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Effect of foliar application of micronutrients on growth and fruit yield of Nagpur Mandarin (*Citrus reticulata* Blanco) in Malwa plateau zone, Madhya Pradesh

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Abstract

The present study was conducted at the Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya Krishi Vigyan Kendra, Farm Science Centre, Rajgarh M.P. During 2019-20 & 2020-21 under institutional research project. The experiment was laid out in randomized block design (RBD). Sixty uniform and healthy tree of mandarin (*Citrus reticulata* Blanco) planted at 6X6 m distance were selected under the experiment. The experiment consisted of 10 treatment combination of micro nutrients with control. Plants were subjected to foliar spray. The spray was applied twice: once at pea stage and gravel stage. The results of the experiment indicate that the foliar application individual and combination of micronutrients the maximum fruit weight (147.67 g.), fruit yield (71.16 kg/plant) and fruit retention (47.40%) was recorded with the spray of T₁₀ ZnSO₄ (0.4%) + CuSO₄ (0.4%) + MgSO₄ (2.0%) + MnSO₄ (0.5%) + Boron (0.1%) over control with application hence the combination of recommended dose of fertilizers i.e. 400:600:400 gm. NPK/Plant.

Keywords: Mandarin, foliar application, micronutrient, growth & yield parameters

Introduction

Mandarin (*Citrus reticulata* Blanco) is considered to be one of the most important cultivated species among citrus and is being commercially grown in certain specific region of the country like; Nagpur Mandarin in central India, Nagpuri Mandarin is finest variety and very popular in India as well as in world for its good quality fruits, fruit size big, subglobose, average weight 110-125 gm., rind medium thick, fairly loosely adherent, surface is also relatively smooth but, segment found in 10-15 number and number of seeds 1-2 per segment, colour of peel pale orange yellow. Fruit have mild flavor, excellent quality, juicy, TSS 10-12, 120 brix, and acidity 0.50-0.70%.

The total production of citrus fruits in India is 4964 Thousand MT. from an area of 404.0 Thousand hectares with the productivity of 12.2 t/ha. In Madhya Pradesh Mandarin covers 81 thousand hectare are with the production of 842.40 mt. and the productivity of 10.4 t/ha. (Ministry of Agriculture and farmers 2019-20). In Rajgarh district Mandarin where it is grown over 18764 ha. area and the production is 266449 tones (district horticulture department 2019). Nutritional deficiencies are closely associated with the poor plant growth and fruit set, heavy fruit drop, inferior quality of produce and also make the tree vulnerable to diseases, pests and other disorders. Nutrients like nitrogen, phosphorus and potash play a vital role in promoting the plant vigour and productivity, whereas micronutrients like zinc, boron, copper, Magnesium and Magnesium perform a specific role in the growth and development of plant, quality produce and uptake of major nutrients.

The Mineral nutrients are composed of major and micronutrients. among the major nutrients, N, P and K are amount while, Ca, Mg and S are the secondary nutrients and most of them are supplied to the trees along with the primary nutrients through the synthetic fertilizers (Singh and Khan 2012) [6]. The micronutrients on the other hand though are required in small amount but play a great role in plant metabolism (Katy, 2004) [3]. These are involved in the synthesis of many compounds essential for plant growth and productivity and are the activators for various enzymes. For instance, Zn is involved in the biosynthesis of Tryptophan, a precursor of naturally occurring auxin, indole acetic acid (IAA). Mn is required in the process of photosynthesis Nanaya *et al.* (1985) [4]. Copper sulphate which is increased the percentage of seed less fruit besides, Soni *et al.* (2017) [7].

Material and Methods

A Field study was conducted at the Rajmata Vijayaraje Scindia Krishi Vishwavidhyalaya Krishi Vigyan Kendra, Farm Science Center, Rajgarh M.P. During 2019-20 & 2020-21 under institutional research project. The experiment was laid out in randomized block design (RBD) 60 uniform healthy selected tree of Mandarin, planted at 6X6 m. distance were selected under the study. Ten treatments (two tree/treatment) with three replications were applied. The spray was applied twice: one at pea stage and gravel stage with object of experiment Effect of Foliar Application of Micronutrients on Flowering, Fruit Yield & Quality of Nagpur Mandarin (*Citrus reticulata* Blanco) in Malwa Plateau zone M.P. There were 10 treatments for foliar spray of ZnSo₄, CuSo₄, MgSo₄, MnSo₄ and Boron in individual and combinations as per detail as - T₁- Control (Only water spray), T₂- ZnSo₄ (0.4%), T₃- CuSo₄ (0.4%), T₄-MgSo₄ (2%), T₅- MnSo₄ (0.5%), T₆- Boron (0.1%), T₇-ZnSo₄ + CuSo₄, T₈ ZnSo₄ + CuSo₄ + MgSo₄, T₉- ZnSo₄ + CuSo₄ + MgSo₄ + MnSo₄, T₁₀- ZnSo₄ + CuSo₄ + MgSo₄ + MnSo₄ + Boron. The experiment was laid out in randomized block design and replicated three times. Foliar applications were given during the August-September and November-December statistical analysis data were subjected to analysis of variance and differences among treatments evaluated through statistics.

Results and Discussion

Results of present study showed that the foliar application of micronutrients (Zn, Cu, Mg, Mn & Bo) was showed increasing and decreasing trends in various growth and yields parameters due to the micronutrients combinations (Table-1).

The data were statistically analyzed the non-significantly affects were recorded on the plant height, stem girth and plant spread and signification difference were observed on various yield parameters due to micronutrients combinations. Results showed that the foliar spray of micronutrients T₁₀ (ZnSo₄ (0.4%) + CuSo₄ (0.4%) + MgSo₄ (0.2%) + MnSo₄ (0.5%) and Boron (0.1%) in combinations had significantly increased yield parameters. Among the yield parameters maximum numbers of fruits/plant (482), maximum fruit weight (147.67 gm), Fruit yield (71.16 kg/tree) and maximum fruit retention (47.40%) at maturity was recorded in T₁₀ (ZnSo₄ (0.4%) + CuSo₄ (0.4%) + MgSo₄ (0.2%) + MnSo₄ (0.5%) and Boron (0.1%) over the control (without any treatment). Micronutrient plays crucial role for better growth, vigor, flowering and fruiting in mandarin. The application of ZnSo₄ (0.4%) + CuSo₄ (0.4%) + MgSo₄ (0.2%) + MnSo₄ (0.5%) + Boron (0.1%) in combinations had significantly increases number of fruits per panicle and tree particularly in mandarin. Maximum number of fruits could be due to increase the hormonal activity by the spraying of micronutrients like; ZnSo₄, CuSo₄, MgSo₄, MnSo₄ and Boron. Particularly ZnSo₄ helps in bio-synthesis of auxin. ZnSo₄, CuSo₄, MgSo₄, MnSo₄ and Boron could be attributed to increase fruit retention with the treatments initially resulting in the more number of fruits per tree. The increase in fruit diameter of Mandarin fruit as influenced by application of zinc exhibited for better increase in size of fruit. These results are agreed with the finding of Bhambota *et al.* (1962) [1] and Vasure *et al.* (2018) [9] reported the increase in number of fruits, diameter, volume and mean weight of fruits in Citrus.

Table 1: Effect of foliar spray of micronutrients and their combination on plant height, stems girth, plant spread and number of fruits/ plant

Treatments	Plant height (cm)		Mean	Stem Girth (cm)		Mean	Plant spread (M)		Mean	Number of fruits per plant		Mean
	2019-20	2020-21		2019-20	2020-21		2019-20	2020-21		2019-20	2020-21	
	T ₁ - Control (Only water spray)	20.14	22.01	21.08	1.0	1.20	1.10	29.13	31.14	30.14	367	347
T ₂ - ZnSo ₄ (0.4%)	19.96	20.15	20.06	1.1	1.30	1.20	30.31	33.61	31.96	382	338	360
T ₃ - CuSo ₄ (0.4%)	19.92	19.32	19.62	1.0	1.10	1.05	31.42	32.53	31.98	402	390	396
T ₄ -MgSo ₄ (2%)	19.48	20.72	20.10	1.0	1.21	1.11	30.30	29.84	30.07	392	352	372
T ₅ - MnSo ₄ (0.5%)	18.35	19.23	18.79	1.0	1.00	1.00	32.54	31.62	32.08	380	298	339
T ₆ - Boron (0.1%)	17.89	18.32	18.11	1.0	1.10	1.05	35.63	36.15	35.89	407	365	386
T ₇ -ZnSo ₄ + CuSo ₄	17.09	17.95	17.52	1.1	1.20	1.15	37.23	38.71	37.97	398	375	387
T ₈ ZnSo ₄ + Cuso ₄ + MgSo ₄	16.91	17.21	17.06	1.2	1.10	1.15	36.92	37.52	37.22	438	424	431
T ₉ - ZnSo ₄ + CuSo ₄ + MgSo ₄ + MnSo ₄	16.62	15.97	16.30	1.3	1.20	1.25	38.85	39.27	39.06	459	439	449
T ₁₀ - ZnSo ₄ + CuSo ₄ + MgSo ₄ + MnSo ₄ + Boron	15.15	15.01	15.08	1.2	1.31	1.26	38.93	39.82	39.38	489	475	482
S.Em.±	-	-	1.326	-	-	0.090	-	-	2.639	-	-	2.940
CD at 0.5%	-	-	NS	-	-	NS	-	-	NS	-	-	8.803

Table 2: Effect of foliar spray of micronutrients combinations on fruit weight, fruit yield and fruit retention % at maturity.

Treatments	Fruit weight (gm)		Mean	Fruit yield (kg/plant)		Mean	Fruit retention % at maturity		Mean
	2019-20	2020-21		2019-20	2020-21		2019-20	2020-21	
T ₁ - Control (Only water spray)	130.55	126.25	128.40	45.73	45.93	45.83	27.13	26.58	26.90
T ₂ - ZnSo ₄ (0.4%)	136.43	131.29	133.88	51.05	54.99	53.02	36.93	37.22	37.10
T ₃ - CuSo ₄ (0.4%)	140.65	139.75	140.20	51.28	49.66	50.47	38.54	39.82	39.20
T ₄ -MgSo ₄ (2%)	131.82	132.33	132.08	50.53	47.72	49.13	35.73	36.28	36.00
T ₅ - MnSo ₄ (0.5%)	137.00	132.25	134.63	47.67	43.59	45.63	37.12	38.15	37.60
T ₆ - Boron (0.1%)	136.95	135.83	136.39	50.75	54.55	52.65	44.87	43.62	44.20
T ₇ -ZnSo ₄ + CuSo ₄	139.05	137.50	138.28	54.82	52.22	53.52	46.12	39.98	43.10
T ₈ ZnSo ₄ + Cuso ₄ + MgSo ₄	142.55	138.15	140.35	62.85	60.15	60.50	46.34	44.74	45.50
T ₉ - ZnSo ₄ + CuSo ₄ + MgSo ₄ + MnSo ₄	138.11	135.66	136.89	63.34	61.60	61.47	47.74	45.38	46.60
T ₁₀ - ZnSo ₄ + CuSo ₄ + MgSo ₄ + MnSo ₄ + Boron	153.33	142.00	147.67	70.54	71.78	71.16	48.55	46.27	47.40
S.Em.±	-	-	1.100	-	-	0.546	-	-	0.915
CD at 0.5%	-	-	3.293	-	-	1.636	-	-	2.738

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