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Efficacy of urea and zinc on sweet orange cv. Sathgudi under hot semi-arid environment of western India

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Abstract

An experiment was conducted on sweet orange cv. Sathgudi to study the effect of urea and zinc, alone and in different combinations, on growth, yield and quality of Sathagudi sweet orange during the year 2002 and 2004 under semi-arid conditions of Panchmahals district of Gujarat. Treatments comprised of zinc as foliar spray (0.5%) alone and in combination with different nitrogen doses in the form of urea in soil as well as foliar spray. Soil application of urea was given in the last week of June and first week of September during both the years of experimentation. Results of the experiments revealed that the growth of plants in terms of plant height, stem girth and plant spread, yield in terms of weight of fruits, fruit size, and quality with respect of juice content, TSS, total sugar and vitamin C increased with the soil application of urea 350 g per tree over control. The parameters further showed an increasing trend when urea was sprayed in addition to soil application. An increase in the percentage of urea in solutions for spray from 0.5 to 1.5 % increased the growth, yield and quality of sweet orange fruits. Among the various treatment combinations evaluated, urea in soil (350 g) + zinc (0.5%) +Urea as foliar spray (1.5%) was found to be the best to increase the growth and yield of quality fruits under semi-arid ecosystem of western India.

Keywords: Sweet orange, zinc, urea, quality, TSS

Introduction

The sweet orange (tight skinned orange) commonly known as *Mosambi* is an important citrus fruit of India. Under humid environment, fruits turned insipid and there is more chance of attacking insect, pests and diseases. However, taste is superior under dry condition of semi-arid ecosystem. Sweet orange is popular for its juice which is rich in vitamin C, but for want of scientific cultivation practices, the orchards are fast declining. Among the factors responsible for citrus decline, plant nutrition occupies an important role. The necessity of maintaining proper nutrition balance in citrus orchard to ensure tree health and productivity has been highlighted by Chapman and Kelly (1943). There are several reports of existence of micro nutrient deficiencies in different part of India and it may be considered to be one of the factors to be associated with low productivity and poor quality fruits. Zinc ranks next only to nitrogen and it also plays role in nucleic acid metabolism, protein and chlorophyll synthesis, and acts as catalyst in oxidation and reduction process (Childers, 1954). Hence there is essentiality of maintaining proper nutrient balance in citrus orchard to ensure proper tree health. Keeping these points in view, an attempt was made to see the effect of urea and zinc on growth, yield and quality of sweet orange under semi-arid ecosystem of western India.

Materials and Methods

The experiment with ten treatments *viz.*, T_1, control; T_2, urea 350g in soil; T_3, zinc 0.5 per cent; T_4, urea in soil plus urea 0.5 per cent foliar application; T_5, urea in soil plus urea 1.0 per cent foliar spray; T_6, urea in soil plus urea1.5 per cent foliar spray; T_7, urea in soil plus zinc 0.5 per cent foliar spray; T_8, urea in soil plus zinc 0.5 per cent plus urea 0.5 per cent foliar spray; T_9, urea in soil plus zinc 0.5 per cent plus urea 1.0 per cent; T_{10}, urea in soil plus zinc 0.5 percent plus urea 1.5 per cent foliar spray; was conducted at Central Horticultural Experiment station, Vejalpur, Panchmahals, Gujarat under the project NATP-HFNS during the 2002-2004. The soil was analyzed for organic carbon, EC, pH, N, P and K following methods used by Bhargava and Raghupati (1993) and soil bulk density and hydraulic conductivity following the methods as suggested by Page *et al.* (1982) before the initiation of the experiment. The soil type was clay-to-clay loam with available N (150.25 kg/ha), P (6.23 kg/ha) and K (145.50 kg/ha) and organic carbon (0.31%), having EC and pH, bulk density and hydraulic conductivity of soil as 0.14 dS m^{1}, 7.95, (1.43g/cc) and (0.27 cm/hr), respectively. The soil depth ranges from 0.75-1.0 m, derived from mixed alluvial basalt, quartzite, granite and layers of limestone, and falls under semi-arid hot climate. The experiment was conducted on seven-year-old sweet orange plants in Randomized Block Design with ten treatments, which were replicated thrice. The urea 350 g was applied in soil twice in a year during June and September. Zinc was applied as foliar application (0.5%) alone and in combination with nitrogen treatments, the required amount of fertilizer was dissolved separately, the pH of zinc

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solution was adjusted by lime and sprayed twice in year in the months of May and September. The total soluble solids and acidity were measured and analyzed using standard methods. Ascorbic acid from juice was determined by methods suggested in AOAC (1990).

Results and Discussion

Soil application of urea 350 g alone and also as foliar application and zinc 0.5 per cent increased the plant height significantly. The plants treated with urea in soil plus urea as foliar sprays in combination with zinc sulphate increased the growth over control (Table 1). Application of 350 g urea and subsequent foliar application of 1.5 per cent urea and 0.5 per cent zinc sulphate recorded maximum increase in plant height (46.54 cm), stem girth (3.78 cm) and plant spread (E-W 48.50 and N-S-43.46 cm) which was closely followed by T_9 (urea 350g in soil + urea 1.0 per cent foliar spray + zinc 0.5 per cent), while minimum increase in plant height (29.70 cm), stem girth (2.56 cm) and plant spread (E-W, 32.10 cm and N-S, 32.95 cm) were recorded under control. These finding are in close conformity with result of several earlier workers like Chanturiya (1974) in mandarin, Samolades (1964) in Unshiu mandarin, Arora and Singh (1970) in guava and Singh and Singh (2005) in grapefruit.

The treatments, which were effective in promoting the vegetative growth, were also found to be responsible for more yield and yield attributing characters (Table 2). Yield more yield and yield attributing characters (Table 2). Yield per plant (54.05 kg and 58.90 kg) was recorded maximum in the plants treated with urea 350 g in soil plus urea 1.5 per cent foliar spray and zinc sulphate 0.5 per cent during both the year of experimentation, which was followed by urea 350 g in soil plus urea as foliar spray(1%) plus zinc (0.5%) (51.12 mg and 52.75 kg) and the same was recorded the lowest in control. The maximum fruit weight (143.50 g and 147.27 g), fruit length (6.86 cm and 6.92 cm), fruit diameter (6.68 cm and 6.70 cm), TSS (12.85 and 13.00) and vitamin C (55.60 and 57.50 mg/100g fresh juice) were recorded with the treatment T_{10} (urea 350g in soil plus zinc 0.5 % plus urea 1.5 % foliar spray), which was closely followed T_9 (urea 350g in soil plus zinc 0.5% + urea 1.0 % spray). These findings are similar to those reported by Ram and Bose (1994) in mandarin orange, Arora and Singh (1970) in guava and Singh and Agrawal (1961) in citrus. Juice content (44.05% and 41.20%) and total sugar (6.82% and 6.84%) were recorded high in the plants which were treated with urea in soil (350g) as well as foliar spray (1.5%) and zinc (0.5%) followed by T_9, urea in soil + urea as foliar spray and zinc 0.5% and it was recorded the lowest in control (table-2). Similar findings have earlier been reported by Ram and Bose (1994) in mandarin and in grapefruit.

Table 1: Effect of urea and zinc on annual growth extension of sweet orange cv Sathgudi (average of two years 2002-04).

Treatments	Plant height (cm)	Stem girth (cm)	Plant spread (cm)	
			E-W	N-S
T1	30.70	2.56	32.10	32.95
T2	32.18	2.62	40.89	39.00
T3	36.76	2.75	34.00	33.15
T4	37.90	2.98	39.14	36.00
T5	40.13	3.20	40.47	41.15
T6	42.02	3.10	40.32	38.95
T7	39.00	3.09	38.86	37.18
T8	44.15	3.28	41.81	39.90
T9	46.85	3.52	43.30	42.00
T10	46.54	3.78	48.50	43.46
C D at 5%	1.87	0.35	2.48	2.32

Table 2: Effect of urea and zinc on yield and physical attributes of sweet orange cv. Sathgudi

Treatments	Yield (kg) /plant		Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
T1	35.00	36.10	159.00	160.42	5.50	5.52	5.54	5.52
T2	38.18	37.25	160.00	162.27	5.53	5.54	5.58	5.59
T3	36.17	38.00	163.23	165.85	5.45	5.59	5.47	5.50
T4	40.15	42.28	178.00	180.18	6.10	6.15	6.09	6.10
T5	43.42	45.00	180.72	182.25	6.00	6.12	6.05	6.17
T6	45.19	43.07	170.00	174.27	5.94	5.98	6.00	6.12
T7	39.15	40.00	164.87	167.15	5.85	5.88	5.90	5.95
T8	49.12	48.15	185.24	190.62	6.33	6.41	6.40	6.39
T9	51.12	52.75	185.93	189.84	6.35	6.44	6.39	6.40
T10	54.05	58.90	198. 50	200.25	6.86	6.92	6.68	6.70
C D at 5%	4.28	4.37	9.67	8.90	0.42	0.51	0.38	0.45

Table 3: Effect of urea and zinc on chemical attributes of sweet orange cv. Sathgudi

Treatments	Juice content (%)		TSS (^{0} Brix)		Total sugar %(fresh weight)		Acidity (%)		Vitamin C (mg/ 100 g fresh juice)	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
T1	38.25	36.18	11.30	11.37	5.95	6.12	1.20	1.29	50.15	51.72
T2	40.00	43.18	11.62	11.57	6.65	6.57	1.34	1.27	52.12	50.15
T3	39.12	36.00	12.82	11.90	6.61	6.68	1.31	1.37	51.12	52.27
T4	41.15	43.15	11.90	12.85	6.50	6.61	1.30	1.34	52.40	51.19
T5	40.18	45.08	12.15	12.90	6.50	6.57	1.40	1.47	53.75	54.12
T6	41.00	44.95	12.18	12.25	6.54	6.32	1.36	1.40	54.14	55.12
T7	42.47	42.45	11.95	12.10	6.62	6.70	1.38	1.38	54.12	55.00
T8	43.15	41.18	12.95	12.64	6.75	6.80	1.43	1.45	52.87	52.19
T9	43.95	42.18	12.92	12.75	6.78	6.89	1.45	1.45	53.29	55.15
T10	44.05	41.20	12.85	13.00	6.95	7.00	1.46	1.47	55.60	54.15
C D at 5%	3.00	3.12	1.34	1.45	N S	N S	N S	N S	4.15	4.20

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