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Influence of new generation PGRs on physical parameter of mango (*Mangifera indica* L.) cv. Dashehari

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Abstract
The present investigation entitled "Influence of new generation PGRs on physical parameter of mango (*Mangifera indica* L.) cv. Dashehari" was conducted at Horticulture experiment Station, Baramunda, OUAT, Bhubaneswar during the year 2017-19. The objective of this experiment was to improve the quality (Physical character) of mango Cv. Dashehari by using Brassinostroids and Triacontanol. The experiment was laid out in Randomized Block Design (RBD) with three replication and 12 treatments. Comprising spraying of Brassinostroids (@ each 0.5 and 1.0 ppm), Triacontanol (@ each 300, 500 and 700ppm) and control and its combination. The observations on different characters of fruit *Viz*. Length of fruit (cm), Girth of fruit (cm), Shape index, Weight of fruit (g), Volume of fruit (ml), Mesocarp-pulp (g), Exocarp- Peel (g), Endocarp-stone (g), Pulp: Peel ratio and Pulp peel stone percentage (%) were recorded. Among the treatments T_{10} (1 ppm BRs and 300 ppm triacontanol) recorded maximum increase in Length of fruit (8.98cm), Girth of fruit (4.95cm), Weight of fruit (182.99g), Volume of fruit (191.02ml), Mesocarp-pulp (135.31g), Pulp: Peel ratio(6.05), Pulp peel stone percentage (25.43%) with least weight of Exocarp- Peel (22.27g) and Endocarp-stone (22.68g),. Shape index (2.15) found maximum in control.

Keywords: PGR, brassinosteroid, triacontanol, physical parameter, mango, dashehari

Introduction

Mango (*Mangifera indica* L.) belongs to family Anacardiaceae originated in Indo-Burma region having chromosome No 2n=40. Mango is one of the major fruit crops of Asia and has developed its own importance all over the world. The mango fruit has been in cultivation in Indian continent for well over 4000 years and has been the favourite of the kings and commoners because of its nutritive value, taste, attractive fragrance and health promoting qualities and now it is recognized as one of the best fruits in the world mark*et al*so known as "king of tropical fruits". Mango is not only delicious but also full of nutritional value. It is high in beta-carotene, a precursor of vitamin-A (4800 I.U.) and is a rich source of the vitamin-C. The total area under cultivation of mango in India is 2273 (000 ha) and production is around 19218 (000MT) according to NHB (2016-2017). In India states Andhra Pradesh, Karnataka, Gujarat, Maharashtra, Tamil Nadu, Chhattisgarh, Bihar and Uttar Pradesh are the leading in production of mango.

Flowering is the foremost event that set the stage for mango production each year. With the availability of favourable growth conditions, timing and intensity of flowering greatly determines when and how much fruit are produced during a current season. Insight into this phenomenon has been of prime interest to scientists and growers for over a century. Farmers are facing problems of low fruit set, fruit drop and poor quality in terms of size of fruit, As it has tremendous export potential. In mango production, yield and quality is influenced by several factors including nutritional and environmental factors. Imbalanced fertilization is considered to be one of the major contributing factors for the low productivity. In mango, heavy fruit drop is an important factor contributing to low fruit yield and sometimes only 0.1% of fruits reached up to maturity. Fruit drop can be classified in to three groups (i) pin head drop (pea stage), (ii) Post setting drop (marble stage) and (iii) fruit drop at maturity stages (Sengupta *et al*., 2006). A number of factors are involved in pre mature fruit drop such as, rains and high wind at the time of flowering and fruit setting, nutrient deficiencies at embryo developmental stage, lack of pollination and serious pest and diseases. The fruit drop at maturity stages significantly affects final fruit retention and fruit yield.

One of the possible reason behind the post fertilization fruit drop is the longer period of stress i.e in the form of high temperature, low soil moisture content, low atmospheric humidity during flowering and fruiting that cause hormonal imbalance, i.e low auxin and high ABA content. In India high deficiency of rain for irrigation, low fertilizer and micro nutrient supply are being the basic cause to create stress during post fertilization period which leads to fruit drop and low fruit quality as its flowering to fruiting period coincides with the high temperature period, So maintenance of fruit yield and quality is critical while, employing any new technology for increasing production and yield. Thus, fruit set in mango is crucial event which greatly influence the ultimate fruit yield.

Brassinosteroids are a new class of plant hormones which play important roles in various physiological processes including, seed development and germination, flower sex expression, fruit development, improvement of quantity and quality of produce and resistance to various biotic and abiotic stresses. Triacontanol is a natural plant growth regulator found in epicuticular waxes. It is used to enhance the fruit production. Quite numbers of research have reported that triacontanol can be used for improvement in growth, yield, photosynthesis, protein synthesis, uptake of water and nutrient in various crops.

Mango cv. Dashehari are high yield potential, almost regular bearer, mid-season variety, having good consumer acceptance, attractive shape, size, and saffron colour pulp with very good keeping quality. In light of the views mentioned above, the present study "Influence of new generation bioregulators on physical parameter of mango" was taken up under the agro climatic conditions prevailing at Horticulture Research Station, Baramunda, OUAT with following objectives to test the efficacy of different bioregulators and their combinations on fruit yield of mango.

Materials and Methods

The present experiment entitled "Influence of new generation bioregulators on physical parameter of mango cv. dashehari" was undertaken during the period March 2017 to July 2019 with an objective to evaluate mango cultivars for physical characters by application of BRs and triacontanol (new generation bioregulators). Experiment was conducted at Horticulture experiment Station, Baramunda, OUAT, Bhubaneswar. It comprised of 144 number of plants having 4 plants per treatment were taken for studied in each treatment at 6th year of plant with spacing of 10m X 10m. The experiment was laid out in Randomized Block Design (RBD) with three replication and 12 treatments. All plants were given similar cultural practices except PGRs application. The substance was first dissolved in alcohol and then diluted with distilled water to the proper concentration. The solution was used straight after the preparation. There were no other manipulations on the clusters. Control vines were sprayed with distilled water Brassinosteroids and Triacontanol were taken at different concentration during whole studies. Treatment combination of 0.5 ppm brassinosteroid (T_2), 1.0 ppm brassinosteroid (T_3), 300 ppm triacontanol (T_4), 500 ppm triacontanol (T_5), 700 ppm triacontanol (T_6), 0.5 ppm brassinosteroid + 300 ppm triacontanol (T_7), 0.5 ppm brassinosteroid + 500 ppm triacontanol (T_8), 0.5 ppm brassinosteroid + 700 ppm triacontanol (T_9), 1.0 ppm brassinosteroid + 300 ppm triacontanol (T_{10}), 1.0 ppm brassinosteroid + 500 ppm triacontanol (T_{11}), 1.0 ppm brassinosteroid + 700 ppm triacontanol (T_{12}) and control (T_1) taken for the study.

Observation taken for this experiment was physical character like Length of the fruit (cm), Girth of fruit (cm), Shape index, Volume of fruit (ml), Weight of fruit (gm), Weight of peel (gm), Weight of stone (gm), Weight of pulp (gm), Pulp: peel ratio, Percentage of pulp, peel and stone (%).

The chemicals as per the treatments, were applied as a foliar spray to panicles at full bloom stage (flowering), pea size stage and at marble size stage of fruits with the help of knapsack hand sprayer. The sprayer was thoroughly washed with distilled water after application of every chemical. Randomly four panicles from all the sides were selected on each tree and average numbers of fruit set per panicle were recorded. Weight of each fruit was noted on electronic balance. Average for each treatment in gram was computed. The volume of each fruit was estimated by water displacement method. The average was computed for each treatment and given in ml. The pulp was extracted by hand, knife and weight was recorded presented as gram of total fruit weight. The skin was removed, made free from pulp and weight was taken and computed as gram of total fruit weight. The stone was cleaned so that no pulp remained adhering with the stone and the weight of stone was taken in gram.

Result and Discussion

Statistical variation was observed among the different treatments in both the years with respect to fruit length from pooled table no (1). The fruit length ranged from 7.83cm in treatment 0.5 ppm brassinosteroid to maximum of 8.98cm in treatment 1.0 ppm brassinosteroid + 300 ppm triacontanol, it was observed that 1.0 ppm brassinosteroid + 300 ppm triacontanol was statistically superior that all the other treatments but it is at par with treatment 0.5 ppm brassinosteroid + 300 ppm triacontanol (8.91). The 0.5 ppm brassinosteroid recorded minimum fruit length i.e 7.83cm and was found significantly different from all other treatments. Similarly, it was found that the maximum fruit girth (4.95 cm) was recorded in the treatment combination1.0 ppm brassinosteroid + 300 ppm triacontanol followed by the treatment combination 0.5 ppm brassinosteroid + 300 ppm triacontanol (4.51cm), 1.0 ppm brassinosteroid + 500 ppm triacontanol (4.40cm) and the minimum fruit girth (4.06cm) was recorded in the treatment combination 0.5 ppm brassinosteroid. However, maximum shape index of 1.97 was recorded in 0.5ppm BRs +300ppm TRIA which is at par with 1ppm BRs+ 700ppm TRIA (1.97), control (1.97), 300ppm TRIA (1.94), 0.5ppm BRs +500ppm TRIA (1.93), 1ppm BRs+ 500ppm TRIA (1.93), 500ppm TRIA (1.93), 700ppm TRIA (1.93), 0.5ppm BRs (1.92), 0.5ppm BRs+700ppm TRIA (1.91) whereas minimum of 1.81 was found in the treatment 1ppm BRs+ 300ppm TRIA. Increased fruit size in terms of length, girth and shape index with brassinolide treatments in the study, Where it can be attributed to increased cell elongation (Gomes *et al*. 2006) [5], increased endogenous auxin content (Khunte *et al*. 2014) [8], improved net photosynthetic rate and greater movement of metabolites and nutrients into the developing fruits (Ramani *et al*. 2014) [9] and triacontanol, attributed to more efficient utilization of food for reproductive growth, higher photosynthetic efficiency and enhanced source to sink relationship in plants, increased uptake of nutrients and water. Similar results found by Shinde *et al.* (2008) [11] in mango.

The interaction effect of different new generation growth regulators significantly influenced the fruit weight. The pooled table (1) divulged that growth regulators played significant role in improving weight of mango fruit. Among the different combination of BRs and TRIA growth regulators used for study, 1.0 ppm brassinosteroid + 300 ppm triacontanol was found more effective in increasing the fruit weight. During the period 2017-2019, the maximum fruit weight (182.99 g) was recorded in the treatment 1.0 ppm brassinosteroid + 300 ppm triacontanol which was statistically superior than the rest of the treatments and at par with 1.0 ppm brassinosteroid + 500 ppm triacontanol (179.84g), 0.5 ppm brassinosteroid + 300 ppm triacontanol (177.19g) and 0.5 ppm brassinosteroid + 700 ppm triacontanol (176.42g) Whereas, the minimum fruit weight was (169.52g) recorded in the treatment T_1 (control). This might be due to the reason that application of triacontanol attributed to more efficient utilization of food for reproductive growth, flowering and fruit set, higher photosynthetic efficiency and enhanced source to sink relationship of the plant, increased uptake of nutrients and water, reduced transpiration and respiration, enhanced translocation and accumulation of sugar and other metabolites (Bhat *et al*. 2011) [3]. Due to BRs which acted through cell elongation (Jain and Singh, 2017) [6] and mobilized metabolites to the fruits that may have improved fruit size (Gomes *et al*. 2016) [5]. In this respect, Zubair *et al*. (2002), Saeed *et al*. (2016) [10] and Tambe (2002) [12], reported that brassinolide increased fruit weight of orange. However, Ramani *et al*. (2014) [9] showed that combined application of TRIA and brassinosteroid increased fruit weight in sweet cherries fruits.

Data presented in the pooled Table (1), revealed that the treatment of growth regulators showed a significant effect with respect of volume of fruits. The statistically analyzed data indicated that the average volume of fruits was influenced at significant level by application of foliar spray of different BRs and traicontanol treatment. Among the levels, fruits harvested from trees in which 1.0 ppm brassinosteroid + 300 ppm triacontanol i.e. T_{10} recorded significantly, the highest fruits volume (191.02ml), followed by 0.5 ppm brassinosteroid + 300 ppm triacontanol (177.51ml). The fruits from 0.5ppm brassinosteroid treatments were recorded to be the significantly average volume of fruits (115.07 ml) during the period 2017-19. Khripach *et al*. 2017reported that exogenous application of BRs can act on each other synergistically and induced increased fruit length and diameter. Additionally, the growth induced by brassinosteroid has been related to increase in RNA and DNA content polymerase activity and protein synthesis (Gomes *et al*., 2006) [5]. Similarly, Bhat *et al* (2011) [3] observed that application of triacontanol at 10 and 20 ppm in plum significantly increased fruit size, weight and TSS content of fruit.

The table (1) disclosed the influence of different treatment on mesocarp content of fruit. The perusal of data from pooled data maximum indicated that significantly maximum mesocarp- pulp (135.31 g) was noticed in foliar application of 1.0 ppm brassinosteroid + 300 ppm triacontanol followed by 0.5 ppm brassinosteroid + 300 ppm triacontanol (131.81g). However, minimum pulp weight (111.37 g) was observed in treatment 0.5 ppm brassinosteroid. During the year 2017-18 and 2018-19, all the growth regulators used under the study reduced the peel weight as compared to 0.5 ppm brassinosteroid. The table (1), highlighted that there was significant variation in peel weight with respect to different treatment growth regulators i.e BRs and TRIAs also observed during 1st year, 2nd year and pooled data. Lowest peel weight (22.27g) was recorded in the treatment 1.0 ppm brassinosteroid + 300 ppm triacontanol followed by the treatment 0.5 ppm brassinosteroid + 300 ppm triacontanol (23.91g) and the treatment 0.5 ppm brassinosteroid was recorded to be the highest one (31.44g). Whereas the treatment 1.0 ppm brassinosteroid + 300 ppm triacontanol recorded the highest pulp to peel ratio (6.05) which was found to be significantly superior over the rest of all, except treatment T_2 i.e 0.5 ppm brasinosteroid. However, the treatment 0.5 ppm brassinosteroid showed the lowest pulp to peel ratio (3.53). From the analysis of collected data during the experiment experiment period of 2017-18 and 2018-19 the table (1) was prepared which stated that the lowest stone weight (22.68 g) was recorded in the treatment1.0 ppm brassinosteroid + 300 ppm triacontanol i.e at par with the treatment 0.5 ppm brassinosteroid + 300 ppm triacontanol (22.79g), 1.0 ppm brassinosteroid + 500 ppm riacontanol (23.30g) and in the treatment 0.5 ppm Brassinosteroid (30.73g) was recorded to be the highest one. The data on pulp, peel and stone percentage of fruit as influenced by application of brassinosteroids and triacontanol. It was presented in Table (1). The pooled table evidenced that all treatments of plant growth regulators had significant effect on fruit during the period 2017-19. The data showed that pulp, peel and stone percentage ranged from 11.55% to 25.43% under different treatments. The maximum value (25.43%) pertaining treatment1.0 ppm brassinosteroid + 500 ppm triacontanol which was however, at par with 1.0 ppm brassinosteroid + 300 ppm triacontanol (24.86%), 0.5 ppm brassinosteroid + 300 ppm triacontanol (23.49%). The minimum pulp, peel and stone percentage (11.55%) was observed in 0.5 ppm brassinosteroid, which was significantly lesser than all the other. This might be due to spraying of triacontanol, attributed to more efficient utilization of food for reproductive growth, higher photosynthetic efficiency and enhanced source to sink relationship in plants, increased uptake of nutrients and water. Similar results found by Jain and Singh (2017) [6] in mango. Similarly, Aftab *et al.* (2010) [2] observed that application of triacontanol at 10 and 20 ppm in plum significantly increased fruit size, weight and TSS content of fruit. Chand (2009) [4] observed that application of triacontanol at 5 ppm in plum proved more effective in promoting tree growth, fruit weight, volume and increased yield. Khunte *et al.* (2014) [8] reported that application of triacontanol at 300, 500, and 700 ppm at flowering, pea and marble stage of fruit development in mango cv. Parbhani Bhusan and showed that spray of 700 ppm triacontanol significantly given maximum length, breadth, volume, weight, mesocarp and lowest proportion of endocarp.

Table 1: Effect of new generation of PGRs on physical parameter of mango (*Mangifera indica* L) cv. Dashehari

Treatment	Pooled Data (2017-2019)									
	Length of fruit (cm)	Girth of fruit (cm)	Shape index	Volume of fruit (ml)	Weight of fruit (gm)	Pulp weight (gm)	Stone weight (mg)	Peel weight (gm)	Pulp: peel ratio	Pulp peel stone percentage (%)
T_1(Control)	8.083	4.117	2.153	157.325	169.527	114.19	27.450	29.148	3.935	15.567
T_2 (0.5ppm BRs)	7.833	4.067	1.940	115.077	171.178	111.37	30.738	31.440	3.535	11.552
T_3 (1ppm BRs)	8.267	4.317	1.830	169.482	175.025	124.53	25.147	25.898	4.797	19167
T_4 (300ppm TRIA)	8.183	4.233	2.020	169.110	171.163	121.512	26.810	27.167	4.492	16.123
T_5(500ppm TRIA)	8.233	4.233	1.870	169.432	175.872	123.168	26.003	26.257	4.688	18.132
T_6 (700ppm TRIA)	8.317	4.350	1.893	169.485	172.490	125.65	24.940	25.372	4.950	19.967
T_7 (0.5ppm BRs +300ppm TRIA)	8.917	4.517	1.860	177.517	177.198	131.81	22.793	23.915	5.518	23.495
T_8 (0.5ppm BRs +500ppm TRIA)	8.133	4.217	1.950	168.375	174.990	116.40	26.942	28.210	4.125	14.823
T_9(0.5ppm BRs+700ppm TRIA)	7.967	4.117	1.910	155.930	176.425	111.95	29.115	30.112	3.708	12.775
T_{10}(1ppm BRs+ 300ppm TRIA)	8.983	4.950	1.880	191.023	182.992	135.312	22.685	22.273	6.057	24.867
T_{11}(1ppm BRs+ 500ppm TRIA)	8.533	4.400	1.927	177.393	179.848	128.582	23.302	24.103	5.332	25.438
T_{12} (1ppm BRs+ 700ppm TRIA)	8.378	4.350	1.867	172.415	174.832	127.282	24.335	24.808	5.137	21.165
Mean	8.319	4.322	1.922	166.047	175.121	122.707	25.855	26.559	4.689	17.483
S.Em(±)	0.111	0.112	0.082	2.530	2.208	1.158	0.286	0.334	0.104	0.638
C.D. (5%)	0.318	0.318	0.255	7.211	6.871	3.299	0.816	0.953	0.323	1.984

Conclusion

Based on the present investigation on "Influence of new generation PGRs on physical parameter of mango (*Mangifera indica* L.) cv. Dashehari", it can be concluded that 1 ppm brassinosteroid and 300ppm triacontanol sprayed at pea stage helped to increase in length of fruit (cm), girth of fruit (cm), weight of fruit (g), volume of fruit (ml), mesocarp-pulp (g) pulp: peel ratio, pulp peel stone percentage (%) with lowest exocarp- peel content (g) and endocarp-stone content (g) were recorded and maximum shape index found in control.

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