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Bael Germplasm Evaluation for Leaf and Fruits Pulp Variability under South Haryana Conditions

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ABSTRACT

The present study was carried out under semi-arid conditions of Haryana at experimental orchard of CCS HAU, Regional Research Station, Bawal. The plants were selected randomly and earmarked randomly and their branches were tagged in each direction for various parameters such as leaf and fruit pulp-shell parameters of different bael germplasm. The leaf area, fresh weight and dry weight per leaf were observed maximum in NB-17, whereas petiole length was maximum in NB-9, while minimum in Seedling-3. Chlorophyll content was reported maximum in CISHB-2 and minimum in NB-9. Pulp weight, shell weight and shell thickness per fruit was maximum in Samastipur Selection. Pulp percent, shell percent and pulp-shell ratio were differ non-significantly.

Key words: *Leaf parameters, Variability, Bael germplasm (Aegle marmelos)*

INTRODUCTION

Bael (*Aegle marmelos* Corr.) is one of the important underutilized medicinal, indigenous fruit crop of India. Its fruits are popular due to its medicinal and nutritional properties and regarded as 'Amrit Phal'. In the Ayurvedic and Siddha systems of medicines used to treat a wide variety of ailments to cure diarrhoea and dysentery, malaria, fever, jaundice, cancer, ulcers, urticaria and eczema[23]. The ripe fruits are aromatic, sweet and astringent, which helps in regeneration of skin, coolant, laxative, febrifuge and good for the heart, brain and in dyspepsia[16].

No organized and systematic orcharding of this fruit crop has been taken in India. Due to mythological importance; it is mainly grown near the temples. It can be grown easily on eroded soils and adverse climatic conditions where most of the other fruits cannot be grown[3]. Bael gene-pool is spread over different parts of the country and has enormous variability with respect to qualitative as well as quantitative characters. In order to identify distinct characters of various bael cultivars, the morphological characters are equally important to the fruit characters.

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Apart from the tree morphological characters, wide variability exists in fruit size and shape, bearing habit, flesh colour, texture, sugar content, mucilage content, number of seeds per fruit, gum locules and pericarp thickness[7]. Variability in ascorbic acid content, fruit weight, fruit length, number and weight of seeds per fruit, fibre content, petiole length; bark and leaves were also observed [14,17]. Identification of suitable genotype for the region is necessary for promoting its production, productivity and quality of the fruits under semi-arid conditions.

MATERIAL AND METHODS

The experimental location is situated at latitude 28.10N, longitude 76.50E 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 44^{o}C) 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, Samastipur Selection, Seedling-1, Seedling-2 and Seedling-3. Experiment was laid out in randomized block design (RBD) and maintained under uniform cultural practices. Mature leaves were collected from each direction of earmarked branches for leaf parameters viz., leaf area, leaf fresh weight, leaf dry weight and petiole length. Leaf area was estimated with the help of digital leaf area meter and their values were expressed in square centimetre (cm²). Fresh weight of leaf was measured with the help of digital electric balance, thereafter, dried in an oven at 60±5 °C till the constant weight achieved and weighed for dry weight (g). The petiole length was measured as a length from twig attachment to the start of leaf blade and the average value was expressed in centimeters (cm).

The fruits of uniform size free from injury, disease or bruising were harvested randomly from tagged branches of each germplasm for pulp 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[12].

RESULTS AND DISCUSSION

The results pertaining to variation of leaf characteristics such as leaf area, fresh weight, dry weight, petiole length and chlorophyll content in respect of various germplasm are depicted in Table 1. Leaf area showed a significant variation ranged from 60.29 cm²/ leaf to 105.42 cm²/ leaf among different genotypes. Higher leaf area (105.42 cm²/ leaf) was observed in NB-17, being at par with Samastipur Selection (98.67 cm²/ leaf). It was lowest (60.29 cm²/ leaf) in Seedling-2; followed by Seedling-3 (62.16 cm²/ leaf), CISHB-1 (63.29 cm²/ leaf), NB-16 (64.70 cm²/ leaf) and Seedling-1 (65.13 cm²/ leaf). Leaf fresh weight was observed significantly higher (2.98 g/ leaf) in NB-17, which was statistically at par with Samastipur Selection (2.92 g/ leaf) and NB-5 (2.84 g/ leaf), while minimum leaf fresh weight (1.52 g/ leaf) was recorded in Seedling-2 and Seedling-1 (1.63 g/ leaf). Highest leaf dry weight (0.98 g/ leaf) was observed in NB-17; which was statistically at par with Samastipur Selection (0.96 g/ leaf), however, lowest dry weight (0.44 g/ leaf) was recorded in Seedling-2. Petiole length (4.93 cm) was highest in NB-9, while lowest (3.20 cm) in Seedling-3 which was at par with Pant Sujata (3.23 cm) and Pant Aparna (3.33 cm).

There was significant variation in leaf chlorophyll content of all the genotypes studied in this investigation. It ranged from 21.58 spad unit to 37.80 spad unit. Maximum chlorophyll content (37.80 spad unit) was recorded in CISHB-2, while the minimum chlorophyll content (21.58 spad unit) was recorded in NB-9, which was at par with Samastipur Selection (22.76 spad unit) and NB-5 (22.78 spad unit).

Variability in leaf morphology of different germplasm varied in specific characters and adaptability to agro-climatic conditions. More or less similar variations with respect to leaf characters in various bael genotypes have been reported by Misra *et al.*[6] and Singh *et al.*[20,] under different agro-climatic conditions. Gupta *et al.*[2] reported significant differences in leaf area and per cent dry weight of leaf in different bael germplasm, whereas there was a non-significant difference in total chlorophyll content among different clones. Rai and Misra[13] studied genetic diversity of 17 genotypes of bael using Mahalanobis'D² technique and reported the existence of substantial genetic diversity. Petiole length of different clusters was observed and recorded as 4.51 cm, 4.45 cm and 5.53 cm in cluster 1, cluster 2 and cluster 3, respectively. They reported that the petiole length contributed maximum genetic divergence.

Singh and Misra[21] evaluated twenty four genotypes of bael and observed variation in fresh weight per leaf from 2.10 to 4.68 g, dry weight per leaf from 0.92 g to 1.68 g. They reported the commercially released cultivars *viz.*, Pant Shivani, Pant Urvashi, Pant Aparna, Pant Sujata and NB-1 invariably showed higher length and breadth of leaflets, leaf area, leaf fresh weight as well as leaf dry weight in addition to the genotypes PB-1 and PB-23, which also exhibited similar results. Dry weight of leaf is directly correlated with fresh weight, nutrients accumulated and other constituents. These traits might have improved the photosynthetic efficiency and thus ultimate growth potential of the plant. Chlorophyll-a, Chlorophyll-b and total chlorophyll contents were found higher in genotypes PB-3, PB-10, PB-22 and PB-24.

Further in 2010[21] studied eighteen bael genotypes and found variation in fresh weight per leaf from 1.23 g to 4.71 g, petiole length from 3.19 cm to 4.63 cm in commercially released cultivars viz. Pant Shivani, Pant Urvashi, Pant Aparna, Pant Sujata and NB-1 along with the genotypes PB-1 and PB-23. High heritability (in broad sense) along with high estimates of genetic advance (% of mean) was observed with leaf fresh weight. They registered higher PCV (phenotypic coefficient of variation) for leaf area and leaf fresh weight, high magnitude of GCV (genotypic coefficient of variation) and PCV indicates a scope for improvement of these traits through selection. Bhawna and Misra[1], observed maximum (144.20 cm²) leaf area in Pant Vishal, whereas it was minimum (35.75 cm^2) in Pant Bael-10. Nicotra *et al*.,[9] reported the leaf shapes can differ in association with variation in other leaf traits due to different climatic factors. Singh *et al.*[19] also reported variation in petiole length of different bael cultivars. Maximum petiole length (5.73 cm) was observed in NB-7, while minimum petiole length (2.56 cm) was observed in NB-5.

Pulp-shell characteristics of fruits: The results pertaining to various pulp-shell parameters such as pulp weight, shell weight, shell thickness, pulp per cent, shell per cent and pulp-shell ratio are depicted in Table 2. Variability in pulp (%), shell (%) and pulp-shell ratio among different germplasm varied non-significant. The pulp weight and shell weight per fruit were significantly lower in seedlings as compared to improved cultivars.

Pulp weight per fruit varied from 172.8 g to 1088.8 g among different genotypes. It was observed significantly higher (1088.8 g) in Samastipur Selection, whereas lower (172.8 g/ fruit) in Seedling-3, which was statistically at par with Seedling-2 (204.3 g) and Seedling-1 (230.6 g). More pulp weight in Samastipur Selection might be due to more fruit weight and volume. Minimum (92.7 g) shell weight was recorded in Seedling-2, which was statistically at par with Seedling-3 (94.6 g) and Seedling-1 (109 g), however, maximum (384.8 g) shell weight per fruit was noticed in Samastipur Selection. There was significant variation in shell thickness of all the genotypes. Significantly lower (2.13 mm) shell thickness was recorded in Pant Aparna, being at par with NB-9 (2.27 mm), Seedling-1 (2.47 mm) and NB-17 (2.63 mm), whereas highest (4.73 mm) shell thickness was recorded in Samastipur Selection.

Variations in fruit weight, fruit size, pulp weight, skull thickness were also recorded in various bael genotypes[8]. Pandey *et al.*[10] reported that the genetic variability in

germplasm collected from different locations as well as different genetic make-up may influence different parameters. Kumar *et al.*[5] observed the pulp content ranged from 539.83 g/fruit to 733.86 g/fruit. Higher pulp content, and lower peel, seed and fibre contents are considered as most desirable quality characters for bael consumers. Kumar and Nath[4] reported minimum skull weight in CHBI-19 genotype and maximum in CHBI-7 under Orissa conditions.

Pandey *et al.*[11] observed range of shell thickness from 2.00 mm to 5.8 mm and pulp weight 0.32 kg/fruit to 2.03 kg /fruit, whereas shell percent from 17.15 to 32.31. The thinner shell and more pulp percent is considered to be desirable quality character of bael[15]. Singh *et al.* [18] observed minimum (1.6 mm) shell thickness in NB-5; followed by CISHB-1 (1.8 mm) and Pant Aparna (2.3 mm) and it was recorded maximum (3.20 mm) in NB-7, whereas maximum shell weight per fruit in Pant Urvashi and minimum in NB-16; followed by NB-5. They also observed highest pulp content (66.52 %) in CISHB-1 followed by NB-5 (65.80 %), Pant Sujata (63.00 %), Pant Aparna (62.43 %) and NB-9 (62.37 %). However, lowest pulp content (62.15 %) was recorded in CISHB-2. They reported the range of shell percent from 13.8 to 17.25 per cent. Pandey *et al.*[10], revealed that the pulp content, seed number, seed size and skull thickness should be given more importance while selecting superior genotypes rather than fruit weight.

Table 1: Leaf characteristics of different bael germplasm under semi–arid conditions of Haryana

Germplasm	Leaf area/ leaf (cm²)	Leaf fresh weight (g)	Leaf dry weight (g)	Petiole length (cm)	Chlorophyll content (Spad Unit)
NB-5	79.58	2.84	0.85	4.33	22.78
NB-9	76.52	2.58	0.80	4.93	21.58
NB-17	105.42	2.98	0.98	4.06	30.97
CISHB-1	63.29	2.02	0.64	3.66	29.76
CISHB-2	81.30	1.93	0.56	3.60	37.80
NB-16	64.70	2.05	0.63	4.60	32.37
Pant Aparna	77.46	1.85	0.62	3.33	30.54
Pant Sujata	94.34	2.48	0.81	3.23	27.29
Samastipur Selection	98.67	2.92	0.96	4.73	22.76
Seedling-1	65.13	1.63	0.52	3.50	29.35
Seedling2	60.29	1.52	0.44	4.23	23.39
Seedling3	62.16	1.67	0.51	3.20	35.11
CD at 5%	7.76	0.15	0.05	0.21	1.45

Table 2: Pulp characteristics of fruits of bael germplasm under semi –arid conditions of Haryana

Germplasm	Pulp weight/ fruit (g)	Shell weight/ fruit (g)	Shell thickness (mm)	Pulp (%)	Shell (%)	Pulp-shell ratio
NB-5	626.6	217.9	3.95	74.20	25.80	2.88
NB-9	427.7	164.2	2.27	72.27	27.73	2.65
NB-17	420.9	168.0	2.63	71.46	28.54	2.51
CISHB-1	373.1	164.6	3.90	69.41	30.59	2.29
CISHB-2	538.8	207.4	3.03	72.19	27.81	2.68
NB-16	469.9	184.0	3.07	71.82	28.18	2.59
Pant Aparna	468.8	201.0	2.13	70.03	29.97	2.43
Pant Sujata	603.4	232.2	3.00	72.24	27.76	2.70
Samastipur Selection	1088.8	384.8	4.73	73.90	26.10	2.96
Seedling-1	230.6	109.0	2.47	67.90	32.10	2.12
Seedling-2	204.3	92.7	2.97	68.79	31.21	2.21
Seedling-3	172.8	94.6	3.66	64.61	35.39	1.83
CD at 5%	58.7	37.6	0.56	NS	NS	NS

CONCLUSION

In studies on "Bael germplasm evaluation for leaf and fruits pulp variability" the leaf biomass (leaf area, fresh weight and dry weight) was observed higher in NB-17. Qualitative characters such as pulp weight, shell weight and shell thickness was maximum in Samastipur Selection. Petiole length was maximum in NB-9 and minimum in Seedling-3, while chlorophyll content was maximum in CISHB-1 and minimum in NB-9. Pulp percent, shell percent and pulp-shell ratio were differ non-significantly.

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