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Biochemical profiling of diverse genotypes of Bael (*Aegle marmelos* Correa)

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Abstract
An experiment on biochemical profiling of diverse genotypes of Bael (*Aegle marmelos* Correa.) were conducted at Department of Horticulture, GBPUAT, Pantnagar 2016-17. The experiment was laid out in completely randomized design in which treatments consist of 18 diverse genotype of Bael and three replications. The biochemical attributes ascorbic acid, pectin content and total soluble solid content were examined in March harvested unripe fruit of different genotypes of Bael. The maximum ascorbic acid content was observed from Pant Bael-3 and Pant Bael-1. However, the minimum ascorbic acid content was obtained from Bael genotype Haldi Nurmohamd -2. The maximum TSS was obtained from Pant Bael -15 followed by Pant Bael -2 and Pant Bael -1. However, the minimum TSS was obtained from Faizabad No.9.

Keywords: bael, biochemical, genotypes

Introduction
Bael (*Aegle marmelos* Correa) is an incredible minor fruit crop indigenous to India belongs to family Rutaceae. Bael tree has wide adaptability to adverse climatic and soil conditions, can tolerant to high salinity of the soil. Therefore, consider as preeminent fruit crop for arid and semi-arid region. In order to achieve increased production from waste lands, arid and semi arid regions Bael is very suitable with minimum inputs. Bael fruits are highly nutritious and very good source of vitamins, minerals, fiber and pectin.
Beside the nutritional significance, it is a wonderful ethanobotanical herb. Bael has been used in the Indian traditional medicines from time immemorial. It is associated with various important medicinal properties. All parts of this tree, *viz.*, root, leaf, trunk, fruit and seed, are used for curing one human ailment or another. The chemical investigation on the different parts of the plant has resulted in the isolation of a large number of novel and interesting metabolites. Another interesting point about Bael is the fact that it is equally useful while still unripe, whereas other fruits become consumable on ripening. The unripe fruit is an astringent, a digestive and stomachic, and is used to cure diarrhoea and dysentery. The unripe fruit has been proved to be potent hypoglycemic agent. The ripe fruit of Bael is used for curing dyspepsia (Jain, 1968) [4]. The plant has been widely used for its having antibacterial, antifungal, antioxidant, antidiarrhoetic, pesticidal, antidote and anti-inflammatory properties. The medicinal and nutritive properties together with its hardy nature make bael an ideal fruits for future. The heterozygous nature leads a wide range of diversity in Bael. Therefore, this study was conducted to explore the variation based on biochemical attributes in different genotypes of Bael.

Material and Method
The experiment was carried out on 18 genotypes of Bael at Experimental laboratory, Department of Horticulture, GBPUAT, Pantnagar during 2016-17. All the plants selected for the experiment were almost uniform in growth and vigour**.** The uniform cultural practices were adopted for all the selected genotypes of Bael under the experimentation. The fruits are harvested in the month of March for biochemical analysis. The experiment was laid out in Completely Randomized Design (CRD) with three replications and 18 genotype of Bael were considered as treatments.

Biochemical characteristics

The Ascorbic acid content was estimated by using 2, 6-Dichlorophenol-indophenol visual titration method (Ranganna, 1986) [2]. Ascorbic acid in terms of mg per 100g pulp weight was calculated by using the following formula:

$$\text{Ascorbic acid (mg / 100g)} = \frac{\text{Titrate x dye factor x dilution x 100}}{\text{Aliquot taken for estimation x weight of sample}}$$

The pectin content were measured by method described by Mazumder and Majumder (2003) [3]. The amount of total pectic content present in the samples were calculated by the following formula.

$$\text{Pectin content (\%)} = \frac{d \times c}{b \times a} \times 100$$

Whereas, a = Weight of sample; b = Volume of aliquot taken for estimation; c = Volume made with distilled water and d = Weight of calcium pectate.

The total soluble solids of fruits were measured by using digital hand refractrometer (Atazo, Japan) at room temperature and results were expressed in terms of degree Brix (°B).

Statistical analysis: The different observations were subjected to statistical analysis by using Completely Randomized Design (CRD). The mean difference was tested by 'F' test at 5 percent level of significance. Critical difference (CD) at 5 per cent level of probability was used for comparison among treatments. Data were subjected to analysis of variance as per the method give by Panse and Sukhatme (1985) [4].

Result and Discussion

Ascorbic acid

The data of ascorbic acid in diverse genotypes of Bael is presented in Table 1. A significant variation was observed among the genotypes in respect of ascorbic acid content. The ascorbic acid content ranged from 9.11 to 20.30mg/100g among the genotypes. The maximum ascorbic acid content was observed from Pant Bael-3 (20.30mg/100g), which was found at par with Pant Bael-1 (18.60mg/100g). However, the minimum ascorbic acid content was obtained from Haldi Nurmohamd -2 (9.11mg/100g). The similar effect of genotype on ascorbic acid content of Bael is reported by Teaotia *et al.*, (1963) [5]; Roy and Singh, (1978) [6] and Srivastava and Singh, (2004) [7]. This variation in ascorbic acid content among the Bael genotypes is due to the variation in genetic composition and its adaptation to the agro-climatic conditions. The values of ascorbic acid in Bael signify potential use of the fruit as a good natural source of ascorbic acid. The recommended daily intake (RDI) of ascorbic acid is about 30 mg/day for adults and 17 mg/day for children. Therefore, its fruits could be considered as good sources of ascorbic acid for purposes of human nutrition.

Pectin content

Data on pectin content reveals that there was significant difference on pectin content among the diverse genotype of Bael (Table 1). The range of pectin content is from 3.96-19.12%. The maximum pectin content was obtained from Haldi Nurmohamd-2 (19.12%) which was found at par with Pant Bael- 3 (18.96%) and Pant Bael-16(17.04%). The minimum pectin content was obtained from Pant Bael -2 (3.96%). Singh *et al.*, (2012) [8] found that pectin content in Bael pulp was 8.8 g/100g. Anup *et al.* (2017) [9] studied the pectin transitions during growth and development of CISH B-1 and CISH B-2 and observed significance differences. This variation in pectin content in the genotype might be due to the fact that differences in synthesis of pectin substances by diverse genotypes. Pectin exhibit the antioxidant activity and it is used in a number of foods as a gelling agent, emulsifier, stabilizer, texturizer and thickener. Bael fruits are rich source of pectin. An study on Bael fruit pectin revealed that, absence of hemagglutinating activity and antinutritional factors together with the activity to confer better emulsion capacity, stability and antimicrobial activity gives bael fruit pectin a clear edge over commercial citrus pectin for exploitation as an additive in food and pharmaceuticals (Jindal *et al.*, 2013) [10].

Total soluble solids (TSS)

The perusal of data in Table 1 indicated that significant effect of genotype on Total soluble solid (TSS) content on Bael fruits. The value of TSS ranged from 22 to 40 °Brix. The maximum TSS was obtained from Pant Bael -15 (40 °Brix) followed by Pant Bael -2 (39 °Brix) and Pant Bael -1(36 °Brix). However, the minimum TSS was obtained from Faizabad No.9 (22 °Brix). This variation might be due to the genetic attributes and adaptation to the agro-climatic conditions. Great variation in total soluble solids (32-34%) of Bael fruits was recorded (Jauhari and Singh, 1971) [11]. Similar finding on effect of bael genotype on TSS also found by Singh *et al*., (2000) [12].

Table 1: Evaluation of different Bael genotypes in respect to biochemical parameters

Treatments	Ascorbic acid (mg/100g)	Pectin content (per cent)	TSS (° Brix)
T_1 : (Pant Bael-1)	18.60	5.04 (2.24)	36
T_2 : (Pant Bael-2)	15.50	3.96 (1.99)	39
T_3 : (Pant Bael-3)	20.30	18.96 (4.35)	35
T_4 : (Pant Bael-4)	15.50	4.44 (2.11)	35
T_5 : (Pant Shivani)	13.90	5.52 (2.35)	30
T_6 : (Pant Urvashi)	10.20	6.56 (2.56)	29
T_7 : (Haldi Nurmohamd-2)	9.11	19.12 (4.37)	30
T_8 : (Patharchatta-1)	12.01	13.44 (3.67)	25
T_9 : (Faizabad No.9)	13.44	13.92 (3.73)	22
T_{10} : (Faizabad Local)	12.90	13.44 (3.67)	30
T_{11} : (Pant Aparna)	14.45	9.72 (3.12)	28
T_{12} : (Pant Bael-10)	11.01	9.54 (3.09)	33
T_{13} : (Pant Sujata)	16.89	9.68 (3.11)	27
T_{14} : (Pant Bael-13)	10.85	10.32 (3.21)	29
T_{15} : (Pant Bael-14)	13.56	12.24 (3.50)	30
T_{16} : (Pant Bael- 15)	14.31	10.92 (3.30)	40
T_{17} : (Pant Bael -16)	12.34	17.04 (4.13)	30
T_{18} : (Gonda No.2)	12.78	10.09 (3.18)	29
S.Em. ±	0.55	(0.18)	0.31
C.D. at 5%	2.03	(0.51)	1.16

Figures in parentheses are square root transformation values.

Conclusion

On the basis of findings of the present study, it can be concluded that the significant variation exist within the genotypes based on biochemical characters. Pant Bael-1 with Pant Bael-3 were found superior in terms of ascorbic acid content. The genotypes Haldi Nurmohamd-2, Pant Bael- 3 and Pant Bael-16 excelled in terms of pectin content. The genotypes Pant Bael -15, Pant Bael -2 and Pant Bael -1 excelled in terms of pectin content. Bael exhibit wide variation in diverse germplasm which can be used for

hybridization purpose and efficient exploration should be undertaken to exploit the potential. Therefore, characterization of diverse forms is an important prerequisite for starting any improvement programme.

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