Variability in Bael (*Aegle marmelos* Correa) Genotypes from Orissa

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Survey was conducted in different part of Orissa to assess the existing natural diversity in bael seedling trees and to identify the superior genotype with desirable horticultural traits. Observations on morphological and physico-chemical parameters of fruit were recorded in 21 promising genotypes. All the genotypes showed considerable variations with respect to physico-chemical characters assessed. The genotypes CHBl-13 and CHBl-14 were found promising with respect to pulp weight (86.04 and 86.92%) and skull thickness (2.32 and 2.22 mm). The CHBl-13 also had higher fruit weight (2.915 kg) and found superior over other genotypes. The minimum seed number was counted in CHBl-15. The maximum Total Soluble Solids (40.43 ^{0}Brix) of fruit was recorded in CHBl-20 whereas the TSS/acid ratio was maximum (107.08) in CHBl-7.

Key Words: Bael, Genotypes, Physico-chemical Characters, Seedling

Introduction

Bael (*Aegle marmelos* Correa) is one of the important under utilized indigenous fruit crop of India. It belongs to family Rutaceae. The fruit has been known in India since the pre historic era. It is a sacred tree dedicated to Lord Shiva and is mentioned in Vedic literature and Ramayana. Fruits are widely and abundantly available in forests of Orissa especially *Dhenkanal, Angul, Bolangir* and *Rayagadha* districts. So far there is no organized and systematic orcharding of this fruit crop has been taken in India (Kumar *et al*., 1994). 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 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). 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) 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 sub-tropical belt of north India. The plains of Bihar and plateau regions of Jharkhand have wide distribution of bael genotypes particularly in dry, undulating/forest lands. 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) 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). Central India has high level of variability in bael. Therefore, a survey was conducted in parts of Orissa state with a view to identify superior genotypes for various horticultural traits.

Materials and Methods

Survey of bael growing region was conducted in *Dhenkanal, Angul, Bolangir* and *Rayagadha* district of Orissa during April, 2007 and 2008 and was undertaken both in cultivated as well as forests as per the method suggested by Gupta and Rai (1996). Efforts were made to select only regular, prolific bearing, dwarf type with thin skull, less seed and fibre, pest and disease free healthy trees with prolific bearing fruit of good size and shape. A total of 21 genotypes having desirable

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fruit characteristics and bearing behaviour were identified. The method of random sampling after gathering information about a particular genotype was followed. Five fruit were randomly collected from all the direction of each genotype to record the morphological and qualitative characters. The extent of variations in physico-chemicals traits of fruit from different locations were recorded. The physical attributes *viz*., fruit weight, length, diameter, skull thickness, number of seeds, seed weight and seed size were estimated/measured following standard procedure. The fruit yield/tree was measured by calculating the number of fruits per tree and multiplying by the average fruit weight. The Total Soluble Solids (TSS) of fruits was estimated by Hand Refractometer and presented in terms of ^{o} Brix. The titratable acidity expressed in terms of percentage of citric acid was recorded by titrating 2 ml juice against N/10 NaOH using phenolphthalene indicator (AOAC, 1960). The pH was estimated by pH meter. The data were statistically analyzed as per the method given by Gomez and Gomez (1984) using randomized block design.

Results and Discussion

Growth and fruit yield

The data on trunk cross sectional area of tree at 30 cm height, fruit yield and its attributes are presented in Table 1. The trunk cross-sectional area of tree varied from 325.85 to 1789.97 cm^2. The highest trunk cross-sectional area of tree was recorded in CHBl-21 and minimum in CHBl-1. Fruit number/tree increased with increasing the trunk cross-sectional area of tree. There is positive and linear relationship between trunk cross-section area and fruit number. Maximum fruit number was recorded in CHBl-21 followed by CHBl-20 and CHBl -19. The fruit weight was maximum in CHBl-13 which was at par with CHBl-1 and CHBl-11. Fruit weight has been considered as one of the desirable character for selection in bael (Pandey *et al.*, 2008). The fruit yield was maximum in CHBl-13 and it was superior over other genotype collected from the region. The fruit length and diameter was maximum in CHBl-13 followed by CHBl-1, CHBl-14 and CHBl-7. The skull weight was minimum in CHBl-19 genotype but lowest per cent of skull weight and skull thickness and the highest pulp recovery percentage was observed in CHBl-14. The thinner skull and maximum pulp per cent is considered to be the good quality characters for bael fruit (Rai *et al.*,1991). Similar variations in fruit weight, fruit size, pulp weight, skull thickness were also recorded in various bael genotypes (Pandey *et al.*, 2008; Nath *et al.*, 2003; Singh *et al.*, 2000). The seed number and weight significantly varied in different

Table 1. Vegetative growth and physical characters of bael fruits collected from Orissa

Genotypes	TCA (cm^2)	No. of fruits/ tree	Fruit Wt. (g)	Fruit yield (Kg/pl)	Fruit size (cm)		Skull characters		Pulp wt. (g)	Pulp (%)	Skull (%)	No. of seed/ fruit	Seed Wt/ fruit (g)	Seed size (mm)	
					Length	Diameter	Weight	Thickness						Length	Diameter
CHBl-1	325.85	34	2695	91.63	16.3	16.9	417.84	2.87	2277.16	84.49	15.51	152	18.97	9.20	7.90
CHBl-2	336.11	35	0860	30.10	13.1	10.1	210.20	2.45	649.80	75.55	24.45	140	15.32	8.70	6.50
CHBl-3	367.85	40	1425	57.00	13.6	13.8	429.58	2.36	995.42	69.85	30.15	104	14.90	9.32	7.61
CHBl-4	389.81	45	1125	50.62	13.2	11.2	325.20	2.46	799.80	71.09	28.91	108	15.12	8.70	7.90
CHBl-5	548.05	47	1490	70.03	14.1	13.5	283.80	2.88	1206.20	80.95	19.05	107	9.38	8.40	6.63
CHBl-6	717.97	48	1350	64.80	14.3	12.6	410.30	2.67	939.70	69.60	30.40	112	15.43	8.20	6.57
CHBl-7	733.17	50	2310	115.5	15.4	16.7	490.10	3.42	1819.90	78.78	21.22	131	10.33	7.34	6.78
CHBl-8	738.17	57	1450	82.65	12.5	11.2	415.40	2.87	1034.60	71.35	28.65	125	12.67	7.12	6.56
CHBl-9	795.54	64	1830	117.12	14.1	15.1	436.15	2.76	1393.85	76.16	23.84	121	7.93	7.20	6.18
CHBl-10	811.53	67	1295	86.76	13.9	13.1	395.50	2.68	899.50	69.45	30.55	105	12.45	8.49	7.88
CHBl-11	820.68	75	2085	156.37	15.2	16.5	429.26	2.88	1655.74	79.41	20.59	175	16.73	9.67	7.28
CHBl-12	827.68	78	1645	128.31	15.3	13.6	405.70	2.78	1239.30	75.33	24.67	145	13.34	7.50	6.89
CHBl-13	877.08	85	2915	247.75	17.2	17.8	406.93	2.32	2508.07	86.04	13.96	120	19.12	7.07	9.60
CHBl-14	910.81	92	1800	165.60	15.5	14.5	235.35	2.22	1564.65	86.92	13.08	130	24.40	7.12	8.35
CHBl-15	997.93	112	1065	119.28	14.3	12.5	219.76	2.59	845.24	79.36	20.64	68	7.87	8.76	6.45
CHBl-16	1052.10	120	1005	120.00	12.5	12.1	217.18	2.63	787.82	78.90	21.10	132	15.83	7.12	8.23
CHBl-17	1449.88	125	1675	209.37	13.5	14.7	298.69	2.95	1376.31	82.16	17.84	156	21.80	7.60	7.20
CHBl-18	1471.43	135	1370	184.95	13.1	12.5	345.23	2.89	1024.77	74.80	25.20	123	14.50	8.23	7.34
CHBl-19	1672.63	136	1060	144.16	11.1	12.2	204.88	2.50	855.12	80.67	19.33	133	11.72	7.54	6.34
CHBl-20	1780.97	140	0700	98.00	10.7	10.3	206.22	2.52	493.78	70.54	29.46	99	9.66	8.76	6.45
CHBl-21	1789.97	152	0930	141.36	12.9	11.6	273.83	2.98	656.17	70.55	29.45	85	11.85	9.12	6.78
CD at 5%	–	–	540.1	–	1.2	1.1	124.45	0.31	530.4	8.24	6.23	55.19	5.67	0.67	0.59

CHBl: Central Horticulture Bael, Trunk cross-sectional area (TCA) : Girth^2 / 4 p genotypes. The maximum seed number was counted in CHBl-11 followed by CHBl-17 and CHBl-1 and the minimum seed number was found in CHBl-15. Whereas seed weight was estimated maximum in CHBl-14 and minimum in CHBl-15. The maximum seed length was measured in CHBl-11 but diameter was maximum in CHBl-13. The lower seed number and weight is the preferred character for selection of superior genotypes in bael (Rai *et al*.,1991). The above observations revealed that while selecting superior bael genotypes, pulp content, seed number and size and skull thickness should be given more importance rather than fruit weight (Pandey *et al*., 2005; Majumdar, 1975).

Fruit quality characters

Variations in fruit quality characters among different genotypes were observed and presented in Table 2. The TSS varied from 31.45 to 40.43 ^{o} Brix in different genotypes. The significantly superior value was obtained in CHBl-20 followed by CHBl-17. The minimum TSS value was recorded in CHBl-2. The highest titratable acidity was estimated in CHBl-10 followed by CHBl-12 and CHBl-8. The TSS:acid ratio was maximum in CHBl-7 followed by CHBl-19 and CHBl-20. The pH of fruit juice was maximum in CHBl-8 and minimum in CHBl-13. The variations in quality parameters of bael were also recorded by Jauhari *et al*., 1969; Pandey *et al*., 1986; Pandey *et al*. 2005; Pandey *et al*., 2008. Based on morphological and quality characters of fruits for the consecutive two years, it was concluded that CHBl-13, CHBl-14 and CHBl-15 and CHBl-20 genotypes were most promising. The scion shoot of these genotypes have been collected and grafted plants are being established in germplasm block at Central Horticultural Experiment Station, Bhubaneswar.

Table 2. Quality characters of bael germplasms collected from Orissa

Genotypes	TSS (^{0} B)	Acidity (%)	TSS/acid ratio	pH
CHBl-1	32.24	0.43	74.97	4.77
CHBl-2	31.45	0.39	80.64	4.74
CHBl-3	32.76	0.40	81.90	5.11
CHBl-4	33.34	0.41	81.30	5.40
CHBl-5	34.56	0.42	82.28	5.20
CHBl-6	35.89	0.38	94.44	4.86
CHBl-7	38.55	0.36	107.08	5.15
CHBl-8	36.36	0.44	82.63	5.45
CHBl-9	36.98	0.36	102.72	4.21
CHBl-10	38.74	0.50	77.48	5.32
CHBl-11	37.56	0.36	104.33	5.12
CHBl-12	38.41	0.45	85.35	4.34
CHBl-13	38.78	0.40	96.95	4.17
CHBl-14	38.87	0.41	94.80	4.50
CHBl-15	38.25	0.36	106.25	5.13
CHBl-16	36.43	0.37	98.45	4.63
CHBl-17	40.21	0.43	93.51	5.20
CHBl-18	37.65	0.39	96.53	5.43
CHBl-19	38.35	0.36	106.52	5.23
CHBl-20	40.43	0.38	106.39	4.65
CHBl-21	31.56	0.40	78.90	4.49
CD at 5%	3.35	0.08	16.07	0.09

References

AOAC (1960) Official methods of analysis, 9th edt. Association of official Agricultural Chemists, Washington.

Gomez KA and Gomez AA (1984) Statistical procedure for agricultural Research, 2nd edn, John Wiley and sons Inc. New York.

Gupta PN and Rai M (1996) Gene poolsampling strategies during collection of fruit crops. In: PN Gupta, M Rai and KPS Chandel (eds) Genetic Resources of Tropical fruits: Collection, Evaluation and conservation strategies. NBPGR, New Delhi, pp 55-63.

Jauhari OS Singh RD and Awasthi RK (1969) Survey of some important varieties of bael (*Aegle marmelos* Correa). *Punjab Hortic. J.* **9**: 48-53.

Kumar D Pathak RK and Ali W (1994) Studies on the effect of duration and methods of budding in bael. *Indian J. Hort.* **51(2):** 150-153.

Majumder, B C (1975) Physico-chemical analysis of some types of bael (*Aegle marmelos* Correa) Fruit growing in West Bengal. *Indian Hort.* **19:** 295-298.

Nath V, Pandey D and Das B (2003) Diversity of bael (*Aegle marmelos* Correa) in East Central India. *Indian J. Plant Genet. Resour.* **16**: 222-225.

Pandey D, Shukla SK and Nath V (2005) Diversity of bael (*Aegle marmelos* Correa) in Bihar and Uttar Pradesh. *Progressive Horti.* **31**: 359-362.

Pandey D, Shukla SK and Kumar A (2008) Variability in bael accession from Bihar and Jharkhand. *Indian J. Hort.* **65:** 226-229.

Pandey NC, Singh AR, Maurya VN and Katiyar RK (1986) Studies on biochemical changes in bael (*Aegle marmelos* Correa) fruit. *Progressive Hort.* **18**: 29-34.

Pathak RK Pandey D and Pramanik PK (2002) Diversity in bael (*Aegle marmelos* Correa) – an under utilized fruit of India. *IPGRI Newsl.* **37**: 22 & 37.

Rai M Gupta PN and Dewedi R (1991) Variability in bael germ plasm. *Indian J. Plant Genet. Resour.* **40**: 86-91.

Singh R Mishra KK and Jaiswal HR (2000) Studies on physicochemical characters in fruit of bael genotypes. *Indian J. Hort.* **57**: 314-317.

Pareek OP and Nath V (1996) Coordinated fruit research in Indian Arid Zone–A two decade profile. NRCAH Bikaner, pp. 1-104.