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Study on physico-morphological characteristics of 14 Bael (Aegle marmelos Corr.) genotypes grown at Chapainawabganj, Bangladesh

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ABSTRACT

Fourteen bael genotypes were evaluated at the Regional Horticulture Research Station, Chapainawabganj, Bangladesh during March 2012 to May 2014 to find out the superior genotypes. Among the genotypes, the highest number of fruits was recorded in AM 07 (69.0) while the minimum was noted in AM 02 (2.0); the largest fruit was found in AM 04 (2.9 kg), while the smallest was found in AM 19 (0.65 kg). The highest fruit length was recorded in AM 04 (28.57 cm) while it was noted to be least in AM (7.16 cm). The highest pulp weight (2303.33 g) and percent edible portion (79.40) was recorded in AM 04, while the lowest (415.0) was noted in AM 19. The skull and fiber weight was recorded maximum (499.0 and 94.33 g) in AM 04, while the lowest (140.67 and 30.00 g) was found in AM 05. Maximum skull thickness was recorded in AM 03 and the least thickness of skull was noted in AM 04, AM 05 and AM 18. The highest number of seeds (167.33) was recorded in AM 06, while it was noted least (81) in AM 10. The highest TSS (%) (37.0) was recorded in AM 03 & AM 04, while the minimum (28.0) was found in AM 13.The highest yield 21.06 t/ha was recorded in AM 07 while the minimum 1.13 t/ha was noted in AM 13. All the genotypes were free from anthracnose but one genotype AM 07 was susceptible to sooty mould disease. Considering fruit weight, pulp weight, edible portion, TSS, eating quality and yield AM 04, AM 05, AM 06 and AM 10 were found superior among the genotypes studied.

Key words: Bael, genotype, physico-morphology, fruit characters

INTRODUCTION

Bael (*Aegle marmelos* Corr.; Family-Rutaceae) is a popular medicinal plant in the Ayurvedic and Siddha systems of medicines used to treat a wide variety of ailments. In India, this plant is known as "Bael Tree". It is mostly found in tropical and subtropical region. The tree grows wild in dry forests on hills and plains of central and southern India, Burma, Bangladesh, Pakistan, Sri Lanka, Northern Malaya, Java and Philippine Islands (Islam *et al*., 1995). This plant is also known as "Bael Tree" in Bangladesh and regarded as minor fruit. The fruit is rich source of carbohydrates, vitamins and minerals. Ripe fruits are generally used for fresh consumption, preparation of squash, nectar and value added products (Singh and Roy, 1984). It is medium sized tree having profuse dimorphic branched, alternate, trifoliate, deep green leaves, membranous leaflets, large sweet scented, greenish white flowers, small to large and globose fruits. It flowers from May to July (Mazumder *et al*., 2006). Bael fruits are gaining popularity due to its medicinal and nutritional properties and regarded as "Amrit Phal" in cure of diarrhoea and dysentry, malaria, fever, jaundice, cancer, ulcers, urticaria and eczema (Nadkarni, 1954). All parts of the tree (stem, bark, root, leaves and fruits) at different maturity stages have one or the other use. It is also used in the preparation of Ayurvedic medicines since ancient times (Rai *et al*., 1991). So far, no organized and systematic orcharding of this fruit has been taken in India (Kumar et al., 1994).It can be easily grown on eroded soil and adverse climatic conditions where most of the fruits can not be grown. Bael gene pool growing in different ecological regions has enormous variability with respect to qualitative and quantitative characters (Singh and Roy, 1984). The bael has a great variability regarding fruit size, shape, taste and other important characters among the germplasm growing in Bangladesh (Islam *et al.*, 2012). Till now there is no recommended variety and systematic orcharding of bael in Bangladesh. Therefore, a programme was undertaken to find out suitable type/ types for commercial orcharding.

MATERIALS AND METHODS

The experiment was conducted at Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Chapainawabganj, Bangladesh during March

show, 2006 were planted in July 2007 and 2008. Among the germplasm 14 were fruited and those were included in the study. Planting distance was maintained at 5 m x 5 m in both ways. Manures and fertilizers were used as follows; Cowdung: 30 kg, Urea: 550 g, Triple Super Phosphate: 300 g, Muriate of Potash: 250 g, Zypsum: 100 g, Zinc Sulphate: 25 g, Boric Acid: 20 g per plant per year. The fruit shape was recorded visually; where as fruit size was recorded by measuring length and diameters of fruits. The rind thickness was determined with the help of vernier-calipers. Peel, pulp, fibre and seeds were separated, weighed and calculated in percent on fresh weight basis. The TSS of fruit pulp was determined with the help of hand refractometer. Data were analyzed statistically using MSTAT computer package programme developed by Russel (1986) and means were separated by DMRT programme. The genotypes were evaluated on the basis of tree volume, number of fruits per tree, fruit size, fruit weight, pulp weight, edible portion, TSS (%) and other qualitative characteristics.

RESULTS AND DISCUSSION

Tree characteristics

The highest tree volume (97.60 m3) was recorded in AM 01 followed by AM 07 (55.07 m3) and AM 05 (48.18 m3) while the lowest (18.55 m3) was noted in AM 09.

Fruit characteristics

Fruit of different bael genotypes showed variation considering various fruit characters (Table1). The number of fruits per tree varied significantly among the genotypes. The maximum number of fruits (69) was recordedin AM 07 followed by AM 06 & AM 01 (46), while it was found minimum (02) in AM 02. The highest fruit length was recorded in AM 04 (28.57 cm) while the lowest was found in AM 06 (7.16 cm). Rai *et al*., (2005) reported that fruit length varied from 10.93 cm to 16.98 cm. The maximum fruit breadth was recorded in AM 04 (62.87 cm) while it was found minimum in AM 19 (10.43 cm). Jaiwal *et al.*, (1969) observed that bael fruit diameter varied from 10.93 to 16.98 cm. The highest fruit weight was found in AM-04 (2.9 kg) while it was noted lowest in AM 19 (0.65 kg). Pandey *et al*., (2005) reported that fruit weight of bael genotypes varied from 0.64 kg to 1.75 kg.

Physical composition of fruit

Physical composition of fruit of different genotypes showed significant variation (Table 1). The maximum pulp weight (2303.33 g) was noted in AM 04 followed by AM 10 (1411.0 g), AM 02 (1410.66 g) while the minimum in AM 19 (415.0 g). Rahman and Uddin (1999) found that pulp weight ranged from 146.0 to 1423.0 g. The outer hard skin of bael is called Skull. The skull weight in different genotypes varied significantly from each other. Skull weight recorded maximum (449.0 g) in AM 04 followed by AM 02 (388.33 g), AM 10 (379.0 g), it was noted minimum in AM 19 (178.0 g). The fibre weight was found maximum (94.33 g) in AM 04 and minimum in AM 05 (30 g). Fibre content in bael is considered to be a negative character particularly with respect to pulp quality whereas for medicinal point of view, fibre and mucilage content are desirable traits. Islam *et al.* (2012) observed that skull weight of bael genotypes varied from 92.5 to 375 g and fibre weight 8.0 to 58.0 g. The thickest skull (0.40 cm) recorded in AM 03 while it was thinner in AM 04, AM 05, AM 18 (0.20 cm) respectively. Pareek and Nath (1996) observed that skull thickness varied from 0.26 to 0.32 cm. The seed number was recorded maximum (167.33) in AM 06 whiles the minimum (81.0) was found in AM 10. The seed weight was recorded maximum (44.67 g) in AM 03 while the minimum (13.0) was noted in AM 04. According to Nath *et al*. (2003) the number of seed and weight varied to different genotypes. Total soluble solids were recorded highest (37) in AM 03 and AM 04 while the lowest (28) was noted in AM 13. The highest fruit yield (21.06 t/ha) per hectare was recorded in AM 07 followed by AM 01 (18.60 t/ha), AM 06 (16.97) while the lowest (1.13 t/ha) was noted in AM 13 (Table 2).

Table 1. Tree and fruit characteristics

Genotypes	Tree volume (m^3)	No. of fruits per tree	Fruit size (cm)		Individual fruit wt. (kg)	Pulp weight (g)	Skull weight (g)
			Fruit length	Fruit breadth			
AM-01	97.60 a	46 b	12.33 e	11.16 ef	0.90d	636.67 g	208.33 i
AM-02	31.49 h	02 h	19.10c	49.73c	1.90b	1410.66b	388.33b
AM-03	36.49 g	14 d	11.43ef	10.80fg	0.75de	415.33k	259.00e
AM-04	27.00 i	09 e	28.57a	62.87a	2.90 a	2303.33a	449.00a
AM-05	48.18 c	37 c	11.16f	11.37ef	0.85d	660.0f	140.67k
AM-06	44.25 e	46 b	7.16g	11.77de	0.90d	556.33i	268.67d
AM-07	55.07 b	69 a	11.00f	10.80fg	0.75de	514.0j	178.67j
AM-08	24.85 j	07 ef	11.60ef	11.67de	0.90d	584.0h	258.67e
AM-09	18.55 l	06 fg	12.23e	11.90de	1.00cd	738.0e	210.00i
AM-10	22.14 k	04 gh	26.50b	53.84b	1.90b	1411.0b	379.33c
AM-13	28.19 i	03 h	13.47d	12.17d	1.10cd	785.0d	239.00g
AM-16	46.47 d	07 ef	13.73d	11.43ef	0.90d	589.0h	234.00h
AM-18	43.75 ef	06 f	14.13d	11.23ef	1.20c	874.0c	248.00f
AM-19	42.46 f	15 d	10.80f	10.43g	0.65 f	415.0k	178.00 j

Values followed by the same letter (s) in a column do not differ significantly (p=0.01) by DMRT.

Table 1 cont..

Genotypes	Fiber weight (g)	Skull Thickness (cm)	Seed number	Seed weight (g)	Edible portion (%)	TSS (%)	Yield (t/ha)
AM 01	32.67i	0.25c	109.0c	18.67f	70.87 c	35.50b	18.60 b
AM 02	80.00c	0.25c	75.67h	17.67g	73.33b	34.00c	7.70 e
AM 03	49.67f	0.40a	149.0b	44.67a	55.31g	37.00a	4.33 fg
AM 04	94.33a	0.20d	87.67f	13.33e	79.40a	37.00a	4.53 f
AM 05	30.00j	0.20d	90.57e	20.00de	77.41a	35.00b	12.87 d
AM 06	49.67f	0.30b	167.33a	26.66b	61.43f	34.50c	16.97 c
AM 07	49.67f	0.25c	94.67d	16.00h	67.18d	31.50d	21.06 a
AM 08	40.00g	0.32b	75.67h	16.33h	64.84e	32.00d	2.42 h
AM 09	40.00g	0.22bc	109.00c	20.67d	73.43b	34.50c	2.30 h
AM 10	89.67b	0.25c	81.00g	20.00de	74.23b	35.50b	2.42 h
AM 13	54.67d	0.25c	86.00f	20.00de	73.26b	28.00f	1.13 i
AM 16	50.00f	0.25c	82.00g	18.00fg	65.65de	29.50f	2.43 h
AM 18	52.00e	0.20d	91.00e	21.67c	73.02bc	31.00e	2.63 h
AM 19	38.00h	0.25	86.67f	17.67g	63.63e	32.00d	4.13 g

Values followed by the same letter (s) in a column do not differ significantly (p=0.01) by DMRT.

Other Physical characters

Other characteristics of fruits of different genotypes have been presented in Table 2. Fruit shape was roundish of most of the genotypes. Apex shape was different among the genotypes such as flat, raised, slightly indented and indented. Pedicel area also different such as slightly raised, flat and level with the surface were observed. Peel colour was noticed light yellow for all the genotypes. Bael fruit quality as judged by its flavour, eating quality, grittiness, bitterness, sweetness and mucilage (Table 2). Fruit flavour were noticed excellent in the genotypes AM 04, AM 05, AM 06, AM 08, AM 10, AM 13, AM 18 and good in AM 01, AM 02, AM 09 and the rest were pleasant. Eating quality was recorded poor to excellent. Grittiness was present in the genotypes AM 06, 08,10, 13, 16 &18 while it was absent in AM 01, 02, 03, 04, 05, 07, 09 & 19. Bitterness was absent in most of the genotypes. Sweetness was varied from less sweet to very sweet. Mucilage was less in most of the genotypes under study.

Table 2: Other physical characteristics

Genotypes	Fruit shape	Apex shape	Pedicel area	Peel color
AM 01	Ovate	Raised	Slightly raised	Light yellow
AM 02	Oblong	Flat	Flat	Light green
AM 03	Oblong	Flat	Flat	Light green
AM 04	Roundish	S. indented	Flat	Light yellow
AM 05	Roundish	Flat	Flat	Light yellow
AM 06	Roundish	S. indented	Flat	Light yellow
AM 07	Round	Flat	Raised	Light yellow
AM 08	Roundish	Indented	Slightly raised	Light yellow
AM 09	Roundish	S. indented	Slightly raised	Light yellow
AM 10	Roundish	S. indented	Flat	Light yellow
AM 13	Ovate	Indented	Raised	Light yellow
AM 16	Ovate	Flat	Slightly raised	Light yellow
AM 18	Oblong	Indented	Slightly raised	Light green
AM 19	Roundish	Flat	Level with surface	Light green

Table 2 cont....

Genotypes	Flavor	Eating quality	Gritty ness	Bitterness	Sweetness	Mucilage
AM 01	Good	Good	Absent	Absent	Medium sweet	Present
AM 02	Good	Good	Absent	Absent	Sweet	Less
AM 03	Pleasant	Good	Absent	Absent	Medium sweet	Present
AM 04	Excellent	Excellent	Absent	Absent	Very sweet	Absent
AM 05	Excellent	Excellent	Absent	Absent	Very sweet	Absent
AM 06	Excellent	Good	Present	Absent	Sweet	Present
AM 07	Pleasant	Poor	Absent	Absent	Sweet	Present
AM 08	Excellent	Excellent	Present	Absent	Medium sweet	Less
AM 09	Good	Excellent	Absent	Absent	Medium sweet	Less
AM 10	Excellent	Excellent	Present	Absent	Very sweet	Less
AM 13	Excellent	Good	Present	Absent	Sweet	Less
AM 16	Pleasant	Good	Present	Absent	Sweet	Less
AM 18	Excellent	Good	Present	Absent	Very sweet	Less
AM 19	Pleasant	Poor	Absent	Absent	Less sweet	Present

Table 3. Insect and disease reaction of different genotypes of bael

Germplasm	Fruit fly Infestation (%)	Disease reaction (Incidence %)	
		Anthracnose	Sooty mould
AM 01	0.00	0.00	Medium
AM 02	0.00	0.00	Not found
AM 03	0.00	0.00	Low
AM 04	0.00	0.00	Not found
AM 05	0.00	0.00	Not found
AM 06	0.00	0.00	Not found
AM 07	0.00	0.00	High
AM 08	0.00	0.00	Not found
AM 09	0.00	0.00	Not found
AM 10	0.00	0.00	Not found
AM 13	0.00	0.00	Not found
AM 16	0.00	0.00	Not found
Germplasm	**Fruit fly Infestation (%)**	**Disease reaction (Incidence %)**	
		Anthracnose	**Sooty mould**
AM 18	0.00	0.00	Not found
AM 19	0.00	0.00	Not found

Most of the genotypes were free from insect- pest and disease attack but a few genotype infected by sooty mould recorded at genotypes AM 001, AM003 and AM 007 while the highest incidence at AM 07 (Table 3).

In consideration of fruit characteristics and percent edible portion AM 04, AM 05, AM 09, AM 10 AM 13 and AM 18 genotypes were found most promising. The available variability for various traits in bael genotypes can be utilized for improvement of this under utilized fruit. Genotypes having less seeds and mucilage content, less fibre content and better aroma can be used for improvement of this native fruit. As there is no recommended variety for commercial cultivation, the superior genotypes may be released as variety.

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