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EFFECT AND ECONOMIC FEASIBILITY OF PLANT GROWTH REGULATORS ON YIELD OF 'NAGPUR MANDARIN' (*Citrus reticulata* Blanco.)

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ABSTRACT
An experiment was carried out at Fruit Research Farm, Department of Fruit Science at College of Horticulture and Forestry, Jhalawar during July, 2012 to April, 2013 to study the effects and economic feasibility of plant growth regulators on yield of Nagpur mandarin (*Citrus reticulata* Blanco.). The maximum increase in yield attributing characters like weight, volume and diameter of fruit along with number of sacs per fruit was recorded with the spray of 100 ppm GA_3, which was closely followed by 30 ppm 2,4-D. The significantly higher number of fruits per tree, fruit retention per cent and yield with best economic feasibility were recorded with the spray of 30 ppm 2, 4-D.

KEY WORDS: NAA, GA_3, 2, 4-D, Triacontanol, yield and economic feasibility.

INTRODUCTION

In India citrus fruits have a prominent place among popular and extensively grown tropical and subtropical fruits after mango and banana. Nagpur Mandarin (*Citrus reticulata* Blanco) which occupies the first position among the citrus in India with respect to area and production is considered one of the most important cultivated varieties among loose skinned oranges and is being commercially grown in Nagpur region of Maharashtra and Jhalawar District of Rajasthan. The Fruit of Nagpur Santra are subglobose, with average weight 110-125g, rind medium thick, fairly loosely adherent, surface is relatively smooth, segment 10-15 number and seeds 1-2 per segment, peel colour pale orange fruits quality good. The use of growth regulators has become an important component of agro-technical procedures for most of the cultivated plants and especially for fruit plants [5]. Therefore, lot of research has been done on the use of PGRs to improve fruit quality with higher production. So this study was carried out to evaluate the effect of plant growth regulators on yield attributing characters of plant along with economic feasibility of the chemicals used in Nagpur Mandarin particularly in Jhalawar location of Rajasthan.

MATERIALS & METHODS

The present investigation was carried out on six years old mandarin (*Citrus reticulata* Blanco.) cv. 'Nagpur' plants of uniform size and growth during first week of July, 2012 to last week of April, 2013. The experiment was consisted of 17 treatments, including four levels of each NAA (50, 100, 150 and 200 ppm), GA_3 (25, 50, 75 and 100 ppm),2, 4-D (10, 20, 30 and 40 ppm) and triacontanol (5, 10, 15 and 20 ppm) along with water spray as control. The experiment was laid out in randomized block design with three replications. Spray of growth regulators was done with a compressed air hand sprayer in first week of July, 2012 under all treatments. The control plants were sprayed with distilled water. The data collected were subjected to statistical analysis of variance. The significance of the treatments was tested through 'F' test at 5 per cent level of significance.

RESULTS & DISCUSSION

Yield and contributing characters

Results of present study indicated that, application of various plant growth regulators at different concentrations significantly improved yield contributing characters of plant like weight, volume, and diameter (horizontal and vertical) of fruits, it also increased significantly the number of fruits per tree, number of sacs per fruit, per cent fruit retention and thereby yield of plant as compared to control. The data recorded on horizontal and vertical diameter of fruit clearly indicate that application of GA_3 at 100 ppm exhibited maximum horizontal and vertical diameter of fruit (8.03 cm) and (8.23 cm) which was found to be at par with 30 ppm 2, 4-D (7.64 cm) and (7.83 cm) treatment. The minimum horizontal (6.12 cm) and vertical diameter (5.64 cm.) of fruit was recorded at control (Table-1). These treatments had also significantly increased the weight and volume of fruits over control. The maximum fruit weight (191.22 g) volume (247.56 cc.) and number of sacs per fruit (12.56) were recorded at 100 ppm GA_3 treatments which were closely followed by 30 ppm 2, 4-D (184.22 g, 211.89 cc and 12.11 respectively). However the maximum number of fruits

per tree (126.0) and fruit retention per cent (70.68%) were recorded at 30 ppm 2, 4-D treatment as compared to minimum at control (Table-1). The application of 2, 4-D at 40 ppm gave significantly maximum number of fruits (64.00)/tree.

Further, amongst the various plants growth regulator treatments attempted the maximum yield of 21.80 kg/plant (6.08 tonnes/ha.) was recorded at 30 ppm 2, 4-D treatment as compare to minimum (12.94 kg/plant and 3.60 tonnes/ha.) at control. The increase in yield contributing parameters of Nagpur mandarin fruits by application of 2, 4-D and GA_3 treatments may be attributed to the fact that partitioning of assimilates by 2, 4-D and GA_3 more towards the fruit development and better translocation of assimilates further leads to improvement in yield contributing characters as evident by the present study which increased the yield. Similar results were also observed by application of 2,4-D treatment in 'Nova' mandarin[3] and Nagpur mandarin[4]. The increase in weight and volume of fruit due to GA_3 treatment were also recorded in pomegranate[6] and mandarin[2]. Similar beneficial effect of 2,4-D on number of fruit per tree and fruit retention was also recorded in Kinnow mandarin[1].

ECONOMICS OF THE TREATMENTS USED

The economic feasibility of different treatments used is presented in Table 2 and the application of 30 ppm 2,4-D, showed the maximum gross return of Rs. 1,21,600/ha with highest net profit (Rs. 48,855/ha) which was Rs. 49600/ha (67.85 per cent) excess over control.

The highest percent increase in net profit due to 30 ppm 2,4-D treatment may be because of highest yield and qualitative fruits under this treatment as evident from the present results. Therefore, the application of this treatment was found to be most economic and desirable treatment.

TABLE -1 Effect of plant growth regulators on yield attributing characters of 'Nagpur' mandarin

Treatments	Diameter of fruit (cm)		Weight of fruit (g)	Volume of fruit (cc)	No. of sacs/fruit	No. of fruits/tree	Fruit retention (%)	Yield (kg/plant)	Estimated yield (tonnes/ha)
	Horizontal	Vertical							
T_0	6.12	5.64	135.56	145.44	9.89	100.67	56.42 (69.43)	12.94	3.60
T_1	6.80	5.97	144.11	155.22	10.89	115.67	67.42 (85.27)	16.67	4.64
T_2	7.02	6.50	150.22	171.78	11.11	112.33	66.32 (83.89)	16.87	4.69
T_3	6.82	6.22	143.11	164.22	11.56	109.33	66.24 (83.78)	15.65	4.35
T_4	7.13	7.44	164.89	189.44	11.11	110.33	65.07 (82.17)	18.19	5.06
T_5	7.26	7.27	141.11	149.89	11.44	107.67	69.04 (87.08)	14.12	3.93
T_6	6.97	6.71	145.56	177.78	10.56	110.33	66.50 (84.11)	16.06	4.46
T_7	6.59	6.37	167.78	181.78	11.44	106.67	67.49 (85.36)	17.89	4.98
T_8	8.03	8.23	191.22	247.56	12.56	113.33	65.29 (82.53)	21.67	6.03
T_9	6.43	6.38	172.11	190.22	11.11	117.67	69.21(87.34)	21.68	6.03
T_{10}	7.46	7.39	149.44	164.22	11.78	123.67	67.25 (85.06)	18.48	5.14
T_{11}	7.64	7.83	184.22	211.89	12.11	126.00	70.68 (89.05)	21.80	6.08
T_{12}	6.97	6.75	144.22	173.78	10.89	119.67	64.60 (81.61)	17.26	4.80
T_{13}	6.90	6.26	156.44	160.56	11.44	101.67	62.96 (79.32)	15.91	4.42
T_{14}	7.40	7.34	164.22	181.56	10.89	107.67	64.17 (81.03)	17.68	4.92
T_{15}	7.08	6.37	164.22	186.78	10.44	105.33	59.93 (74.88)	17.30	4.81
T_{16}	6.65	6.28	152.11	172.78	10.56	114.67	61.20 (76.79)	17.44	4.85
SEm±	0.20	0.25	7.95	10.66	0.42	3.12	1.03	0.50	0.14
C.D. at 5%	0.59	0.72	22.89	30.69	1.21	8.98	2.99	1.44	0.40

(**T_0**- Control, **T_1**- NAA 50ppm, **T_2**- NAA 100ppm, **T_3**- NAA 150ppm, **T_4**- NAA 200ppm**,** **T_5**- GA_3 25ppm, **T_6**- GA_3 50ppm, **T_7**- GA_3 75ppm, **T_8**- GA_3 100ppm, **T_9**- 2,4-D 10ppm, **T_{10}**- 2,4-D 20ppm, **T_{11}**- 2,4-D 30ppm, **T_{12}**- 2,4-D 40ppm, **T_{13}**- Triacontanol 5ppm, **T_{14}**- Triacontanol 10ppm, **T_{15}**- Triacontanol 15ppm, **T_{16}**- Triacontanol 20ppm)

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TABLE 2: Economic feasibility of plant growth regulator treatments used in mandarin cv. 'Nagpur'

Treatments		Additional treatment cost	Yield (tones/ha)	Gross return (@ Rs. 20/kg)	Excess income over control	Net profit due to treatment	% Increase in yield over control	% Increase in net profit over control
Control	(T_0)	-	3.60	72,000	-	-	-	-
NAA 50 ppm	(T_1)	914.50	4.64	92,800	20,800	19,885	28.89	27.62
NAA 100 ppm	(T_2)	1129.00	4.69	93,800	21,800	20,671	30.28	28.71
NAA 150 ppm	(T_3)	1343.50	4.35	87,000	15,000	13,656	20.83	18.97
NAA 200 ppm	(T_4)	1558.00	5.06	1,01200	29,200	27,602	40.56	38.39
GA_3 25 ppm	(T_5)	2515.00	3.93	78,600	6,600	4,085	9.17	5.67
GA_3 50 ppm	(T_6)	4330.00	4.46	89,200	17,200	12,870	23.89	17.88
GA_3 75 ppm	(T_7)	6345.00	4.98	99,600	27,600	21,255	38.33	29.52
GA_3 100 ppm	(T_8)	7960.00	6.03	1,20,600	48,600	40,640	67.50	56.44
2,4-D 10 ppm	(T_9)	714.85	6.03	1,20,600	48,600	47,885	67.50	66.51
2,4-D 20 ppm	(T_{10})	729.70	5.14	1,02800	30,800	30,070	42.78	41.76
2,4-D 30 ppm	(T_{11})	744.55	6.08	1,21,600	49,600	48,855	68.89	67.85
2,4-D 40 ppm	(T_{12})	759.40	4.80	96,000	24,000	23,240	33.33	32.28
Triacontanol 5 ppm	(T_{13})	2350.00	4.42	88,400	16,400	14,050	22.78	19.51
Triacontanol 10 ppm	(T_{14})	4000.00	4.92	98,400	26,400	22,400	36.67	31.11
Triacontanol 15 ppm	(T_{15})	5650.00	4.81	96,200	24,200	18,550	33.61	25.76
Triacontanol 20 ppm	(T_{16})	7300.00	4.85	97,000	25,000	17,700	34.72	24.58

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