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Studies on the collection and evaluation of bael cultivars

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Abstract
The present investigation was carried out at Research Orchard of Department of Horticulture, Chaudhary Charan Singh Haryana Agricultural University, Hisar during the year 2018-19. The experiment was laid out in Factorial Randomized Block Design with three replications and three cultivars. The plant height (5.82 m), stem girth (63.7 cm) and spread of plants (6.24 x 5.92 m) were found maximum in NB-7. The flowering started from 1st week of June to third week of June in cultivar NB-5 and Ist week to 2nd week of June in NB-7 and NB-9. The maximum fruit weight (2.50 kg) was observed in NB-7. Whereas minimum fruit weight (1.32 kg) was recorded in NB-5. Maximum TSS (30.2%) was recorded in NB-9 followed by NB-5 (29.7%). However, maximum yield (52 kg) was recorded in NB-7 and minimum (23 kg) in the NB-5.

Keywords: Bael cultivars, plant height, fruit weight and yield

Introduction
Bael (*Aegle marmelos*) is important underutilized indigenous fruit crop of India, belongs to family Rutaceae. It is a subtropical and deciduous tree, which is very hardy and can thrive well under diverse agro-climatic conditions. The tree generally reaches a height of 6 to 8 metres with trifoliate, aromatic leaves, while the terminal leaflet is 5.7 cm long and 2.8 cm broad with a long petiole. Moreover, two lateral leaflets are 4.1 cm long and 2.2 cm wide, almost sessile (Allen, 1969) [1]. It can easily be grown on eroded soil and adverse climatic conditions where most of the other fruits cannot be grown. Bael fruits are popular due to its medicinal and nutritional properties and regarded as 'Amrit Phal' in cure of diarrhoea and dysentery. All part of tree (stem, bark, root, leaves and fruits) at different maturity stages has one or the other use. It is also used in the preparation of Ayurvedic medicines since ancient times (Rai *et al*., 1991) [12]. In India, it is found in wild form in sub-Himalayan tract and in dry deciduous forest of central and southern Indian region (Pandey *et al*., 2005) [8] since pre-historic times and, therefore, a large number of landraces are available in the different diversity regions. A wide range of diversity of bael tree has been noticed in dry subtropical belt of north India. Bael (*Aegle marmelos*) is important underutilized indigenous fruit crop of India, belongs to family Rutaceae. It is a subtropical and deciduous tree, which is very hardy and can thrive well under diverse agro-climatic conditions. The tree generally reaches a height of 6 to 8 metres with trifoliate, aromatic leaves, while the terminal leaflet is 5.7 cm long and 2.8 cm broad with a long petiole. Moreover, two lateral leaflets are 4.1 cm long and 2.2 cm wide, almost sessile (Allen, 1969) [1]. Some leaf abnormalities of A. marmelos have been noticed (Rao, 1951) [13]. Abnormalities of lobation have also been reported by Dutta and Mitra (1960) [2]. The leaf characters, development pattern and shoot growth of eight selected genotypes of bael were studied by Misra *et al*. (1999) [6]. The fruit has been known in India since the pre historic era. Bael fruit grows throughout the Indian Peninsula as well as in Sri Lanka, Nepal, Pakistan, Bangladesh, Burma, Thailand and most Southeast Asian countries. Bael is a valuable tree species and its fruits are recognized for their medicinal and nutritive properties. It is traditionally used in curing several diseases and as ingredients of nutritive foods. The livelihoods of some ethnic groups depend on bael fruit collection, processing and marketing (Roy and Singh, 1979; Shrestha and Parajuli, 2002) [14]. It can easily be grown on eroded soil and adverse climatic conditions where most of the other fruits can not be grown.

Bael fruits are apopular due to its medicinal and nutritional properties and regarded as 'Amrit Phal' in cure of diarrhoea and dysentery. All part of tree (stem, bark, root, leaves and fruits) at different maturity stages has one or the other use. It is also used in the preparation of Ayurvedic medicines since ancient times (Rai *et al*., 1991) [12]. Bael cultivars have been identified and found useful for commercial cultivation i.e., Narendra Bael 5, NB-7 and NB-9 from Narendra Dev University of Agriculture and Technology, Kumarganj, Faizabad (Pareek and Nath, 1996); Pant Aparna, Pant Sujata, Pant Shivani and Pant Urvashi from GB Pant University of Agriculture & Technology Pant Nagar, Nainital (Singh *et al*., 2000) [16] and CISH-B1 and CISH-B2 from Central Institute for Sub-tropical Horticulture, Lucknow (Pathak *et al*., 2002). The location specific genotypes of bael need to be identified and evaluated in iso-climatic regions to develop good cultivars on one hand and known by local people for high degree of variability with regards to qualitative characters are on the verge of extinction due to urbanization and industrialization. Therefore, there is an immediate need to conserve them for the use of posterity (Rai *et al*., 1991) [12].
Keeping in sight the importance of these aspects, the present investigation was executed with the objective to evaluate different cultivars of bael under HIsar conditions.

Material and Methods

The experimental location is situated at latitude 28.10 N, longitude 76.50 E and 266 m above mean sea level in South-West zone of Haryana. It has a typical semi-arid climate with hot and dry summer (temperature around 44ºC) and extremely cold winter (temperature as low as freezing point) having sandy loam soils. About 65-70 per cent of the annual rainfall (about 271 mm) is received during July to September. A few showers also occur during December to March due to the western disturbances.
The experiment was carried out on uniformly grown nine years old trees of different germplasm viz., NB-5, NB-9, NB-16, NB-17, Pant Aparna, Pant Sujata, CISHB-1, CISHB-2 and Samastipur. Experiment was laid out in randomized block design (RBD) and maintained under uniform cultural practices. Parameters viz., plant height, stem girth, fruit size, fruit weight, yield, TSS, acidity, spread of plants and time of flowering.
The fruits of uniform size free from injury, disease or bruising were harvested randomly from tagged branches of each germplasm for fruits characteristics. The pulp was scooped from selected fruits, thereafter, pulp as well as shell weighed separately for weight and their ratio. The thickness of pulp detached shell was expressed in millimeters (mm). The data was analysed using statistical method described by Panse and Sukatme (1967) [9].

Results and Discussion

It is evident from data presented in table 1 that the plant height showed a significant variation ranged from 3.45 m to 5.82 m among different genotypes. Higher plant height (5.82 m) was observed in NB-7, being at par with NB-9 (5.50m). It was lowest (3.45 m) in NB-5. Stem girth was observed significantly higher (63.7 cm) in NB-7, which was statistically at par with NB-9 (57.4 cm) while minimum stem girth (42 cm) was recorded in NB-5. Spread of Plant showed a significant variation ranged from 4.60x4.12 m to 6.24x5.92 m among different genotypes. Higher Spread of Plant (6.24x5.92m) was observed in NB-7, being at par with NB-9 (4.60x4.75m). It was lowest (4.60x4.12 m) in NB-5. Time of flowering was observed 1st to3rd week of June NB-5 followed by 1st to 2nd week of June in NB-7 and NB-9. Variations in different growth parameters might be due to the different genetic constituent of cultivars of bael. Singh *et al.,* 2014; Jana *et al*., 2014 [4] also depicted the considerable variation in different bael cultivars.
It is clearly depicted from table 2 that fruit weight showed a significant variation ranged from 1.32 to 2.50 kg among different genotypes. Maximum Fruit weight (2.50 kg) was observed in NB-7, being at par with NB-9 (1.90 kg). It was lowest (1.32 kg) in NB-5. Fruit length was observed significantly higher (15.45 cm) in NB-7, which was statistically at par with NB-5 (12.65 cm) while minimum fruit length (11.20 cm) was recorded in NB-9. Fruit breadth was observed significantly higher (16.28 cm) in NB-7, which was statistically at par with NB-9 (13.46 cm) while minimum fruit breadth (12.50 cm) was recorded in NB-5. Different cultivars of bael have constituted of different genetic makeup which results in significant variation in the quality parameters.
Total soluble solids showed a significant variation ranged from 27.8 to 30.2 percent among different genotypes. Maximum TSS (30.2%) was observed in NB-9, being at par with NB-5 (29.7%). It was lowest (27.8%) in NB-7. Fruit acidity was observed significantly higher (0.48%) in NB-9, which was statistically at par with NB-7 (0.46%) while minimum fruit acidity (0.42%) was recorded in NB-5. Fruit yield per plant was observed significantly higher (52.0 kg) in NB-7, which was statistically at par with NB-9 (44.0 kg) while minimum fruit yield per plant (23.0 kg) was recorded in NB-5. Variations in different quality parameters were also recorded by Kumar and Nath, 2010 [5]; Jana *et al*., 2014 [4]; Nagar *et al.,* 2017 [7].

Table 1: Assessment of bael cultivars for growth parameters

Cultivars	Plant height (m)	Stem girth (cm)	Spread of plants (NS-EW) (m)	Time of flowering
NB-5	3.45	42.0	4.60 x 4.12	1st to 3rd week of June
NB-7	5.82	63.7	6.24 x 5.92	Ist to 2nd week of June
NB-9	5.50	57.4	4.60 x 4.75	-do-

Table 2: Assessment of bael cultivars for quality parameters

Cultivars	Fruit weight (kg)	Fruit length (cm)	Fruit breadth (cm)	Total soluble solids (%)	Acidity (%)	Yield/ Plant (kg)
NB-5	1.32	12.65	12.50	29.7	0.42	23.0
NB-7	2.50	15.45	16.28	27.8	0.46	52.0
NB-9	1.90	11.20	13.46	30.2	0.48	44.0

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