.e. fruit weight (0.859-1.964 kg), fruit length (7.63-19.86 cm), fruit circumference (29.66-48.33 cm), number of seed per fruit (8.66-22.66), skull weight (0.177-0.487 kg) and skull thickness (1.83-3.33 mm) in among the collected genotypes.

Table 7: Estimates of Number of cavity of fruits in bael genotype.

Bael genotypes	Number of cavity
ND/AH-8	12.00
ND/AH-9	15.00
ND/AH-10	13.00
ND/AH-11	16.00
ND/AH-12	15.00
ND/AH-16	14.00
ND/AH-17	16.00
ND/AH-21	13.00
ND/AH-25	13.00
ND/AH-26	13.00
ND/AH-27	11.00
NB-21	13.00
S. Em ±	10.41
CD at 5%	40.86

8. Shell thickness (mm)

The shell thickness varied between 3.21 mm to 2.19 mm. Among the genotype NB-21 (3.21 mm) recorded maximum shell thickness closely followed by ND/AH-12(2.94 mm), whereas, minimum shell thickness was found in ND/AH-26 (2.19 mm). Pandey *et al.* (2006) [19] noted great variability w showed in morphological characters of bael fruit, i.e. fruit weight (0.859-1.964 kg), fruit length (7.63-19.86 cm), fruit circumference (29.66-48.33 cm), number of seed per fruit

(8.66-22.66), skull weight (0.177-0.487 kg) and skull thickness (1.83-3.33 mm) in among the collected genotypes.

Table 8: Estimates of shell weight of fruits in bael genotype.

Bael genotypes	Shell weight(gm.)
ND/AH-8	386.00
ND/AH-9	393.33
ND/AH-10	389.33
ND/AH-11	415.67
ND/AH-12	377.00
ND/AH-16	390.67
ND/AH-17	386.33
ND/AH-21	344.67
ND/AH-25	412.67
ND/AH-26	364.33
ND/AH-27	356.33
NB-21	400.67
S. Em ±	7.16
CD at 5%	20.98

9. Fruit yield (Q./ha.)

The present finding revealed that the maximum fruit yield (224.06 Q/ha.) was recorded in genotype ND/AH-8 followed by genotype ND/AH-17 (151.5) and ND/AH-9 (147.27). Fruits yield (Q./ha)ranged from 21.33 to 224.06 in bael were also recorded by (Kumar *et al*. (2010) [12]. The minimum number of fruit per plant was recorded in cultivar/ genotypes ND/AH-12 and ND/AH-1. This might be due to poor adaptability due to sodicity. A significant variable difference were noted in number of fruits per tree varied from (110–315) and fruit yield per tree (94.50–356.50 kg) by Pandey *et al*. (2008) [18]. Singh *et al*. (2005) [32] reported that Pusa Giant recorded the greatest number of fruits per plant (24.54).

Table 16: Estimates of fruit yield of fruits in bael genotype.

Bael genotypes	Fruit yield (Quintal/hectare)
ND/AH-8	224.06
ND/AH-9	147.27
ND/AH-10	135.67
ND/AH-11	28.22
ND/AH-12	21.33
ND/AH-16	35.42
ND/AH-17	151.53
ND/AH-21	117.17
ND/AH-25	65.29
ND/AH-26	74.82
ND/AH-27	33.32
NB-21	44.66
S. Em ±	7.73
CD at 5%	22.25

Conclusion

Based on present investigation it can be concluded that the evaluation of physical & yield attributes of bael fruit *viz*. fruit length, fruit width, fruit weight, specific gravity, shell weight, shell thickness, pulp weight, number of seed/fruit, and yield, genotypes ND/AH-8, ND/AH-11, ND/AH-17, ND/AH-25 and NB-21 can be recommended for commercial cultivation in Eastern Uttar Pradesh.

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