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Response of Exogenous 2,4-D, Urea and $ZnSO_4$ on Biochemical Composition and Plant Leaf Nutrients of Kinnow

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ABSTRACT: The present investigations were carried out at the RHR&TS, Dhaulakuan, District Sirmour of Dr. Y. S. P. University of Horticulture & Forestry, Nauni, Solan. There are also several challenges that need to be considered, including leaf surface and plant coverage, timing and frequency, chemical compatibility, environmental factors, and cost-effectiveness. This investigation was conducted on 15 year old Kinnow fruit trees, with 8 treatments as T_1 Urea as 1%, T_2 $ZnSO_4$ as 0.4%, T_3 2,4-D as 20 ppm, T_4 Urea as 1% + $ZnSO_4$ as 0.4%, T_5 Urea as 1% + 2,4-D as 20 ppm, T_6 $ZnSO_4$ as 0.4% + 2,4-D as 20 ppm, T_7 Urea as 1% + $ZnSO_4$ as 0.4% + 2,4-D as 20 ppm and T_8 Control. From the observation in maximum fruit quality of Kinnow as TSS, Juice content, Acidity, Sugars and Vitamin C was recorded with T_7 treatment. In case of macro and micro leaf nutrients was also recorded with Urea, Zinc and 2,4-D combination. From the this view it may be concluded that combination of the Urea, Zinc and 2,4-D increase the fruit quality and leaf nutrients.

Keywords: Leaf Nutrients, Kinnow, 2,4-D, Urea, Zinc Sulphate.

INTRODUCTION

Citrus fruit is the most widely traded agricultural commodity in the world, and it is also one of the key horticulture crops that are grown all over the world. Citrus fruits are said to have originated in Southeast Asia and then spread to other parts of the world; however, the precise location of their point of origin is still up for question. Citrus fruits are now widely grown all over the world. Citrus fruit is a crop that is grown not just in rich countries but also in poor countries (Langgut, 2017).

Citrus is an evergreen shrub that is a member of the Rutaceae family and is native to the subtropical and tropical regions of South Asia, China, India, and the Malay Archipelago (Liu *et al.,* 2012). It appear to be prospective sources for a wide variety of human nuts. These types of citrus make up the majority of the remaining 2.0% of the total citrus population.

Citrus fruits are important contributors to healthy diets since they are important sources of food and energy and play an important part in doing so. Citrus fruits are excellent sources of dietary fibre and contain a majority of carbs such as sucrose, glucose, and fructose (Prasad *et al.,* 2013). Dietary fibre is known to help prevent diseases of the digestive tract and encourage high levels of circulating cholesterol (Prasad *et al.,* 2015). Citrus fruits, in particular oranges, lemons, and limes, are rich in vitamin C and a variety of other beneficial chemicals (Makni *et al.,* 2018). It has been hypothesised that the antioxidant capabilities of these components, along with their ability to be transformed into vitamin A, make them of critical significance in the process of bettering human health. Yet, citrus fruits are still put to use in a variety of ways, including the production of juice, jam, jelly, squash, pies, cake, candies, and marmalades, among other things (Prasad *et al*. 2013).

Citrus phytochemicals may possess properties that are antibacterial, antiviral, antifungal, anticarcinogenic, antithrombotic, or anti-inflammatory Abobatta (2019). Citrus fruits have been suggested for examination in a number of studies as a diet that is both nutritious and enjoyable (Economos and Clay 2005). Previous studies revealed that fruit and items made from citrus are rich sources of dietary fibre, vitamins, and minerals (Ghanem *el al.,* 2012). Citrus fruits, on the other hand, are valued for the bioactive and non-nutrient molecules they contain, which are recognised for their ability to lower the risk of a variety of chronic diseases (Bamise and Oziegbe 2013).

Citrus is a highly nutrient-responsive crop, and as a result, a reduction in the availability of nutrients can have a negative impact on the amount of fruit that can be harvested from each tree (Zoremtluangi *et al.,* 2019). Even though the amount of micronutrients a plant needs is far lower in comparison to the amount of major nutrients, the micronutrients are just as essential to the plant's metabolic process, growth, and development (Bhanukar *et al.,* 2018). The production of fruits of a high yield and quality is directly correlated to an appropriate supply of micronutrients (Babu and Yadav 2005). Yet, as a result of their lack, the growth and yield are both negatively affected. Orchard establishment is negatively affected by a lack of micronutrients, which also results in a significant loss of production and poor quality (Marschner, 2012).

Micronutrients applied through foliar spray are more effective than those applied through soil application, and the plants respond to the spray more quickly (Bhanukar *et al.,* 2018). Foliar application is seven to twenty one times more effective than soil application (Zaman *et al.,* 2019), due to the fact that nutrients are directly placed onto the leaves, which is where the plant's metabolism occurs, and it produces a quicker reaction due to easy access to the nutrients (Harris and Puvanitha 2018). In addition to this, citrus is a fruit crop that has deep roots, which means that topically applied soil micronutrients may not have as great of an effect (Prasad *et al*., 2015).

Because of this, a great number of researchers have become interested in the subject in an effort to find positive control techniques that can be implemented on quality and leaf nutrient through the use of exogenous use of plant growth regulators (PGRs) and other substances. A investigate was carried out on" response of exogenous 2,4-d, urea and zinc sulphate on biochemical composition and plant leaf nutrients of kinnow" which was carried out with the intention of determining the cause of fruit quality and leaf nutrients.

MATERIAL AND METHODS

The present investigations were carried out at the RHR&TS, Dhaulakuan, District Sirmour of Dr. Y. S. P. University of Horticulture & Forestry, Nauni, Solan. It is located between 35.5° North latitude and 77.5° East longitude at an elevation of 468 meters above mean sea level. The climate of experimental farm is humid subtropical condition. The experiment were carried out on 15 year old 24 Kinnow trees, uniform in growth with 8 treatments. T_1 Urea as 1%, T_2 $ZnSO_4$ as 0.4%, T_3 2,4-D as 20 ppm, T_4 Urea as 1% + $ZnSO_4$ as 0.4%, T_5 Urea as 1% + 2,4-D as 20 ppm, T_6 $ZnSO_4$ as 0.4% + 2,4-D as 20 ppm, T_7 Urea as 1% +$ZnSO_4$ as 0.4% + 2,4-D as 20 ppm and T_8 Control. 1st spray of $ZnSO_4$, Urea and 2, 4-D was sprayed 14th April, 7th April and 14th May, respectively. 2nd spray of Urea, $ZnSO_4$ and 2, 4-D was sprayed 5th September, 12th September and 13th September, respectively.

After the fruit harvest juice observation expressed on per cent. TSS were recorded with digital hand refractometer. Titratable acidity was calculated in terms of citric as per methods (A.O.A.C., 1980). Vit-C and Sugars content of juice was determined as per method A.O.A.C. (1980). TSS /acid ratio was calculated by dividing the value of TSS with titratable acidity. For the estimation of leaf P, K, Ca, Zn, Fe, Cu, Mg and Mn, digestion was done in di-acid mixture. Total nitrogen content was determined by Micro Kjeldahl's method (A.O.A.C., 1980). Total phosphorus content was determined by vanadomolybdophosphoric (Jackson, 1975) and total potassium content on flame photometer (Toshniwal, TMF 45), total calcium and magnesium contents with atomic absorption spectrophotometer. The micro nutrients zinc, iron, copper and manganese were also determined with the help of atomic absorption spectrophotometer (1414 model).

RESULTS AND DISCUSSION

The experimental findings of present studies conducted on the "Response of exogenous 2,4-D, Urea and Zinc on fruit quality and leaf nutrient status of Kinnow" are presented as:

A. Response of exogenous 2,4-D, Urea and Zinc on fruit quality of Kinnow mandarin

Perusal of data given in Table 1 reveals that maximum juice 51.90% content was observed with T_7 treatment. However, the minimum juice 43.16% content was observed under control. In case of TSS that increased as compared to control but T_7 treatment recorded highest TSS 15.4 °Brix as compared to minimum was observed under T_8 (13.63 °Brix). In relation to titratable acidity 1.09 % was recorded with T_8 treatment whereas, minimum titratable acidity was recorded under T_7 (1.01 %) treatment. Fruit TSS/Acid ratio reveals that T_7 treatment observed highest TSS/Acid Ratio 15.25 with minimum TSS/Acid ratio was observed under T_8 12.50. The increase in total soluble solids, Juice, and decreasement in acidity as a result of urea and Zn sources spray might be increased photosynthesis and production of maximum assimilates due to auxin synthesis. Huang and Huang (2005) also reported similar by application of foliar application of growth regulators, urea and micronutrient increased significantly fruit quality on fruits.

B. Response of exogenous 2,4-D, Urea and Zinc Sulphate on sugars per cent and vitamin C content of Kinnow mandarin

Maximum 6.25 % non-reducing sugars was observed with T_7 treatment with the minimum non-reducing sugars under T_8 5.75 %. Perusal of data presented in Table 2 indicated that highest reducing sugars 3.52% was observed in T_8 treatment whereas, lowest reducing sugars was observed with T_8 3.20 %. Data presented in Table 2 that maximum total sugars 10.10 % was recorded T_8 treatment. However, the minimum total sugars was observed with T_8 8.96 %. Vitamin-C was recorded with T_8 37.73 mg/100 g and minimum Vitamin-C with T_8 30.20 mg/100 g. Various workers also noticed that the growth regulators application causes improvement of sugars content and fruit quality (Singh and Singh 1981; Prasad *et al*., 2015).

C. Response of exogenous 2,4-D, Urea and Zinc Sulphate on leaf macro- nutrients in percentage of Kinnow

It is evident from the data given in Table 3 that leaf nitrogen (2.55%), phosphorus (0.21 %), potassium (1.11%), calcium content (2.57%) and Magnesium (0.61 %) was maximum with T_7 treatment. However, minimum leaf nitrogen (2.11 %), phosphorus (0.14 %), potassium content (0.97 %), calcium (2.17%) and Magnesium content was observed with control (0.44 %). It may be due to source-sink relationship by application of exogenous growth regulators that enhance the sink strength of leaves for greater attraction and mobilization of micro nutrients from other plant organs (Shindy *et al*, 1973).

D. Response of exogenous 2,4-D, Urea and Zinc Sulphate on leaf micro- nutrients of Kinnow

The data presented in Table 4 that maximum zinc content in leaf 17.96 ppm and Fe content 120.88 ppm were observed with T_5 treatment. Minimum zinc content in leaf 12.16 ppm and iron content 110.22 ppm was recorded with T_8 treatment that as control. Highest leaf cu content 16.82 ppm was recorded with T_7 treatment. Lowest leaf cu 13.21 ppm content with T_8. Maximum manganese content in leaf 54.26 ppm was observed with T_5 treatment. Whereas, minimum leaf manganese 42.92 ppm content was observed under (T_8) control. Similar finding in citrus also reported by Randhawa (2004). It may be efficient translocation and utilization available micronutrients in the plant.

Table 1: Response of exogenous 2,4-D, Urea and Zinc Sulphate on fruit quality of Kinnow mandarin.

Treatment	TSS (°Brix)	Juice (%)	Titratable Acidity (%)	TSS/Acid ratio
T_1	13.93	46.01	1.04	13.39
T_2	14.10	44.40	1.06	13.30
T_3	14.20	47.22	1.07	13.27
T_4	14.47	48.01	1.02	14.19
T_5	14.13	47.97	1.05	13.46
T_6	14.67	46.61	1.03	14.24
T_7	15.40	51.90	1.01	15.25
T_8	13.63	43.16	1.09	12.50
$CD_{0.05}$	**1.33**	**1.91**	**0.03**	**1.22**

Table 2: Response of exogenous 2,4-D, Urea and Zinc Sulphate on sugars per cent and vitamin C content of Kinnow mandarin.

Treatment	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Vitamin C (mg/100g)
T_1	3.40	5.52	9.21	31.30
T_2	3.41	5.58	9.28	31.80
T_3	3.34	5.50	9.13	31.93
T_4	3.48	5.77	9.55	33.07
T_5	3.41	5.60	9.30	31.73
T_6	3.48	5.64	9.42	32.97
T_7	3.52	6.25	10.10	37.73
T_8	3.20	5.47	8.96	30.20
$CD_{0.05}$	**0.63**	**0.35**	**0.55**	**1.01**

Table 3: Response of exogenous 2,4-D, Urea and Zinc Sulphate on the leaf macro-nutrients in percentage of Kinnow mandarin.

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
T_1	2.45	0.18	1.03	2.52	0.55
T_2	2.18	0.16	1.04	2.30	0.48
T_3	2.23	0.17	1.07	2.33	0.47
T_4	2.38	0.19	1.06	2.41	0.53
T_5	2.40	0.15	1.01	2.49	0.52
T_6	2.32	0.16	1.05	2.24	0.51
T_7	2.55	0.21	1.11	2.57	0.61
T_8	2.11	0.14	0.97	2.17	0.44
$CD_{0.05}$	**0.25**	**0.03**	**0.07**	**NS**	**0.07**

Table 4: Response of exogenous 2,4-D, Urea and Zinc Sulphate on the leaf micro-nutrients of Kinnow mandarin.

Treatment	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)
T_1	12.58	117.07	15.76	51.12
T_2	16.95	113.89	14.77	45.53
T_3	14.09	115.99	15.53	46.39
T_4	15.50	120.88	15.66	48.09
T_5	14.13	119.24	16.49	54.26
T_6	17.96	114.28	15.09	44.62
T_7	16.77	117.64	16.82	52.31
T_8	12.16	110.22	13.21	42.92
$CD_{0.05}$	**1.26**	**3.32**	**1.61**	**3.73**

CONCLUSIONS

This investigation was conducted as T_1 Urea as 1%, T_2 $ZnSO_4$ as 0.4%, T_3 2,4-D as 20 ppm, T_4 Urea as 1% + $ZnSO_4$ as 0.4%, T_5 Urea as 1% + 2,4-D as 20 ppm, T_6 $ZnSO_4$ as 0.4% + 2,4-D as 20 ppm, T_7 Urea as 1% + $ZnSO_4$ as 0.4% + 2,4-D as 20 ppm and T_8 Control. From the observation in maximum fruit quality of Kinnow as TSS, Juice content, Acidity, Sugars and Vitamin C was recorded with T_7 treatment. In case of macro and micro leaf nutrients was also recorded with Urea, Zinc and 2,4-D combination. From the this view it may be concluded that combination of the Urea, Zinc and 2,4-D increase the fruit quality and leaf nutrients. By following proper guidelines and recommendations, growers can effectively use foliar spray to enhance the nutritional value, shelf life, and appearance of Kinnow fruit.

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Conflict of Interest. None.

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