

Original Research Article

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## Effect of Foliar Application of Plant Growth Regulators on Flowering, Growth, Fruit Set, Fruit Drop, Yield, Quality of Kinnow Mandarin (*Citrus reticulata*)

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### ABSTRACT

#### Keywords

Kinnow Mandarin (*Citrus reticulata*), Plant growth regulators, Flowering, Fruit drop, Fruit set, Yield, Quality

#### Article Info

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A field experiment was carried out during the months of March to November, 2019-2020 at Horticulture Research Farm, Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj to study the “ Effect of foliar application of plant growth regulators on flowering, growth, fruit set, fruit drop, yield, quality of Kinnow Mandarin (*Citrus reticulata* ). The research was conducted under the Prayagraj Agro climatic conditions and Randomised block design is followed. The Experiment was conducted on Kinnow mandarin with various treatments (Control, NAA-25ppm, 52ppm, 75ppm, 100, 2,4-D -5ppm, 10ppm, 15ppm, 20ppm, GA3-25ppm, 50ppm, 75ppm, 100ppm) in three replications. The Maximum plant height ranged from (211.18cm to 240.04cm). The Minimum plant height ( 167.31cm) was recorded in control ( water spray) compared to the other treatments. Based on the results recorded during the trial the most number of flowers obtained after the spraying of growth regulators are (188.56), the maximum number of fruits per plant (171.93), the maximum fruit weight per plant (126.93), the maximum fruit length per plant (6.16cm) was found superior in the plants treated with 2,4-D 20ppm. The minimum fruit drop was recorded in T<sub>8</sub> at 20 ppm (12.07%). Among these treatments, the most effective treatment of foliar spray for plant height (cm) number of flowers, fruits per plant, fruit weight, fruit drop, fruit length is 2,4-D at 20ppm.

### Introduction

Kinnow, a mandarin hybrid between King Mandarin (*Citrus reticulata*) was introduced in India in 1958 at the Regional Fruit Research Station, Abohar (Punjab). In India this variety was introduced by Bakhshi in 1954 at the Punjab Agriculture University, Regional Fruit Research Station, Abohar. A noble

introduction of this cultivar inspired the growers to extend the cultivation in adjoining areas and has become the most favourite citrus cultivar among citrus growers because of its adaptability under semi-arid and sub-mountainous foothill conditions where other citrus varieties have failed. Citrus fruits have special importance due to their distinct flavour and therapeutic values. These are rich

in Vitamin-C with the fair amount of vitamin A & B. They are rich source of minerals like calcium, phosphorus and iron. It is a hybrid of two citrus cultivars-King (*Citrus Nobilis*) x willow leaf (*Citrus deliciosa*). The genus *Citrus* L. belongs to subfamily Aurantioideae of the family Rutaceae. It was first developed by Howard B. Frost in 1915 and released in 1953 at the University of California, Citrus experiment station.

Kinnow now has attained a prime position in north western states of Punjab, Haryana, Rajasthan, Uttar Pradesh and Himachal Pradesh since its fruit is very refreshing, juicy, melting and aromatic flavour with a fine sugar-acid blend, total soluble solids (10-12%) and acidity (0.75-1.2%). However, with the change in climate, the growers are facing various problems like erratic bearing, severe fruit drop, decline and poor fruit size. Among these, fruit drop and small fruit size are of great concern, which result in huge economic loss to the farmers. Citrus are relatively high nutrients-demanding crops<sup>31</sup> and highly responsive to applied nutrients in the form of fertilizers. Enhanced growth with improved fruit yield can be obtained with the application of proper compound fertilizers because any nutrient either deficient or excess can lead to huge reduction in crop yield. Inadequate nutrition is one of the major constraints limiting the potential productivity of a Kinnow orchard, thus, the judicious application of fertilizers plays a pivotal role in the productivity of Kinnow plantation.

The use of plant growth regulators has become an important component in the field of citriculture because of the wide range of potential role they play in increasing the productivity of development by regulation of the endogenous processes and there exogenous applications have been exploited for modifying the growth response. These regulators have also been used to influence

fruit quality factors like peel quality and colour, fruit size, juice quality and to improve total soluble solids in different citrus species, This review may serve as a complete treatise on the possible roles of growth promoting substance on the physiological processes of citrus plant.(Harsimrat *et al.*, 2015). Fruit drop in kinnow is a serious problem world wide. Flowering and fruit set, and its retention depends on several factors and hormonal regulation is one of them (Huchcche *et al.*, 2012). Pre harvest fruit drop is a very complex problem and mostly occurs due to formation of abscission layer. Tree drops its fruit when the concentration of auxins decreases and the concentration of abscissic acid (ABA) increases (Marin ho *et al.*, 2005) as the endogenous hormones and their balance play an important role in mobilization of nutrients to the developing organ. The application of different plant growth regulators are recommended to reduce premature fruit drop by various workers across the world (Ashraf *et al.*, 2012, Uniyal *et al.*, 2015).

## Materials and Methods

The experiment was carried out in Randomised Block Design with 13 Treatments replicated thrice. The Experiment was carried out on Kinnow plants at the Central Research Field of Department of Horticulture, Naini Agriculture University, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. The experimental site is situated at of latitude of 20° and 15° North and longitude of 60°3' East and at an altitude of 98 meters above mean sea level (MSL). The Treatments were T<sub>0</sub> Control (Spaying of water), T<sub>1</sub> (NAA-25ppm), T<sub>2</sub> (NAA- 52ppm), T<sub>3</sub>(NAA-75ppm), T<sub>4</sub> (NAA-100), T<sub>5</sub> (2,4-D -5ppm), T<sub>6</sub> (2,4-D-10ppm), T<sub>7</sub> (2,4-D-15ppm), T<sub>8</sub> (2,4-D-20ppm), T<sub>9</sub> (GA3- 25ppm), T<sub>10</sub> (GA3-50ppm), T<sub>11</sub> (GA3-75ppm), T<sub>12</sub> (GA3-100ppm).

**Climatic conditions in the experimental area**

The area of Allahabad district comes under subtropical belt in the South East of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46°C-48°C and seldom falls as low as 4°C-5°C. The relative humidity ranged between 20-94 percent.

The average rainfall in this area is around 1013.4mm annually. However, occasional precipitation is also not uncommon during winter months. The average monthly rainfall, maximum and minimum temperature and relative humidity recorded at SHUATS,

Allahabad during 2019-2020 the observatory period

**Results and Discussion**

Based on the observations recorded during the trial, the Maximum plant height is 240.04cm. The Minimum plant height 167.31cm was recorded in control (water spray) compared to the other treatments. The most number of flowers obtained after the spraying of growth regulators are (188.56), and the minimum number of flowers are 116.36cm. The maximum number of fruits per plant (171.93) and the minimum number of fruits per tree are 98.87. The maximum fruit weight per plant (126.93) and the minimum fruit weight per plant was 91.59gm.

**Table.1** Treatment combination data of Foliar application of plant growth regulators like NAA, 2,4-D, GA3 used for Kinnow mandarin (*Citrus reticulata*)

Treatment symbol	Treatment combination	Plant height Maximum	No.of flowers	No.of fruits	Fruit weight	Fruit length	Fruit drop	Yield per plant	Yield per hectare
Control	Water spray	209.85	116.36	98.87	91.59	4.06	16.25	9.06	25.08
NAA	25 ppm	209.54	135.59	120.39	106.56	5.54	15.48	12.83	35.53
NAA	50 ppm	219.84	137.59	119.31	109.53	5.41	15.04	13.07	36.20
NAA	75 ppm	214.10	139.26	121.07	112.52	5.32	14.67	13.62	37.74
NAA	100 ppm	220.99	148.30	124.63	109.19	5.76	14.22	13.61	37.69
2,4-D	5 ppm	226.28	181.93	162.19	119.93	6.12	14.15	19.45	53.88
2,4-D	10 ppm	228.87	183.76	164.12	121.93	6.26	13.60	20.01	55.44
2,4-D	15 ppm	234.84	184.98	168.53	122.89	6.30	12.69	20.71	57.37
2,4-D	20 ppm	240.04	188.56	171.93	126.93	6.16	12.07	21.82	60.45
GA3	25 ppm	222.77	182.63	169.56	113.89	5.85	15.48	19.31	53.47
GA3	50 ppm	217.27	179.35	170.58	116.27	5.94	15.01	19.83	54.93
GA3	75 ppm	219.38	177.89	168.60	112.34	5.64	14.97	18.94	52.46
GA3	100 ppm	223.00	177.10	166.96	110.57	5.30	14.40	18.46	51.14
	<b>F-test</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	<b>C.D. at 0.5%</b>	<b>3.047</b>	<b>3.216</b>	<b>1.908</b>	<b>1.374</b>	<b>0.579</b>	<b>0.79</b>	<b>0.239</b>	0.662
	<b>S.Ed (±)</b>	<b>1.476</b>	<b>1.558</b>	<b>0.924</b>	<b>0.666</b>	<b>0.281</b>	<b>0.54</b>	<b>0.116</b>	0.321

The maximum fruit length per plant (6.16cm) was found superior in the plants treated with 2,4-D 20ppm and the minimum fruit length

was 4.06cm. 2,4-D is most effective in controlling the fruit drop and the minimum fruit drop was recorded on T<sub>8</sub> 2,4-D at 20

ppm (12.07%). Among these treatments, the most effective treatment of foliar spray for plant height (cm) number of flowers, fruits per plant, fruit weight, fruit drop, fruit length is 2,4-D at 20ppm.

On the basis of results obtained, It is concluded that the treatment T<sub>8</sub> (2,4-D at 20 ppm) was found to be the best in improving plant height, Number of branches, leaf area(cm), plant spread, Number of flowers, Number of fruits, Fruit weight, Fruit length(cm), Number of seeds per plant, Fruit yield per plant, Fruit yield qha-1, T.S.S(Brix<sup>o</sup>), Vitamin-C, Acidity (%). The combination of these treatments modifies several physiological process in plants which are extensively and profitably used in horticultural crops. They are also used for increasing vegetative growth and increase yield and increase quality. Since these findings are based on the data, this experiment may not be sufficient to have expression on these treatments. Therefore, further investigations are needed to confirm the above results prior to its recommendation to the growers in controlling fruit drop for higher production and income returns. The most effective treatment of foliar spray for better flowering, fruit set, yield, fruit drop, quality of kinnow mandarin is found to be T<sub>8</sub> having the proportion 2,4-D at 20 ppm as shown in the Table 1.

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