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Influence of Foliar Fertilization of Micronutrients on Leaf Macro Nutrient Status of Mandarin Orange (*Citrus reticulata* Blanco.) in Lower Pulney Hills

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ABSTRACT

A field investigation was carried out during 2015-2016 at farmer field, lower pulney hills of Tamilnadu. The experiment was conducted in RBD with 15 treatment consisting of different combination of ZnSO4 (0.2%), $FeSO_4$ (0.2%), H_3BO_4 (0.2%), $MnSO_4$ (0.3%) and $CuSO_4$ (0.4%) which is replicated 3 times. The results showed that foliar application of micronutrient alone or in combination significantly enhanced the major nutrient status N and K of mandarin orange leaves except phosphorous.

Key words: *Mandarin orange, Micro-nutrients, Foliar application, Leaf nutrient status*.

INTRODUCTION

Citrus (*Citrus reticulata* Blanco.) is one of the most important fruit crops of the globe, extensively cultivated in tropical and sub-tropical climate. In India, there are 26 states involved in citrus production but nine states cover more than 70% of area and 89% of total production. India is the fourth largest citrus producing country in the world contributing 6.5 percent of production. In India, citrus ranks 3rd in area and production, area of citrus fruit was about 0.98 million hectares with a production of 11.06 million tons and average productivity of 9.69 tons/ha[2] (Anon, 2016). Total mandarin production in India is 3.86 million tons with 0.35 million ha area and 9.3 tons/ha as productivity. Citrus requires 17 essential elements for the normal growth and production. Deficiency of' micronutrients occur at various stages of growth and developments of citrus plants. Micronutrients are required in very small quantities, yet they are very effective in regulating plant growth. Application of these mineral nutrients in deficiency condition improves the growth and development of citrus tree and also physico-chemical composition of fruits.

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A number of studies on macro nutrient deficiencies in citrus have been reported and detailed investigations were done on the effect of application of micronutrients especially zinc, iron, boron, manganese and copper on growth and development of citrus trees. Application of these nutrients through foliar spray have resulted perceptible changes in several aspects of growth, flowering, fruit set, yield and quality of citrus species[3]. Foliar application of nutrients often gives a quicker response than application to soil[1,9], since plant nutrients are readily absorbed through the leaf surface.

MATERIAL AND METHODS

The field experiment was conducted in farmer field under lower Pulney hills of Kaanalkadu (Thadiyankudisai), Tamilnadu during the year 2014-16. For conducting this study six-year-old uniform trees of mandarin orange were selected. Soils of pulney hill region are red laterite having brown to dark brown colour. They are deep well drained and possess sandy clay loam structure which is appropriate for citrus cultivation. An altitude of 1098 m above MSL and the annual rainfall is around 1400 mm. The mean maximum and minimum temperature were 32.6 ºC and 17.7 ºC respectively with mean relative humidity of 66.5 %.

There were 15 treatment replicated thrice tested in randomized block design. The effects of ZnSO4 (0.2%), $FeSO_4$ (0.2%), H_3BO_4 (0.2%), $MnSO_4$ (0.3%) and $CuSO_4$ (0.4%) alone or in combination was studied. The micronutrient was applied as a foliar sprays thrice at monthly interval from July to October 2015 and spray was given in the evening hours between 3.00-5.00 pm by using a hand sprayer**.** The required quantities of micronutrients were dissolved in water separately and then pH of these nutrient solutions was adjusted by lime and sprayed in vegetative, flowering and fruitset stages. The simple water spray was done on the tree under control treatment. In each spray treatment Teepol was added as sticking agent in prepared solution. The four to five months old 30-50 leaf sample were collected for analysis. The leaf samples were analyzed for N, P and K by the following standard procedure laid out by Jackson[6] and Humphries[5].

Observation of growth and estimation of leaf nutrient content were recorded and data were subjected to statistical analysis.

Treatment details:

$T_{1:}$ Control (Water spray), $T_{2:}$ $ZnSO_4$ (0.2%), T_3: $FeSO_4$ (0.2%), T_4: H_3BO_4 (0.2%), T_5: $MnSO_4$ (0.3%), T_6: $CuSO_4$ (0.4%), T_7: $ZnSO_4$ (0.2%) + $FeSO_4$ (0.2%),T_8: $ZnSO_4$ (0.2%) + H_3BO_4 (0.2%), T_9: $ZnSO_4$ (0.2%) + $MnSO_4$ (0.3%), T_{10}: $ZnSO_4$ (0.2%) + $CuSO_4$ (0.4%), T_{11}: $ZnSO_4$ (0.2%) + $FeSO_4$ (0.2%) + H_3BO_4 (0.2%), $T_{12:}$ $FeSO_4$ (0.2%) + H_3BO_4 (0.2%) + $CuSO_4$ (0.4%), T_{13}: $ZnSO_4$ (0.2%) + $MnSO_4$ (0.3%) + $CuSO_4$ (0.4%), T_{14}: $FeSO_4$ (0.2%) + H_3BO_4 (0.2%) + $MnSO_4$ (0.3%) and T_{15}: $ZnSO_4$ (0.2%) + $FeSO_4$ (0.2%) + H_3BO_4 (0.2%) + $MnSO_4$ (0.3%) + $CuSO_4$ (0.4%).

RESULT AND DISCUSSION

The foliar application of micronutrients Zn, Fe, B, Mn and Cu applied alone and in combination, increased leaf nitrogen, potassium and decreased phosphorous was observed. The data on leaf nitrogen varied significantly among the treatments at different stages (Table 1). At vegetative, flowering and fruit set stage, the highest leaf nitrogen content (2.87, 2.79 and 2.65 per cent) was registered in T_{15} and the lowest leaf N content (1.90, 1.78 and 1.69 per cent) was recorded in the treatment T_1 respectively. In case of leaf phosphorous content (Table 2), maximum value (0.179, 0.175 and 0.169 per cent) was noticed in T_1 whereas minimum value (0.118, 0.110 and 0.101 per cent) was recorded in T_2 respectively. The perusal of data related to highest leaf potassium content (2.31, 2.20 and 1.89 per cent) was observed in T_{15} and lowest content (1.40, 1.33 and 1.11 per cent) was observed in T_1 (Table 3). The increased level of macronutrient N and K by foliar application of zinc may be due to synergetic relationship with Zn, Fe and Cu and decrease in phosphorous may be due to antagonistic effect by application of Zn. Similar results were

obtained for foliar spraying of zinc on leaf mineral content in Blady mandarin, Valencia orange and Kinnow mandarin[11,12,]. According to Labanwskas[7] in valance orange and Hasani *et al*[4]., in pomegranate, foliar applied zinc and copper decreased the phosphorous content due to antagonistic effect.

Meena *et al*[8].,in kinnow mandarin reported that foliar application of Fe, Zn and Cu increased the leaf nitrogen content due to foliar application of micronutrients particularly iron, copper and zinc corrected iron, copper and zinc deficiency in leave and thus chlorotic leaves become normal, resulting in better assimilation of nitrogen in the leaves. According to Rasouli- Sadeghiani *et al*[10]., foliar application of Zinc reduces the leaf p in apple leaves.

Table 1: Effect of foliar application of micronutrients on leaf nitrogen content (%)

Treatments	Vegetative stage	Flowering stage	Fruit set stage
T_1	1.90	1.78	1.69
T_2	2.15	2.08	1.96
T_3	2.08	2.03	1.92
T_4	2.06	1.99	1.89
T_5	1.99	1.89	1.80
T_6	2.03	1.95	1.86
T_7	2.44	2.35	2.24
T_8	2.35	2.28	2.18
T_9	2.23	2.14	2.03
T_{10}	2.29	2.21	2.11
T_{11}	2.76	2.66	2.57
T_{12}	2.68	2.56	2.47
T_{13}	2.60	2.48	2.39
T_{14}	2.53	2.43	2.32
T_{15}	2.87	2.79	2.65
SEd	0.021	0.020	0.020
CD (0.05)	0.042	0.042	0.041

Note: NS- Not significant

Table 2: Effect of foliar application of micronutrients on leaf phosphorous content (%)

Treatments	Vegetative stage	Flowering stage	Fruit set stage
T_1	0.179	0.175	0.169
T_2	0.118	0.110	0.101
T_3	0.164	0.158	0.151
T_4	0.164	0.168	0.155
T_5	0.172	0.171	0.164
T_6	0.166	0.165	0.157
T_7	0.151	0.145	0.127
T_8	0.153	0.148	0.133
T_9	0.158	0.153	0.145
T_{10}	0.155	0.153	0.143
T_{11}	0.136	0.134	0.108
T_{12}	0.138	0.135	0.112
T_{13}	0.147	0.139	0.117
T_{14}	0.159	0.154	0.148
T_{15}	0.131	0.127	0.104
SEd	0.001	0.001	0.002
CD (0.05)	0.002	0.003	0.003

Note: NS- Not significant

Table 3: Effect of foliar application of micronutrients on leaf potassium content (%)

Treatments	Vegetative stage	Flowering stage	Fruit set stage
T_1	1.40	1.33	1.11
T_2	1.84	1.67	1.25
T_3	1.83	1.61	1.24
T_4	1.80	1.55	1.19
T_5	1.61	1.53	1.17
T_6	1.52	1.48	1.14
T_7	1.95	1.84	1.57
T_8	1.92	1.82	1.49
T_9	1.91	1.78	1.31
T_{10}	1.88	1.73	1.29
T_{11}	2.22	2.12	1.83
T_{12}	2.14	2.04	1.77
T_{13}	2.06	1.97	1.73
T_{14}	2.00	1.90	1.67
T_{15}	2.31	2.20	1.89
SEd	0.017	0.017	0.019
CD (0.05)	0.035	0.035	0.039

Note: NS- Not significant

CONCLUSION

The results revealed that foliar application of micronutrient in combination enhanced the major nutrient status of mandarin orange leaves. Therefore, judicious foliar application of micronutrients as spray enhances the growth and yield attributes.

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