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Effect of Macro and Micronutrients on Establishment of Sweet Orange (*Citrus sinensis*) c.v. Mosambi

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ABSTRACT: The present investigation was carried out during the year 2020-2021 was undertaken at the Central Research Field, SHUATS, Prayagraj. The experiment was laid out in Randomized Block Design (RBD) with 10 treatments and 3 replications they are as follows : T_0 : RDF (Control), T_1 : $ZnSO_4$ 2% + RDF (50%), T_2 : $FeSO_4$ 2% + RDF (50%), T_3 : $CuSO_4$ 2% + RDF (50%), T_4 : $ZnSO_4$ 1% + $FeSO_4$ 1% + RDF (50%), T_5 : $ZnSO_4$ 1% + $CuSO_4$ 1% + RDF (75%), T_6 : $ZnSO_4$ 2% + $FeSO_4$ 2% + RDF (50%), T_7 : $ZnSO_4$ 2% + $CuSO_4$ 2% + RDF (75%), T_8 : $ZnSO_4$ 1% + $FeSO_4$ 1% + $CuSO_4$ 1% + RDF (75%) and T_9 : $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%). The main objective is to find out the most suitable treatment combination on plant growth and establishment of Sweet Orange (*Citrus sinensis*) c.v. Mosambi and to assess the effective treatment combination on survival percentage of Sweet Orange (*Citrus sinensis*) c.v. Mosambi. From the present investigation it is found that the treatment T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) was superior in respect of the parameters, survival percentage (100%), Plant height (81.45), Number of leaves (143.58), number of branches per plant (14.80), leaf area (17.59 cm^2), plant spread (84.22), Chlorophyll Content in leaves (85.15) and Stem Girth (2.47). Hence T_9 was found superior based on the above parameters.

Keywords: Sweet orange, Mosambi, Macro and Micronutrients, Establishment.

INTRODUCTION

Sweet Orange is considered the most important fruit crop of a citrus group with its wholesome nature multifold nutrition and medicinal value have made them so important. Sweet Orange (*Citrus sinensis* L.) belongs to the family Rutaceae. Sweet Orange is native to Southern China. It is now widely distributed and naturalized in the subtropical zone of India. It is cultivated particularly in Brazil, China, Japan, Turkey and India. Andhra Pradesh, Karnataka, Maharashtra, Punjab, Rajasthan and Haryana are the main Sweet Orange growing states. Sweet Orange needsa dry climate and arid weather with distinct summer and winter seasons with low rainfall. It is grown on a wide range of soil ranging from clay to light sandy and sensitive to salt. Sweet Orange is well grown on medium black, red, alluvial riverbank loamy soil of Maharashtra state and Goradu soil of Gujarat.

In Sweet Orange 100 g fruit contains 60-80 % fruit juice, protein 0.8-1.4 g, fat 0.2-0.4 g, fiber 0.8 g, vitamin-A 198 I.U, 0.113 mg vitamin B1, 0.046 mg riboflavin, 65.69 mg vitamin C, 0.2-0.8 mg iron, 0.16 mg calcium, potassium 192-201 mg Khan *et al*., (2016). Sweet Orange tree is medium to large with dense foliage, generally with slender somewhat flexible rather blunt spines in the axils of leaves, leaves oval or ovate-oblong, smooth, shiny, lighter below, margin entire, petioles smaller than those of Citrus aurantium, calyx cupped, sepals four or five thick greenish, persistent, petals usually five thick, fleshy recurved, stamens 20-25 hypogynous, filaments flattened, inverted in group shorter than petals distinctly divide into stigma, style and ovary, stigma knob-like, style long and slender, ovary rounded. 10-14 loculed fruit globose or oblate, light orange to reddish, rind smooth, pulp juicy, sub-acid. Yellow to orange or reddish, core solid. Peel tight juice sacs spindle-shaped, seeds few or many, white inside highly polyembryonic.

The application of macro-nutrients particularly nitrogen, phosphorus and potassium playan important role in yield Liu *et al.*, (2010). However, nitrogen is the key component forcitrus growers, as it has more influence on tree growth and fruit yield than any other element Zewdie and Reta (2021); Miller *et al.*, (1988). A significant increase in shoot growth of different citrusspecies by urea sprays was also reported by Dubey *et al.*, (2003). Inadequacy of potassiumis one of the most striking factors that regulate fruit size. Foliar spray of potassium two months after flowering increases the fruit size of Valencia oranges Liu *et al.*, (2010). Potassium is also important for fruit formation and enhancing fruit size Abbas and Fares (2008). Its deficiency leads to the production of small fruits with thin skin, while its excess results in the production of large fruits with thicksk in an dacoarse texture.

Micronutrients are required in very small quantities,yet they are very effective in regulating plant growth. Application of these mineral nutrients in deficiency conditions improves the growth and development of citrus trees and also the physicochemical composition of fruits. Several studies on micronutrient deficiencies in citrus have been reported and detailed investigations were done on the effect of the application of micronutrients especially zinc, iron, boron, manganese and copper on the growth and development of citrustrees Anees *et al.*, (2011); Kumar *et al.*, (2017). Application of these nutrients through foliar spray has resulted in perceptible changes in several aspects of growth, flowering, fruit set, yield andquality of citrus species. Foliar application of nutrients often gives a quicker response than application to soil (Obreza *et al.*, 2001; Anees *et al.*, 2011). since plant nutrients are readily absorbed through the leaf surface. The mineral nutrients enter into leaf in three steps: (1) penetration through thecuticle and epidermal walls; (2) adsorption on the surface of the plasma lemma and (3) pass a gethrough the plasmalem main to the cytoplasm. The growth of citrusisalsoinfluenced by micronutrients such as Zinc (Zn), Iron (Fe), Boron (B), Manganese (Mn)and Copper (Cu) application. These elements affect metabolic functions in the plantsystem. Zinc(Zn) is an important micro element essential for plants due to its involvement in the synthesis of tryptophan which is a precursor of indole acetic acidsynthesis (Ahmad *et al.*, 2012; Kaur *et al.*, 2015).

MATERIALS AND METHODS

Experimental Site: The experiment was carried out at the Central Research Field, NAI, Sam Higginbottom University of Agriculture, Science and Technology, Prayagraj during the rabi season (2020-2021). The region is located on the right bank of the Yamuna, 6 kilometers south of Prayagraj city, on the Rewa road. It is located at 25°57' North latitude, 81°51' East longitude, and is 98 meters above sea level (MSL). Prayagraj district is located in Uttar Pradesh's subtropical region, which has very hot summers and relatively mild winters. The location's highest temperature ranges from 46°C to 48°C, with temperatures seldom falling below 4°C or 5°C. The relative humidity levels range from 20% to 94%. The average yearly rainfall in this area is about 1013.4 mm.The experiment was laid out in Randomized Block Design (RBD), with 10 treatments replicated thrice. Statistical analysis of variance was performed on the data collected throughout the experiment. The significance of the treatments was determined using the 'F' test at a level of significance of 5%. Treatments are shown in Table 1.

Table 1: Details of treatments combination.

Treatment notation	Treatment combinations
T0	RDF (Control)
T1	$ZnSO_4$2% + RDF (50%)
T2	$FeSO_4$2% + RDF (50%)
T3	$CuSO_4$2% + RDF (50%)
T4	$ZnSO_4$1% + $FeSO_4$1% + RDF (50%)
T5	$ZnSO_4$1% + $CuSO_4$1% + RDF (75%)
T6	$ZnSO_4$2% + $FeSO_4$2% + RDF (50%)
T7	$ZnSO_4$2% + $CuSO_4$2% + RDF(75%)
T8	$ZnSO_4$1% + $FeSO_4$1% + $CuSO_4$1% + RDF(75%)
T9	$ZnSO_4$2% + $FeSO_4$2% + $CuSO_4$2% + RDF(100%)

(RDF) N:P: K=200:100:100 g/plants

RESULT AND DISCUSSION

According to the data in Table 2 and Fig. 3.

Survival Percentage: The maximum survival percentage (100%) were recorded under application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%), and the minimum survival percentage (66.67) were recorded under T_0 RDF (Control).

Plant Height: The maximum Plant height (81.45 cm) were recorded under application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) whereas the minimum Plant height (60.18 cm) were recorded under T_0 RDF (Control). These findings are similar to those of Arshad and Ali (2016); Kumar *et al*., (2020)

Number of Leaves: The maximum number of leaves per plant (143.58) were recorded under the application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) and whereas the minimum number of leaves per plant (80.22) were recorded under T_0 RDF (Control).

Number of Branches Per Plant: The maximum number of branches per plant (14.80) was recorded under the application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) and whereas the minimum number of branches per plant (9.45) were recorded under T_0 RDF (Control). These findings are similar to Haleema *et al*., (2018).

Leaf Area: The maximum leaf area (17.59cm^2) were recorded under the application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) whereas the minimum leaf area (8.74 cm^2) were recorded under T_0 RDF (Control), These findings are similar to Sikarwar and Tomar (2018); Kumari *et al.*, (2020) in sweet orange respectively.

Plant Spread: The maximum plant spread (84.22 cm^2) were recorded under application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) and whereas the minimum plant spread (61.44 cm^2) were recorded under T_0 RDF (Control). These findings are similar to Bhanukar *et al*., (2018) in sweet orange.

Chlorophyll content: The maximum Chlorophyll content (85.15) were recorded under the application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) and whereas the minimum Chlorophyll content (43.63) were recorded under T_0 RDF (Control). These findings are similar to Baviskar *et al.*, (2018) in Guava.

Stem Girth: The maximum Stem Girth (2.30 cm) were recorded under the application of T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) and whereas the minimum Stem Girth (2.30 cm) were recorded under T_0 RDF (Control). These findings are similar to Kumar *et al.*, (2013) in Citrus.

Fig. 2. Recording chlorophyll content in leaves (left) and measuring plant height (right) respectively.

Table 2: Effect of Macro and Micronutrients on Establishment of Sweet Orange (*Citrus sinensis*) c.v. Mosambi.

Treatment notation	Survival percentage	Plant height (cm)	Number of leaves	Number of branches	Leaf Area (cm^2)	Plant Spread (cm^2)	Chlorophyll SPAD	Stem Girth (cm)
T_0	66.67	60.18	80.22	9.45	8.74	61.44	43.63	1.96
T_1	100.00	67.14	106.29	11.45	11.16	64.45	65.40	2.09
T_2	100.00	66.70	109.14	13.21	10.34	66.96	67.81	2.08
T_3	100.00	67.92	103.66	12.65	10.47	72.96	71.74	2.13
T_4	100.00	74.59	111.83	12.77	10.68	73.22	56.14	2.22
T_5	88.89	66.14	122.21	13.99	10.56	76.07	59.18	2.11
T_6	88.89	69.24	124.70	13.83	10.56	76.55	57.48	2.17
T_7	88.89	74.13	132.50	14.21	15.09	77.89	75.06	2.30
T_8	100.00	75.92	138.18	14.78	16.43	82.48	80.04	2.38
T_9	100.00	81.45	143.58	14.80	17.59	84.22	85.15	2.47

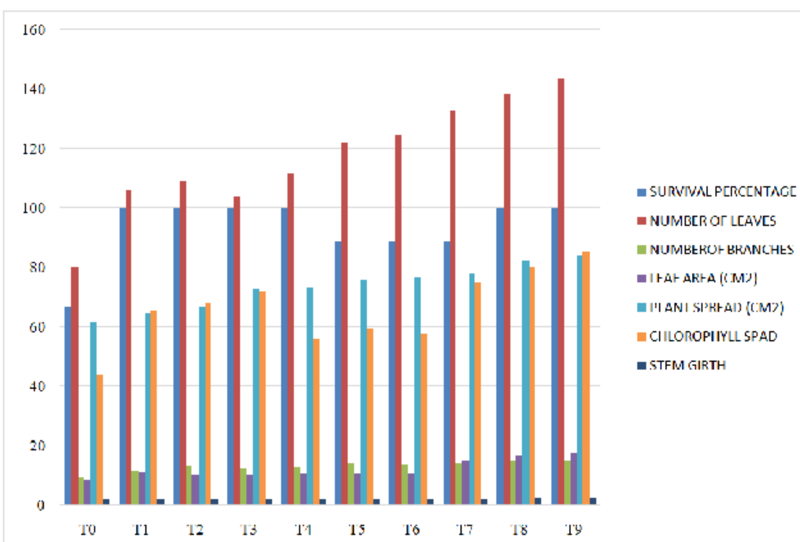

Fig. 3. Effect of Macro and Micronutrients on Establishment of Sweet Orange (*Citrus sinensis*) c.v. Mosambi.

CONCLUSION

From the present investigation, it is concluded that T_9 $ZnSO_4$ 2% + $FeSO_4$ 2% + $CuSO_4$ 2% + RDF (100%) resulted in the highest vegetative growth parameters like survival percentage, plant height, number of leaves per plant, number of branches per plant, leaf area, plant spread, chlorophyll content in leaves and stem girth.

FUTURE SCOPE

Based on the present investigations it is concluded that there is a good interactive effect of different combinations of macro and micronutrients on growth attributes like survival percentage, plant height, number of leaves per plant, number of branches per plant, leaf area, plant spread, chlorophyll content and stem girth taken to the emergence of 1st new leaf after treatment establishment of Mosambi. These technologies would help in improving the establishment percentage and vegetative parameters of mosambigraftings. It also helps in early growth and helps to meet the increasing demand of growers as of custard apple plants.

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Conflict of Interest. As a Corresponding Author, I Shivam Chaurasia, confirm that none of the others have any conflicts of interest associated with this publication.

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