



Influence of New Generation PGRs on Yield Parameter and Economics of Mango (*Mangifera indica* L.) cv. Dashehari

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled "Influence of new generation PGRs on yield 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 fruit retention of mango, Yield and its economic in c.v. 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 700 ppm) and control and its combination. The observations on different characters of fruit viz., fruit set per panicle at pea stage, fruit retention per panicle at marble stage, fruit drop %, fruit retention per panicle at harvest stage, fruit retention per shoot cluster, fruit retention per tree, number of days taken from spraying to ripening, yield per tree (kg), and its economics were recorded. Among these treatments 1 ppm brassinosteroid and 300ppm triacontanol sprayed at pea stage has increased in fruit retention per panicle at harvest stage (5.95), fruit retention per shoot cluster (30.04) and fruit retention per tree (174.84) along with early maturity (81.66 days) and yield (31.87 kg) found whereas 1 ppm brassinosteroid give maximum fruit set per panicle at pea stage (35.16) & Fruit retention per panicle at marble stage (14.63) and

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minimum fruit drop percentage (49.25%) were found in 300 ppm triacontanol. Maximum gross return (Rs74,625/-) and B:C ratio (1: 2.94) also found in the treatment 1 ppm brassinosteroid and 300 ppm triacontanol.

Keywords: PGR; brassinosteroid; triacontanol; yield; economics; mango; Dashehari.

1. INTRODUCTION

Mango (*Mangifera indica* L.) belongs to family Anacardiaceae originated in Indo-Burma region having chromosome No $2n=40$. Mango is otherwise called as National fruit of India due to its nutritive value, taste, attractive fragrance and health promoting qualities. 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, 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. 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. Heavy fruit drop is an important factor contributing to low fruit yield and sometimes only 0.1% of fruits reached up to maturity. The fruit drop at maturity stages significantly affects final fruit retention and fruit yield. One of the possible reasons 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 yield and quality 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 and economic feasibility of mango.

2. MATERIALS AND METHODS

The present experiment entitled "Influence of new generation bioregulators on yield and quality of mango cv. Dashehari" was undertaken during the period March 2017 to July 2018 with an objective to evaluate mango cultivars for yield characters by application of BRs and triacontanol (new generation bioregulators). Experiment was conducted at Horticulture Experiment Station, Baramunda, OUAT, Bhubaneswar. Six year old 144 plants grown with a spacing of 10 x 10 m were taken for the experiment with 4 plants per treatment. 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 ethanol and then diluted with distilled water to the proper concentration. The solution was used straight after the preparation. There was no other modification on the clusters. Control vines were sprayed with different concentration of Brassinosteroids and Triacantanol along with distilled water during the complete study as mentioned in Table 1.

Observation taken for this experiment were Fruit set per panicle at pea stage (Numbers), Fruit retention per panicle at marble stage (Numbers), Fruit drop percentage at marble stage (%), Fruit retention per panicle at harvest stage (Numbers), Fruits retention per shoot cluster (Numbers), Fruit retention per tree (Numbers), Number of days taken from spraying to ripening (Days) and Yield per ha (kg) and its economics (Rupee).

3. RESULTS AND DISCUSSION

Fruit set per panicle at pea stage was significantly influenced by different levels of Plant growth regulators. From the pooled data, Table 2, it was observed that the maximum fruit set per panicle at pea stage (35.16) was recorded in the treatment T₃ (1.0 ppm brassinosteroid) followed by the treatment T₁₀ (1.0 ppm brassinosteroid + 300 ppm triacantanol) (29.38) and the minimum fruit set per panicle at pea stage (16.45) was recorded in the treatment T₁ control treatment) during the period 2017-19. It is well established that brassinosteroids improves resistance of the plants against various biotic and abiotic stresses [1]. Brassinosteroids helps to promote flowering by interacting with other florigens which will additive effect of brassinosteroids with other flowering hormone [2].

It was observed that treatment T₃ bearing the chemical application of 1.0 ppm brassinosteroid

was recorded to be the maximum fruit set per panicle at marble stage (14.63) in mango cv. Dashehari, where fruit set per panicle at marble stage was significantly different from all other different growth regulators combination. Whereas, minimum fruit set per panicle at marble stage (7.70) was recorded in the treatment T₁ (control) during the period 2017-19. Spray of 1.0ppm 28-HBR promoted auxin sensitivity thereby auxins at low concentration also reduced the fruit drop. Possibly, due to these collective reasons the trees sprayed with 1.0ppm 28-HBR retained more number of fruits per panicle at marble stage [3].

Minimum fruits drop 49.25 % was observed in the treatment 300ppm triacantanol which is at par with 0.5 ppm of brassinosteroids (49.99%), 0.5 ppm brassinosteroid + 300 ppm triacantanol (51.99%), 1.0 ppm brassinosteroid + 500 ppm triacantanol (53.06%), control (53.67%), 0.5 ppm brassinosteroid + 700 ppm triacantanol (54.13%), 500 ppm triacantanol (54.54%) and 1.0 ppm brassinosteroid + 300 ppm triacantanol (54.86%) in both the year from 2017- 2019 which differed significantly from each other but maximum fruit drop (58.41%) was observed in the treatment combination of 1.0 ppm brassinosteroid. Heavy fruit drop during early stages of fruit development may be attributed to unsuccessful fertilization or ovule degeneration. [4]. The probable might be due to application of triacantanol 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 [5].

Table 1. Treatment combination

S.I. no	Treatment number	Treatment combination (ppm)
1	T ₁	Control (No spray)
2	T ₂	0.5 ppm Brassinosteroid
3	T ₃	1.0 ppm Brassinosteroid
4	T ₄	300 ppm Triacantanol
5	T ₅	500 ppm Triacantanol
6	T ₆	700 ppm Triacantanol
7	T ₇	0.5 ppm Brassinosteroid + 300 ppm Triacantanol
8	T ₈	0.5 ppm Brassinosteroid + 500 ppm Triacantanol
9	T ₉	0.5 ppm Brassinosteroid + 700 ppm Triacantanol
10	T ₁₀	1.0 ppm Brassinosteroid + 300 ppm Triacantanol
11	T ₁₁	1.0 ppm Brassinosteroid + 500 ppm Triacantanol
12	T ₁₂	1.0 ppm Brassinosteroid + 700 ppm Triacantanol

The maximum fruit retention at harvest stage per panicle (5.95) was recorded in treatment T₁₀ i.e 1.0 ppm brassinosteroid + 300 ppm triacontanol. Brassinosteroids are well known to promote photosynthesis efficiency by enhancing regeneration of RuBP and followed by an increase of CO₂ fixation in photosynthesis. It also regulates stomatal activity and increases level of CO₂ inside the leaves [6]. Triacontanol when sprayed on trees enhanced photosynthesis which increased the potential of tree to develop more flower bud and fruit set [3].

It was found that 1.0 ppm brassinosteroid + 300 ppm triacontanol recorded maximum number of fruits set per shoot cluster (30.04). Whereas minimum number of fruits set per shoot cluster was recorded in control (20.58). Brassinosteroids are well known to promote photosynthesis efficiency by enhancing regeneration of RuBP and followed by an increase of CO₂ fixation in photosynthesis. It also regulates stomatal activity and increases level of CO₂ inside the leaves [7]. 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 [5].

The number of fruit set was increased to the maximum extent (174.84) following the application of 1.0 ppm brassinosteroid + 300 ppm triacontanol, however this treatment was statistically at par with the 1.0 ppm brassinosteroid + 500 ppm triacontanol (145.85). Apart from these treatments, the remaining plant growth regulator has also significantly more over the control (110.83). The trees sprayed with 1.0ppm 28-HBR at new leaf initiation stage during post monsoon period had recorded significantly higher length and girth of the shoots before flowering which may be due to increased cell division and enlargement [8]. Naeem and Khan [9] indicated that triacontanol increase plant photosynthesis activities.

The data recorded on the yield per plant seems to have pronounced influence under various treatments and are presented in Table 2; foliar spray of different plant growth regulators (Brassinosteroids and Triacontanol) had a positive effect on yield as compared to control.

However, pre-harvest spray of individual brasinosteroids (0.5 ppm and 1 ppm) and triacontanol s (100ppm, 200pmm and 300 ppm) significantly increased the fruit yield. 1.0 ppm brassinosteroid + 300 ppm triacontanol resulted (31.87kg) followed by 1.0 ppm brassinosteroid + 500 ppm triacontanol (26.16kg), 0.5 ppm brassinosteroid + 300 ppm triacontanol (25.10kg) and 0.5 ppm brassinosteroid + 700 ppm triacontanol (24.55kg). The minimum total yield per plant was recorded under control having yield of 18.78 kg. Brassinosteroids also increase CO₂ fixation during photosynthesis by increasing stomatal activities and regeneration of RuBP which allow CO₂ in Calvin cycle by bonding it resulting into more photoassimilates production [6]. Triacontanol when sprayed on trees enhanced photosynthesis which increased the potential of tree to develop more flower bud and fruit set [3].

Significant results were obtained due to spraying of new generation growth regulators in respect of number of days taken from spraying to ripening. The early ripening (81.66days) was noticed in the treatment 1 ppm brassinosteroids + 300ppm triacontanol. The highest number of days taken from spraying to ripening (93.16day) was recorded in the treatment control. It may be due to spray of brassinosteroids on leaves helps to promote flowering by interacting with other florigens which will additive and synergistic effect of BRs with other flowering hormone [10] and 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 [2].

The economics of mango cultivation on basis of application of different plant growth regulators was worked out in terms of prevailing market price and presented in Table 3, The study exhibited that the treatment T₁₀ which included the application of growth regulators, like 1.0 ppm brassinosteroid along with 300 ppm triacontanol gave highest gross return, net income and benefit cost ratio as well in both the year of 2017-18 and 2018-19. This contributed a total gross return of amount Rs 74625/-, net return of Rs 49372/- and benefit cost ratio of 1: 2.94 which highlighted as the superior among the all.

Table 2. Effect of new generation of PGRs on yield parameter of mango (*Mangifera indica* L) cv. Dashehari

Treatment	Pooled data (2017-2019)							
	Number of fruits per panicle at pea stage (Nos.)	Number of fruits per panicle at marble stage	Fruit drop percentage per panicle at marble stage (%)	Number of fruit per panicle at harvest stage	Number of fruits per shoot cluster	Number of fruits per tree	Yield per tree (Kg)	Days taken from spraying to ripening
T ₁ (Control)	16.458	7.70	53.672	2.458	20.583	110.833	18.781	93.16
T ₂ (0.5ppm BRs)	19.350	9.633	49.990	3.167	21.958	119.417	20.428	87.50
T ₃ (1ppm BRs)	35.165	14.633	58.415	3.792	24.333	128.567	22.477	86.83
T ₄ (300ppm TRIA)	17.087	8.733	49.256	2.257	21.667	118.033	20.191	87.16
T ₅ (500ppm TRIA)	24.797	11.3	54.543	3.958	25.167	130.400	22.918	91.33
T ₆ (700ppm TRIA)	23.890	10.033	58.163	3.292	22.583	121.474	20.941	91.50
T ₇ (0.5ppm BRs +300ppm TRIA)	25.530	12.267	51.991	4.292	27.458	141.972	25.108	82.66
T ₈ (0.5ppm BRs +500ppm TRIA)	24.553	10.633	56.585	3.583	24.208	124.400	21.729	84.00
T ₉ (0.5ppm BRs+700ppm TRIA)	24.937	11.467	54.135	4.000	25.542	136.898	24.550	86.66
T ₁₀ (1ppm BRs+ 300ppm TRIA)	29.382	13.267	54.864	5.958	30.042	174.848	31.879	81.66
T ₁₁ (1ppm BRs+ 500ppm TRIA)	26.982	12.583	53.061	4.625	29.292	145.858	26.168	83.33
T ₁₂ (1ppm BRs+ 700ppm TRIA)	24.445	10.033	58.303	3.542	23.000	123.000	21.478	86.50
Mean	24.381	11.043	54.415	3.764	24.653	131.503	23.054	86.86
SEm(±)	0.439	0.174	1.931	0.232	0.292	2.789	0.367	0.454
C.D. (5%)	1.251	0.496	6.011	0.662	0.833	8.679	1.142	1.413

Table 3. Effect of new generation of PGRs on economics of mango (*Mangifera indica* L) cv. Dashehari

Treatment	Gross income			Total expenditure			Net return			BCR		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
T ₁ (Control)	34600	43750	39175	13610	16466	15038	20990	27284	24137	2.54	2.65	2.59
T ₂ (0.5ppm BRs)	43400	50500	46950	14685	17741	16213	28715	32759	30737	2.95	2.84	2.90
T ₃ (1ppm BRs)	45400	52000	48700	15325	18381	16853	30075	33619	31847	2.96	2.82	2.89
T ₄ (300ppm TRIA)	48600	59500	54050	22410	25466	23938	26190	34034	30112	2.16	2.33	2.25
T ₅ (500ppm TRIA)	44600	51500	48050	28010	31066	29538	16590	20434	18512	1.59	1.65	1.62
T ₆ (700ppm TRIA)	39200	46250	42725	33610	36666	35138	5590	9584	7587	1.16	1.26	1.21
T ₇ (0.5ppm BRs +300ppm TRIA)	49400	61000	55200	23085	26141	24613	26315	34859	30587	2.13	2.33	2.23
T ₈ (0.5ppm BRs +500ppm TRIA)	46400	56750	51575	28685	31716	30200	17715	25034	21374	1.61	1.78	1.70
T ₉ (0.5ppm BRs+700ppm TRIA)	41400	49250	45325	34285	37341	35813	7115	11909	9512	1.20	1.31	1.26
T ₁₀ (1ppm BRs+ 300ppm TRIA)	65000	84250	74625	23725	26781	25253	41275	57469	49372	2.73	3.14	2.94
T ₁₁ (1ppm BRs+ 500ppm TRIA)	54000	63250	58625	29325	32381	30853	24675	30869	27772	1.84	1.95	1.89
T ₁₂ (1ppm BRs+ 700ppm TRIA)	38800	46250	42525	34925	37981	36453	3875	8269	6072	1.11	1.21	1.16

4. CONCLUSION

Based on the present investigation, it can be concluded that 1 ppm brassinosteroid and 300 ppm triacontanol sprayed at pea stage helped to increase in yield along with early maturity in mango cv. Dashehari with high B: C ratio.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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