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Yield and quality improvement in bael (*Aegle marmelos*) by plant growth regulators

Moupiya Kundu and S.N.Ghosh*

Department of Fruits and Orchard Management, Faculty of Horticulture,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur,
Nadia, West Bengal, India. PIN 741252

**Email : profsnghosh@yahoo.co.in*

ABSTRACT

With the view to know the role of different plant growth regulators on fruit setting, controlling fruit drop and to increase the yield and fruit quality of bael an investigation was taken up at the Horticultural Research Station, Mondouri, of Bidhan Chandra Krishi Viswavidyalaya during 2014-15. There were 5-treatments viz., NAA at 20 and 40 ppm; GA 10 and 20 ppm and control (water spray). The experiment was conducted following randomized block design having 4-replications in each treatment. From the results of the investigation it was concluded that two times foliar application of NAA 20 ppm at 50 % flowering stage and 21 days later helps to increase fruit yield and quality of bael fruits grown in New Alluvial soils of West Bengal.

Keywords : Bael, fruit yield and quality, plant growth regulators, gangetic Alluvial soil

INTRODUCTION

Bael is one of the arid fruit crops, having good nutritive value, hardy in nature, good processing quality and wide adaptability over tropics and sub tropics. It has attained an important position among fruits in India, because of its high medicinal and nutritional values. It is considered as a hardy tree and can thrive well even in swampy alkaline soil as well as strong acid soil, having pH ranging from 5-10, where many other fruit trees fail to grow. It grows easily in wasteland and sandy soils of arid eco-system, having low fertility status and poor moisture holding capacity.

Bael is one of the most important under-utilized fruit crops grown in poor soils and in adverse climatic situation where fruit setting and fruit drop seems to be a common problem. There are many reports regarding beneficial effects of various plant growth regulators on fruit setting and controlling fruit drop in arid fruit crops like Aonla (Ghosh *et. al.*,2009), Pomegranate (Ghosh *et. al.*, 2012), Ber (Ghosh *et. al.*,2009) etc but such report on bael is scanty and practically nil under Nadia condition (alluvial soil) of West Bengal. With the view to know the role of different plant growth regulators on fruit setting, controlling fruit drop and to increase the yield and fruit quality of bael an investigation was taken up at the Horticultural Research Station, Mondouri, of Bidhan Chandra Krishi Viswavidyalaya.

MATERIAL AND METHODS

The experiment was conducted at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India during the period of 2015-2016. The experimental field was situated at 23.5Ú N latitude and 89Ú E longitude with an elevation of 9.75 m above mean sea level. The soil texture of the experimental field was sandy loam. In the experimental field, pH of the soil was 6.8, available nitrogen was 230.00 kg/ha, available P_2O_5 was 35.20 kg/ha, and available K_2O was 88.00 kg/ha. The climate of the Research Station was sub-tropical humid with maximum temperature ranging between 25.05Ú C to 38.21Ú C and minimum temperature ranging between 9.85Ú C to 25.38Ú C during the period of investigation. Major rainfall was received during the month of July and September. The relative atmospheric humidity prevailed during the period of experiment varied from 48.14 percent to 98.40 percent.

There were 5-treatments, viz., NAA at 20 ppm and 40 ppm; GA at 10 ppm and 20 ppm and control (waterspray). The experiment was conducted on

6-year old budded plants of a local elite type, planted at 5m x5 m spacing; following randomized block design having 4-replications in each treatment. Plant growth regulators were sprayed on the leaves thoroughly two times *i.e.*, 1st spray at 50% flowering stage and 2nd spray at 21 days after 1st spray. Sticker was used in spray solution and spraying was done before 8.00 AM.. Observations were recorded on fruit set percentage, fruit retention percentage, fruit drop pattern, number of fruits per plant, fruit yield per plant, average fruit weight, pulp content, TSS, acidity, Total sugar percentage, vitamin C content and anthocyanin content in fruit pulp.

Fruit set was calculated from the tagged 100 flowers after 30 days of flower opening and fruit set percentage was calculated. Fruit retention was calculated from 100 tagged fruit. The tagging was made at pea stage of fruit development i.e., after fruit set and fruit retention was observed every month till harvest. Number of fruits dropped in each month were recorded starting from July 2015 to May 2016, until harvest. Fruit yield per plant was calculated by multiplying number of fruits per plant with average fruit weight. Average fruit weight was measured at mature stage in the month of May 2016 on the basis of 3 fruits taken from each plant randomly with the help of a weighing balance and average weight was expressed in grams (gm). Pulp was extracted from three fruit per plant separately, weighed and average pulp weight calculated and expressed in grams (gm).

TSS of fruits was estimated with the help of a digital hand refractometer (range: 0-53%), calibrated at 0Ú brix at 20Ú C. Acidity percentage of the fruits was estimated by titrating the aqueous extract of known quantity of fruit juice against (N/10) NaOH solution using phenolphthalein as indicator (Rusk, 1969). Total, reducing and non reducing sugar content of the fruit were determined by titrimetric procedure as per A.O.A.C. (1984) and expressed in percentage (%).Vitamin C content of the fruit was estimated by using 2,3-dichloropyenolindophenol dye titration method (A.O.A.C., 1984) and expressed as mg per 100gm of fruit pulp. The data obtained were analyzed statistically by analysis of variance as suggested by Panse and Sukhatme (1978) and the significance was worked out by Fisher's 'F' test of probability levels at 0.05%. Angular transformation of data on percentage was done.

RESULTS AND DISCUSSION

Fruit set and fruit retention

Data presented in Table 1 revealed that spraying of plant growth regulators influenced fruit set percentage of bael significantly. Spraying of NAA at 20 ppm resulted in maximum fruit set percentage (51.25%) followed by spraying of GA at 20 ppm (46.25%). While control (water spray) plants resulted in minimum fruit set percentage (23.75%). Fruit retention percentage affects the ultimate yield of a plant. It was evident from the data that fruit retention percentage varied significantly. Spraying of NAA 20 ppm resulted in maximum fruit retention percentage (11.25%) followed by GA 20 ppm (6.75%). Fruit retention percentage was found minimum in control plants (0.5%). The results corroborate with the findings of Uniyal and Misra (2015) who also found minimum fruit drop (90.64%) and maximum fruit retention (9.36%) with NAA 20 ppm when sprayed in bael tree cv. Pant Shivani. From the investigation, it was clear that bael tree experiences severe fruit drop after fruit setting and the drop seems to be related to many factors like hormonal imbalances (Uniyal and Misra, 2015), nutrition, moisture stress etc.

Fruit yield per plant

Fruit yield per plant varied significantly with growth regulator application. From Table 1, it was found that fruit yield was highest in plants treated with NAA 20 ppm (19.92 kg/plant); followed by GA 20 ppm (17.77 kg/plant). Control plants gave minimum fruit yield per plant (8.75 kg/plant). Maximum fruit yield from NAA or GA sprayed plants was due to higher fruit set and final retention of fruits. Beneficial role of NAA application in reducing fruit drop may be explained from the fact that it maintain the on-going physiological and biochemical process of inhibition of abscission (TomasZewska and TomasZewski, 1970).

Table 1: Effect of plant growth regulators on fruit yield and physical characters of bael

Treatment	Fruit set (%)	Fruit retention (%)	Fruit yield /plant (kg)	Fruit weight (g)	Pulp percentage
NAA 20 ppm	51.25 (45.69)	11.25 (19.58)	19.92	885.41	75.24
NAA 40 ppm	33.75 (35.50)	3.00 (9.9)	10.86	819.58	70.64
GA-10 ppm	45.00 (42.11)	4.50(12.23)	13.46	897.25	65.19
GA-20 ppm	46.25 (42.83)	6.75(15.04)	17.77	911.25	75.33
Control(Water spray)	23.75 (29.15)	0.50 (3.46)	8.75	777.91	62.66
SE(m)±	0.282 (0.17)	0.253 (0.64)	0.345	0.333	0.204
C.D. at 5%	0.879 (0.53)	0.789 (2.01)	1.076	1.039	0.637

Figures in parentheses are angular transformed values

Table 2: Effect of plant growth regulators on quality attributes of bael fruit.

Treatment	TSS (^{0}Brix)	Acidity (%)	Total sugar (%)	Vitamin C (mg/100g)	Anthocyanin (mg/100g)
NAA 20 ppm	35.42	0.37	24.58	9.0	5.6
NAA 40 ppm	35.30	0.37	24.40	8.8	5.5
GA-10 ppm	34.08	0.40	24.20	8.7	5.3
GA-20 ppm	35.01	0.39	24.34	9.6	5.4
Control(Water spray)	33.79	0.41	22.39	8.5	4.9
SE(m)±	0.173	0.087	0.173	0.463	0.283
C.D. at 5%	0.538	NS	0.538	NS	NS

Fruit weight and pulp percentage

It is evident from the data in Table 1 that different treatments showed significant variation in fruit weight.It was highest in plants treated with GA 20 ppm (911.25 g); followed by GA 10 ppm (897.25 g) and NAA 20 ppm (885.41 g). Control plants showed minimum weight of fruits (777.91g). Many workers also reported beneficial effect of NAA on fruit weight and size in fruit crop like ber (Singh, *et al.,* 2001; Ram *et al.,* 2005).

Fruit pulp in bael is the final product utilized for fresh consumption or for preparation of different preserve or other products. The pulp recovery percentage was maximum from the fruit of the plant sprayed with GA at 20 ppm (75.33 %) closely followed by NAA at 20 ppm (75.24%). Minimum pulp recovery was obtained from the contol plants (62.66%).

Fruit quality

It is evident from data, presented in Table 2 that TSS of bael fruits it varied significantly with different treatments. It was maximum in fruits from the plants sprayed with NAA 20 ppm (35.42Ú Brix) and minimum in fruits from contol plants (33.79Ú Brix). Though acidity percentage of bael fruits from different growth regulators treated plants did not vary significantly but plants treated with NAA 20 ppm and NAA 40 ppm (0.37% each) resulted in

fruits with minimum acidity; followed by fruits of GA 20 ppm (0.39%), and GA 10 ppm (0.40%). Control plants resulted in fruits with maximum acidity (0.41%).

Total sugar content varied significantly and was highest in NAA 20 ppm (24.58%) treated plants (Table 2). Control plants resulted in fruits with minimum total sugar (22.39%) content. Vitamin C content did not vary significantly to different treatments and was highest in GA 20 ppm treated plants (9.60 mg/100g) followed by NAA 20 ppm treated plants (9.00mg/100g) (Table 2). Fruits from the control plants had lowest vitamin C content (8.50 mg/100g). Anthocyanin content of the fruit was also found varying non-significantly with different treatments. However, it was highest in fruits from the plants sprayed with NAA 20 ppm (5.6 mg/100g) and least in the control plants (4.9 mg/100g). Fruit quality improvement due to NAA and GA application was also noted by Ghosh *et al.* (2009) in pomegranate.

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