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Effect of plant growth regulators on yield and yield attributing characteristics of mango (*Mangifera indica* L) cv. Dashehari

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Abstract
The present investigation entitled "Effect of plant growth regulators on yield and yield attributing characteristics of mango (*Mangifera indica* L.) cv. Dashehari" was carried out at the instructional Farm, Dept. of Horticulture, College of Agriculture, IGKV, Raipur (C.G) during the year 2017-18 employing Randomized Block Design with three replications. Three levels of NAA *i.e.*, 15, 25 and 35 ppm, three levels of GA_3 *i.e.* 15, 25 and 35 ppm and three levels of 2, 4-D i.e. 15, 25 and 35 ppm were sprayed at pea and marble stage of fruit development. All the treatments significantly influenced the number of fruits retained at pea, marble and harvesting stage of fruit growth and development as compared to the control. Foliar application of 35 ppm GA_3 at pea and marble stage of fruit development increased number of fruits (880.49) as well as total yield (135.46 kg/plant). Physical characters of fruit *viz.*, Fruit Length (11.65cm) and width of fruits (6.82cm), average fruit weight (177.84g), volume (173.63g) and pulp weight (130.41g) were also improved with the foliar application of 35 ppm GA_3. While, stone weight (25.39g) and peel weight (19.02g) was reduced with the foliar application of 35 ppm NAA and 25 ppm foliar application of 2, 4-D.
Among the different concentrations of plant growth regulators; the foliar application of 35 ppm NAA, 35 ppm GA_3, 35 ppm 2, 4-D were found to be optimum concentration by which yield and yield attributing characteristics of fruits can be significantly influenced.

Keywords: *Mangifera indica L*, Dashehari, significantly influenced, characteristics

Introduction
Mango (*Mangifera indica* L.) is the native of Indo-Burma region (De Candole, 1904 [4] and Mukherjee, 1951), belongs to the family Anacardiaceous. It is one of the most cultivated and favorite fruit of the tropics and has developed its own importance all over the world. Being a useful and delicious fruit, it is the part of culture and religion since time immemorial. Besides taste and its good qualities, it is called "The King of Fruits". Mango (*Mangifera indica* L.) is cultivated in the Indian subcontinent for well over 4000 years (De Candole, 1904) [4]. The fruit is highly nutritive and delicious with excellent flavour. It is an excellent source of vitamin A and C (4800 IU and 13mg/100mg) respectively, as well as good source of calories, protein, total carbohydrate, fat, cholesterol, sodium, potassium. The pulp is a rich source of beta carotene, sucrose, glucose and fructose. Mango fruit is utilized at all stages of its development both in its immature and mature or ripe stage and can also be processed into products such as jams, juices, cut fresh fruit, dried chips, fruit concentrate and fruit leather. Mango is one of the most extensively exploited fruits for food, juice, flavor, fragrance and color. (Bayarri *et al.*, 2001) [2].
In India flowering period starts from January and extended up to April. The flowering period of mango is usually of short duration of 2 to 3 weeks; low temperature may extend it, whereas higher temperature may shorten it. The numbers of flower in one panicle varies between 1000-6000, depending upon the cultivars and age of the tree. The time it takes for mango trees to produce mature, harvest-ready fruit from the time of flowering ranges from 100 to 150 days, depending on the cultivar, growing region and various weather factors. Fruit varies according to cultivar variety and growing location. Most varieties bear fruit between May and September. Fruit production is heaviest during June and July.
Foliar spray of growth regulators (NAA and GA_3) could be used as one of these horticultural practices that reduce fruit drop, enhance yield and fruit quality of mangoes (Anila and Radha, 2003) [1]. NAA application induced high positive effect in reducing fruit drop

(Chattha *et al*. 1999) [5]. Moreover, NAA application reduced flowers drop and gave high flowers retention and increased yield as well as improved fruit quality of mango (Haidery *et al*., 1997 [6] and Vejendela *et al*., 2008). Many investigators found that spraying mango trees with NAA at different concentrations (20, 25 and 40 ppm) respectively, increased fruit set and fruit retention (Oksher *et al*., 1980 [7] and Singh and Ram, 1983) [9]. Auxin is well known as inhibitors of ethylene action in a number of plants (Beyer, 1976).

Material and methods

Twenty two years old mango trees, planted at 10 x 10 m spacing were used for experiment, which was carried out during the year 2017-18 at instructional farm, Dept. of Horticulture, College of Agriculture, IGKV, Raipur. Chhattisgarh is reputed for producing early maturing and best quality of Dashehari mango. Therefore, above said variety was selected for the present investigation. Thirty healthy, vigorous and uniform, disease free, bearing trees of about twenty years of age were selected for the experiment. Selected trees were kept under uniform cultural practices, i.e. irrigation, weeding and hoeing etc. Plant growth regulators were sprayed on 25th February and 11th March 2017 from 9.00 a.m. to 2.00 p.m. Three levels of NAA i.e., 15, 25 and 35 ppm, three levels of GA_3 i.e. 15, 25 and 35 ppm and three levels of 2, 4-D i.e. 15, 25 and 35 ppm were sprayed at pea and marble stage of fruit development. In all the treatments, solutions were sprayed on fruit and foliage of the tree.

The total numbers of fruits per plant were recorded at each harvest. The total number of fruits per plant were calculated after completion of harvesting. For length of fruits, fruits were harvested at maturity stage from each treatment and with the help of vernier calipers their length was measured in centimeters and under each treatment average length was recorded. Fruit breadth was also measured with the help of vernier calipers. From each treatment, five fruits were weighed separately on sensitive electronic balance and average value of fruit weight was recorded in gram.

For calculating fruits volume, measuring cylinder of one litre capacity was taken and filled with water upto the marks, then the mango fruits were dipped into the water, some amount of water displaced and it was measured. This displaced amount of water was equal to the volume of fruits. Specific gravity is a single non-destructive test which is employed for judging maturity of the fruit and was calculated by dividing the fresh weight of fruit and fruit volume.

By subtracting the weight of stone and peel from the weight of the whole fruits the weight of pulp was calculated.

Wt. of pulp = Total wt. of fruit – (Wt. of stone + Wt. of peel)

From each treatment the peel of three fruits were removed and on sensitive electronic balance weighed separately then average peel weight was recorded in gram. The pulp free stones of three fruits from each treatments were weighed on sensitive electronic balance and average stone weight was recorded in grams. At each harvest, weight of fruits per plant were recorded separately. Then the total weight of harvested fruit were calculated at final harvest in kilogram.

Results and discussion

Analysis of variance (ANOVA) showed significant difference amongst yield and yield attributing characteristics of mango (Table 1, 2).

Generally, all treatments of plant growth regulators significantly enhanced the yield and yield attributing characteristics of mango. The Maximum number of fruits (880.49), yield per plant 135.46 kg, fruit length 11.65 cm, fruit breadth 6.82 cm, fruit weight 177.84 g, fruit volume 173.63 cc, peel weight (21.34 g), pulp weight 130.41 g was recorded under T_6 and minimum stone weight 25.39 g was recorded under T_3 presented in table 2 and 3. The positive effect on yield was due to their favorable influence on yield-attributing characters like increase in fruit retention, size and weight of individual fruit. It might be due to reason that application of GA_3 accelerated the fruit growth and fruit size by increasing, elongation or enlargement of cells and greater accumulation of sugars and water in expanded cells.

Table 1: Number of fruits per plant, Total yield (kg / plant), Average fruit length (cm) Average fruit breadth (cm) as influenced by foliar application of plant growth regulators in mango cv. Dashehari

Notations	Treatments	Number of fruits per plant	Total yield (kg / plant)	Average fruit length (cm)	Average fruit breadth (cm)
T_0	Control	783.64 ^{h}	120.56 ^{h}	9.12 ^{e}	5.08 ^{g}
T_1	NAA (15 ppm)	861.97 ^{c}	132.61 ^{bc}	11.43 ^{a}	6.24 ^{bc}
T_2	NAA (25 ppm)	852.67 ^{d}	131.08 ^{cd}	11.35 ^{a}	6.11 ^{c}
T_3	NAA (35 ppm)	829.08 ^{f}	127.55 ^{fg}	9.89 ^{cd}	5.43 ^{ef}
T_4	GA_3 (15 ppm)	837.07 ^{e}	128.78 ^{ef}	10.02 ^{bcd}	5.51 ^{def}
T_5	GA_3 (25 ppm)	817.57 ^{g}	125.78 ^{g}	9.58 ^{d}	5.29 ^{fg}
T_6	GA_3 (35ppm)	880.49 ^{a}	135.46 ^{a}	11.65 ^{a}	6.82 ^{a}
T_7	2,4-D (15 ppm)	870.35 ^{b}	133.9 ^{ab}	11.49 ^{a}	6.41 ^{b}
T_8	2,4-D (25 ppm)	848.90 ^{d}	130.6 ^{cde}	10.35 ^{b}	5.71 ^{d}
T_9	2,4-D (35 ppm)	839.34 ^{e}	129.13 ^{def}	10.25 ^{bc}	5.68 ^{de}

Table 2: Average Fruit weight, stone weight, peel weight, pulp weight and fruit volume as influenced by foliar application of plant growth regulators in mango cv. Dashehari

Notations	Treatments	Average Fruit weight (g)	Average stone weight (g)	Average Peel weight (g)	Average pulp weight (g)	Average fruit volume (cc)
T_0	Control	148.55 ^{f}	30.66 ^{bc}	21.87	96.02 ^{f}	145.83 ^{e}
T_1	NAA (15 ppm)	170.21 ^{abc}	31.28 ^{ab}	21.21	117.72 ^{bcd}	167.01 ^{abc}
T_2	NAA (25 ppm)	165.96 ^{bcd}	26.62 ^{def}	19.78	119.56 ^{abc}	160.28 ^{bcd}

T_3	NAA (35 ppm)	154.39 ^{ef}	25.39 ^{f}	20.07	108.09 ^{def}	151.82 ^{de}
T_4	GA_3 (15 ppm)	154.24 ^{ef}	29.46 ^{c}	20.68	104.1 ^{ef}	150.32 ^{de}
T_5	GA_3 (25 ppm)	152.34 ^{ef}	27.79 ^{d}	21.34	103.21 ^{ef}	148.12 ^{e}
T_6	GA_3 (35ppm)	177.84 ^{a}	26.65 ^{de}	20.78	130.41 ^{a}	173.63 ^{a}
T_7	2,4-D (15 ppm)	175.33 ^{ab}	32.05 ^{a}	20.65	122.63 ^{ab}	171.28 ^{ab}
T_8	2,4-D (25 ppm)	161.15 ^{cde}	26.35 ^{ef}	19.32	115.48 ^{bcd}	157.54 ^{cde}
T_9	2,4-D (35 ppm)	156.53 ^{def}	26.45 ^{ef}	19.02	111.06 ^{cde}	152.89 ^{de}

Conclusion

Conclusions drawn on the basis of results obtained from the present investigation are as under: The yield-contributing characters, foliar application of 35 ppm GA_3 at pea and marble stage of fruit development gave maximum number of fruits as well as total yield. Length and width of fruits, average fruit weight, fruit weight, volume and pulp weight were also improved with the foliar application of 35 ppm GA_3. While, stone weight and peel weight was reduced with the foliar application of 35 ppm NAA and 25 ppm foliar application of 2, 4-D.

It can also be concluded that the foliar application of 35 ppm NAA, 35 ppm GA_3, 35 ppm 2, 4-D were found to be optimum concentration by which yield and yield attributing characteristics of fruits can be significantly influenced.

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