

Original Research Article

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Morphological and Bio-chemical Characterization of Bael (*Aegle marmelos* Correa.) in West Garo Hills, Meghalaya, India

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ABSTRACT

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The present study entitled, “Morphological and Biochemical Characterization of Bael (*Aegle marmelos* Correa.) in West Garo Hills, Meghalaya” was carried out in Garo Hills of Meghalaya, India during 2017-2018 at Department of Horticulture, North Eastern Hill University, Chasingre, Tura campus, in West Garo Hills Districts, Meghalaya. Thirty different accessions of bael fruits were collected from different locations of West Garo Hills and the analysis of variance was carried out in a Completely Randomized Design with three replications. The result revealed that significant variation in respect of their morphological and biochemical characters. Based on the quantitative, biochemical and organoleptic characters, accessions collected from location-3 i.e., Cherangre, location-5 i.e., Sampalgre and location-6 i.e., Babupara were found to be the best and promising accessions.

Introduction

Bael (*Aegle marmelos* Correa.) also known as Bengal quince, Bilva, Bilpatre, Maredu, Shul, Vilvam, Shaiphal, etc., belongs to the family Rutaceae. In Garo language, bael is called as ‘Selfree’. It is a subtropical plant which can grow up to an altitude of 1200 m from the sea level. The generic name ‘*Aegle*’ is of Greek origin and the species ‘*marmelos*’ is of

Portuguese origin. *Aegle* belong to one of the three monotypic genera of orange sub family Aurantioideae, tribe Clauseneae and sub-tribe Balsamocitrinea (Nair and Barche, 2016). The chromosome number $2n = 36$. Bael can adapt a wide range of habitat and can be cultivated worldwide. It is native to India and has its origin from Eastern Ghats and Central India. In India, it is distributed throughout the country but concentrated area under bael is in

Eastern parts of the Gangetic plains and nearby areas particularly in Uttar Pradesh, Bihar, West Bengal and Orissa. It is also available in wild form in sub-Himalayan tract from Rajasthan to West Bengal, Central and Southern India.

The bael fruit has been known in India from prehistoric writings dating back to 800 B.C. The leaves of the tree are traditionally used as sacred offerings to "Lord Shiva," according to Hindu customs. It is also called *Shivadurme*, the tree of *Shiva*. According to Hindu mythology, the tree is another form of Lord *Kailashnath*. It is also sacred to Parvati and is the *Vilvarupra*, one of the *Patricas*, or nine forms of Goddess *Kali* (Sharma *et al.*, 2007).

Bael is a nutritious and medicinal fruit, which is most suitable for water scarce areas of the country. Every part of the bael tree whether stem, bark, root, leaves or fruit at different maturity stages is utilized for various purposes. It is used in the preparation of several Ayurvedic medicines since ancient times (Rai and Dwivedi, 1992). Marmelocin is probably the therapeutically active factor of bael fruit and is known as the 'panaceae' of the stomach ailments.

Materials and Methods

The present study entitled, "Morphological and Biochemical Characterization of Bael (*Aegle marmelos* Correa.) in West Garo Hills, Meghalaya" was carried out in Garo Hills of Meghalaya, India during 2017-2018 at the Department of Horticulture, North Eastern Hill University, Chasingre, Tura campus, in West Garo Hills Districts, Meghalaya situated approximately between the latitudes of 90° 30' and 89° 40'E, and the longitudes of 26° and 25° 20' N. Thirty different accessions of bael fruits were collected from different locations in West Garo Hills *viz.*, location-1 *i.e.*, Rongram, location-2 *i.e.*, Rongkhon,

location-3 *i.e.*, Cherangre, location-4 *i.e.*, Reserve Gittim, location-5 *i.e.*, Sampalgre, location-6 *i.e.*, Babupara, location-7 *i.e.*, Hawakhana, location-8 *i.e.*, Sangsangre, location-9 *i.e.*, Dobasipara and location-10 *i.e.*, Sunny Hills, and the analysis of variance was carried out in a Completely Randomized Design with three replications. The trees and fruits characters collected from all the locations were measured for their morphological characters. The bio-chemical characters of the fruits also was analysed using the standard methods (AOAC 1990). The organoleptic quality of the fruit pulp of all the accessions collected from different locations were distributed to a team of panellist for overall acceptability that actually included the point like colour, aroma/flavour, taste and acidity on a 5.00 Point Hedonic Scale (Amerine *et al.*, 1965). The accessions receiving high score in pulp colour, pulp taste, pulp aroma, and low score in pulp acidity was considered acceptable.

Statistical analysis

The test for significance was done by following the method described by Panse and Sukhatme (1967), while the method described by Mahalanobis (1932) was followed for Completely Randomized Block Design and Factorial Completely Randomized Design. The analysis of variance (ANOVA) of the data was carried out by the techniques as suggested by Ragharamula *et al.*, (1983). Correlation analysis was done by using SPSS Software Version 16.0.

Results and Discussion

Morphological characters

The variations observed among the accessions collected were recorded and presented in Table 1. The highest tree height was recorded from location-6 *i.e.*, Babupara (8.67 m), while

the lowest tree height from location-4 i.e., Reserve Gittim (5.67 m). The maximum trunk girth was recorded from location-5 i.e., Sampalgre (132.03 cm), while the lowest trunk girth was recorded from location-1 i.e., Rongram (66.13 cm). The maximum tree spread in term of North-South direction was recorded from location-8 i.e., Sangsangre (7.62m) and the maximum tree spread in term of East-West direction was recorded from location-5 i.e., Sampalgre (6.81 m), the minimum tree spread in term of both North-South and East-West direction was recorded from location-3 i.e., Cherangre (4.83 m) and (3.57 m).

Similar finding were found by Patil *et al.*, (2017); Simla *et al.*, (2017), Kumar *et al.*, (2014) and Goswami *et al.*, (2011) while working on the morphological characters of the fruit crop, they found that there was a wide variation in the tree height, width, tree spread and number of fruits per tree.

Quantitative characters of the fruits

Significant variations were recorded from among the accessions collected from different locations and have been presented in Table 2.

Maximum fruit length was recorded from location-5 i.e., Sampalgre (16.31cm), while the lowest fruit length was noted in location-3 i.e., Cherangre (11.50cm). The accessions collected from location-5 i.e., Sampalgre recorded significantly maximum fruit width (16.94cm), significantly highest fruit weight (0.57 kg), significantly maximum pulp weight (62.11g) and maximum number of seeds per fruit (52.71). Location-3 i.e., Cherangre recorded the minimum fruit length (11.50 cm), significantly minimum fruit width (9.34 cm), significantly lowest fruit weight (0.15kg), minimum fruit skull thickness (2.19 mm), significantly lowest pulp weight (31.66g), significantly minimum numbers of fruits per

tree (14.33) and significantly minimum number of seeds per fruit (31.57). Such Similar findings with respect in this parameter were reported by Singh *et al.*, (2000); Lal (2002); Shrivastava and Singh (2004); Saroj *et al.*, (2008); Pandey *et al.*, (2008); Mitra *et al.*, (2010); Pandey *et al.*, (2013); Kumar and Nath (2015); Uddin *et al.*, (2016) and Nagar *et al.*, (2017).

Bio-chemical characters

The variations observed among the accessions collected have been presented in Table 3. Significantly highest TSS (35.47 °Brix) was recorded from location-3 i.e., Cherangre, while the lowest TSS (24.80°Brix) from location-1 i.e., Rongram. The accessions collected from location-3 i.e., Cherangre recorded minimum titrable acidity (0.23 %) and highest total sugars (25.38 The highest reducing sugar was recorded from location-10 i.e., Sunny Hills (8.84 %), while the lowest was recorded from location-9 i.e., Dobasipara (4.69 %).

Lowest total sugars and non reducing sugars was recorded from location-1 i.e., Rongram (14.34 %) and (6.67 %). The highest titrable acidity was recorded from location-7 i.e., Hawakhana (0.45 %). Earlier workers also reported similar variation in these characters Nagar *et al.*, (2017); Kaur and Kalia (2017); Uddin *et al.*, (2016); Kumar and Nath (2015); Singh *et al.*, (2014a); Singh *et al.*,(2014); Ram and Singh (2003) and Bhadre and Sen (1997).

Organoleptic characters

Pulp characters from the accessions collected from different locations were recorded and presented in Table 4. The highest pulp taste was recorded from accessions from location-6 i.e., Babupara (3.34), while the lowest pulp colour was recorded from location-3 i.e., Cherangre (2.90).

Table.1 Morphological characters of the trees

Location	Tree height(m)	Trunk girth(cm)	Tree spread (m)	
			North- South	East-West
L₁-Rr	6.53	66.13	6.45	6.03
L₂-Rk	8.57	117.10	5.34	5.95
L₃-Cg	7.13	84.66	4.83	3.57
L₄-Rg	5.67	71.78	5.17	5.03
L₅-Sp	7.40	132.03	7.20	6.81
L₆-Bp	8.67	78.93	6.83	6.71
L₇-Hk	7.47	77.40	5.73	6.37
L₈-Sg	6.47	84.34	7.62	6.50
L₉-Dp	6.30	75.53	5.36	5.56
L₁₀-Sh	6.43	79.35	6.12	6.47
S.Ed	0.68	7.01	0.54	0.53
CD (5%)	1.433	14.72	1.13	1.12
CV%	11.82	9.90	10.88	11.03

Table.2 Quantitative characters of the fruits

Location	Fruit length (cm)	Fruit width (cm)	Fruit weight (kg)	Fruit skull thickness (mm)	Pulp weight (g)	No. of seeds/ Fruit	No. of fruits/tree	Length :Width ratio
L₁-Rr	13.50	13.33	0.34	2.59	40.68	36.67	36.67	1.02
L₂-Rk	12.79	11.04	0.17	2.58	37.27	43.75	22.13	1.04
L₃-Cg	11.50	9.34	0.15	2.19	31.66	31.57	14.33	1.18
L₄-Rg	16.21	13.00	0.32	2.65	42.05	43.07	21.73	1.24
L₅-Sp	16.31	16.94	0.57	2.76	62.11	52.71	26.70	0.98
L₆-Bp	14.42	13.60	0.23	2.35	38.70	49.73	36.30	1.20
L₇-Hk	12.23	12.67	0.24	2.34	37.12	45.10	25.77	0.87
L₈-Sg	12.62	11.62	0.22	3.64	34.67	35.98	28.67	1.12
L₉-Dp	13.76	12.25	0.26	2.61	41.01	42.43	31.90	1.08
L₁₀-Sh	14.86	14.51	0.28	2.67	45.75	47.39	24.43	1.14
S.Ed	0.91	0.66	0.024	0.20	2.82	4.19	3.02	-
CD (5%)	1.92	1.38	0.10	0.42	5.92	8.79	6.35	-
CV%	8.095	6.27	10.74	9.26	8.40	11.97	13.78	-

Table.3 Biochemical characters of the fruits

Location	TSS (°Brix)	Titration acidity (%)	Total sugar	Reducing sugar	Non-reducing sugar	TSS:Acid ratio	Sugar:Acid ratio
L ₁ -Rr	24.80	0.38	14.34	7.31	6.67	60.11	37.59
L ₂ -Rk	29.07	0.36	21.80	7.26	13.82	78.42	62.18
L ₃ -Cg	35.47	0.23	25.38	8.84	15.71	108.21	114.43
L ₄ -Rg	27.33	0.34	18.16	6.16	11.40	83.53	54.57
L ₅ -Sp	32.33	0.26	16.74	8.67	7.67	76.27	39.32
L ₆ -Bp	25.20	0.43	15.48	8.17	6.94	80.95	59.43
L ₇ -Hk	25.60	0.45	17.29	8.38	8.47	57.11	38.63
L ₈ -Sg	29.73	0.35	22.93	6.80	15.33	79.40	64.80
L ₉ -Dp	25.27	0.37	23.26	4.69	17.64	69.80	63.32
L ₁₀ -Sh	27.40	0.33	19.61	7.86	10.23	85.49	60.93
S.Ed	2.26	0.04	1.53	0.79	1.15	-	-
CD(5%)	4.71	0.08	3.20	1.65	2.40	-	-
CV%	9.81	13.74	9.64	13.01	12.26	-	-

Table.4 Organoleptic characters of the fruit pulp

Location	Pulp colour	Pulp aroma/flavour	Pulp taste	Pulp acidity
L ₁ -Rr	2.94	2.98	3.50	1.35
L ₂ -Rk	3.08	3.04	3.82	1.25
L ₃ -Cg	2.90	3.1	3.89	1.03
L ₄ -Rg	3.16	3.14	2.51	1.28
L ₅ -Sp	3.06	2.99	3.14	1.33
L ₆ -Bp	3.34	3.61	3.92	0.96
L ₇ -Hk	2.95	3.07	2.22	1.06
L ₈ -Sg	2.91	3.12	2.76	1.34
L ₉ -Dp	3.04	3.49	3.85	0.99
L ₁₀ -Sh	3.24	3.41	2.20	1.31
S.Ed	0.11	0.17	0.06	0.12
CD (5%)	0.22	0.34	0.13	0.03
CV%	5.68	8.35	3.11	1.98

The accessions collected from location-6 i.e., Babupara showed highest pulp taste (3.92), highest pulp flavour (3.61) and lowest pulp acidity (0.96).

The different accessions of bael fruits collected from different locations of West

Garo Hill varied significantly with respect to plant morphology, bearing habit, fruiting, fruit growth and morpho-physico-chemical properties of fruits. Based on the results obtained from the present investigation, it can be concluded that all the accessions of bael exhibited noticeable variation in their

morphological and bio-chemical characteristics.

Based on the quantitative characters of the fruit, it was recorded that the best accessions was recorded from location-5 i.e., Sampalgre with fruit length (16.31 cm), fruit width (16.94 cm), fruit weight (0.57 kg), pulp weight (62.11 g) and number of seeds per fruit (52.71).

With respect to the fruit quality, the best accessions were recorded from location-3 i.e., Cherangre with a TSS (35.47 ° Brix), titrable acidity (0.23%), total sugars (25.38%), reducing sugars (8.84), TSS: acid ratio (108.21) and Sugar: acid ratio (114.43).

Based on the organoleptic quality viz., pulp colour (3.34), pulp flavour/aroma (3.61), pulp taste (3.92) and pulp acidity (0.96) was considered acceptable from location-6 i.e., Babupara. The correlation between the quantitative and biochemical characters among bael accessions were observed be have a significant positive and negative between the accessions.

Therefore, the accessions collected from these three locations namely, location-3 i.e., Cherangre, location-5 i.e., Sampalgre and location-6 i.e., Babupara could be used for further evaluation.

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