



STUDY THE EFFECTS OF ZINC SULPHATE, BORAX, COPPER SULPHATE AND FERROUS SULPHATE ON GROWTH AND DEVELOPMENT OF PLANTS OF KAGZI LIME (*CITRUS AURANTIFOLIA* SWINGLE.)

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Abstract

An experiment entitled Study the effects of Zinc sulphate, Borax, Copper sulphate and Ferrous sulphate on growth and development of plants of kagzi lime (*Citrus aurantifolia* Swingle.) was conducted in the Garden Department of Horticulture Chandra Shekhar Azad University of agriculture & technology kanpur during the year 2015-16. Sour lime is a highly polyembryonic distinctive species of great commercial importance. Tree is small bushy with small but sharp spines, leaves small arth normally winged petioles, flowers and fruits small fruits round to oval maturing irregularly throughout the year, greenish .length of shoots recorded during investigation and observed that the longer shoot 17.33cm was found under the treatment T_2 when foliar application of $FeSO_4$ at 0.50 percent applied ,the next longer shoot length 17.00cm were recorded under the treatment T_8 when Borax 0.50 percent was sprayed all other treatments increased length of shoots more or less when compared with control. Diameter of shoot 0.43cm was also recorded under the treatment T_2 when foliar application of $FeSO_4$ 0.50 percent was sprayed followed by T_5 and T_8 using $ZnSO_4$ 0.25 percent and Borax 0.50 percent as spray form. All other treatments improved diameter of shoot significantly over control 0.30cm.

Keywords - Borax, Copper sulphate ,effects , Ferrous sulphate, Zinc sulphate

I. INTRODUCTION

Acid lime (*Citrus aurantifolia* Swingle.) is also known as kagzi lime in India and belong to family **Rutaceae** with chromosome no (2n)= 18 is native to India and it is one of the important fruit crop of citrus industry. Fruits of acid lime possess great medicinal and nutritional value. Among the citrus group, Kagzi lime is one of the most important horticultural crops in India. Kagzi lime (Pati lime, Spur lime, Acid lime, Mexican lime) in Hindi is known as 'Neebu or Nimbu', whereas in Gujarati, it is known as 'limbu', Lime (*Citrus aurantifolia*) is the most important fruit crop in India as the demand for its consumption is very high due to the nutritional value and its availability at cheap prices. Lime is popular for its beautiful appearance and pleasing flavour and for its excellent food qualities. Lime does not edible in same manner as the other Citrus species .

II. MATERIALS AND METHODS

The present research work was carried out to study “Effect of foliar application of micro-nutrients on growth, flowering fruit set, yield and quality parameters of kagzi lime (*Citrus aurantifolia* Swingle.)” The techniques adopted following sub heads.

1. Site and location of experiment:

The experiment was conducted in the Horticulture Garden of Chandra Shekhar Azad University of Agriculture and technology, Kanpur (U.P) during the year 2015 -2016.

Kanpur is geographically situated in the Gangetic plains of central Uttar Pradesh between 25.26° to 26.38° North latitude and 79.31° to 80.34 ° East longitude at an elevation of 125.90m above mean sea level.

2.1 Weather conditions:

In Uttar Pradesh Kanpur is characterized by subtropical climate with hot dry summer and cold winters. The annual rainfall is about 752.70mm, most of which is received from July to September 2015, with scattered showers in winter through north-east monsoon. The maximum temperature ranges from 20° C to 46° C and minimum temperature varies from 3.8° C to 26° C with relative humidity from 35-85% in different months of the year.

Table1: Meteorological data during the experiment period (June-2015 to January-2016)

Months	Temperature (°C)		Rainfall (mm)	Relative humidity (%)	
	Max.	Min.		Max	Min
June - 2015	43.0	23.4	7.5	83.3	29.4
July -2015	36.3	23.1	10.7	88.0	55.0
Aug.-2015	34.3	22.9	17.7	88.6	61.7
Sept. -2015	37.0	19.5	14.1	87.9	44.0
Oct. -2015	35.8	14.5	2.7	87.9	50.0
Nov. -2015	30.5	8.8	3.7	93.9	46.4
Dec. -2015	28.2	1.8	0.0	94.0	36.7
Jan. -2016	24.9	6.2	1.6	96.3	43.6

Source: Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur.

2.2 Soil analysis:

The composite soil sample drawn from experimental field 10-20 cm depth prior to experimentation was subjected to mechanical, physical and chemical analysis of the soil in soil testing laboratory of Chandra Shekhar Azad University of Agriculture and Technology Kanpur (U.P.) during the year 2015. The results obtained are given below.

Table 2.1: Mechanical analysis of soil components

Components	Percentage	Method used
Sand	54.86%	International Pipette method (Wright, 1934)
Silt	17.90%	International Pipette method (Wright, 1934)

Clay	23.65%	International Pipette method (Wright,1934)
Texture	-----	Sandy loam

Table 2.2: Physical analysis of soil components

Components	Value
Field capacity (%)	20.59
Water holding capacity (%)	42.31
Permatent wilting point (%)	5.38
Bulk density(gm/cm ²)	1.58
Partical dencity (gm/cm ²)	2.62

Table 2.3: Chemical analysis of soil sample

Characters	Value	Categories	Method used
p ^H	7.20	Neutral	1:2 soil water suspension (Jackson1967)
Organic carbon %	0.47	Low	Walkely&Black (1967)
EC (mmhos/cm)	0.35 dsm ⁻¹	Low	EC meter, conductivity meter Jackson(1967)
Available N (kg/ha)	206	Low	Kjeldahl'smethod (Jackson 1967)
Available P (kg/ha)	27.63	Medium	Oleson method (oleson,1954)
Avalable K(kg/ha)	305	Medium	Jackson(1967)

III. EXPERIMENTAL MATERIALS

Twenty years old uniform Citrus plants planted at 6×6 m apart were taken for investigation. Nutrients application and other orchard management practices were followed as per recommended package and practices for Citrus.

Recommended dose of FYM and NPK which is applied in each treatment.

FYM	=	30kg/plant
N	=	500g/plant (In two split doses)
P	=	350g/plant
K	=	250g/plant (In two split doses)

Source of irrigation:

The source of irrigation Tube well through plastic pipe line.

Cultural practices:

All the experimental bushes received identical manurial, irrigation, desuckering and other cultural practices carrird out during the whole period of experimentation.

Weeding:

Mechanically weeding and hoeing operations were carried out periodically for removing weeds and conserving soil moisture.

3.3.1: Experimental details :

The experiment was laid out in Randomized Block Design with three replication in the month of June 2015. One plant was taken as one unit per plot. The details of experimental plan employed in the present investigation are as follows:

Treatment	-	9
T ₁	-	Ferrous sulphate (0.25%)
T ₂	-	Ferrous sulphate (0.50%)
T ₃	-	Copper sulphate (0.25%)
T ₄	-	Copper sulphate (0.50%)
T ₅	-	Zinc sulphate (0.25%)
T ₆	-	Zinc sulsulphate(0.50%)
T ₇	-	Borax (0.25%)
T ₈	-	Borax (0.50%)
T ₉	-	Water spray
II- Design	-	Randomized Block Design.
III. Replications	-	3
IV. Plant unit	-	1
V. Total no. of plants	-	27
VI. Time of spraying	-	First spraying was done on 20 June. 2015 (15 days before flowering) and Second the 20 August, 2015 (after fruit set).

3.3.2: Mineral Nutrients Used

For the supply of Boron, Copper, Zinc and Iron the following sources were employed.

- Ferrous Sulphate
- Copper sulphate
- Zinc Sulphate
- Borax

Treatments and their concentration

Two concentrations of each mineral nutrient were used as given below:

- Ferrous sulphate - 0.25%&0.50%
- Copper sulphate - 0.25%&0.50%
- Zinc sulphate - 0.25%&0.50%
- Borax - 0.25%&0.50%
- Control - Water Spray

Statistical analysis

The statistical analysis of the data obtained in different set of experiment were calculated as Analysis of variance

Source of variance	d.f.	S.S.	M.S.S.	F. cal	F.tab
Replication	(r-1)=2				
Treatment	(t-1)=8				
Error	(r-1)(t-1)=16				
Total	(rt-1)=26				

The standard error (SEm±) for the difference of treatment means were computed as follows:

$$SEm\pm = \frac{MS_E}{r}$$

Where, r = Mean sum of square due to error
 r = number of replication

The calculation of C.D. at 0.5% at table values will be carried out with the help of following formula:

$$CD = \frac{SEm\pm \times \sqrt{2}}{t \text{ error d.f.}}$$

Where, CD = Critical difference
 $SEm\pm$ = standard error of mean.

IV. EXPERIMENTAL FINDING

Table No. 4.1:

Treatments	Length of shoot (cm)	Diameter of Shoots(cm)	No.of flowers Per shoot
T ₀ Water	15.33	0.30	4.67
T ₁ FeSO ₄ (0.25%)	16.00	0.33	5.67
T ₂ FeSO ₄ (0.50%)	17.33	0.43	7.67
T ₃ CuSO ₄ (0.25%)	15.67	0.33	5.00
T ₄ CuSO ₄ (0.50%)	16.00	0.37	6.00
T ₅ ZnSO ₄ (0.25%)	16.67	0.40	7.67
T ₆ ZnSO ₄ (0.50%)	15.67	0.36	8.67
T ₇ Borax (0.25%)	16.33	0.35	6.67
T ₈ Borax (0.50%)	17.00	0.40	7.00
S.E.(d)	0.35	0.02	0.95
C.D at 5%	0.76	0.05	2.01

Fruit set percent:

The data recorded on fruit set were analysed statistically (**Appendix-4**) and mean values are presented in **Table-2** indicates clearly that the fruit set was significantly maximum in treatment T₅ (62.67%) when ZnSO₄ (0.25%) was sprayed closely followed by T₈(61.33%) and T₄ (60.00%) respectively, when Borax (0.50%) and CuSO₄ (0.50%) were sprayed. It is evident from the table that treatment T₆ (56.67%) and T₇(58.00%) were at par when compared between them. The fruit set under control (45.00%) was significantly minimum when compared with all other treatments

Table 4.2 :

Treatments	Fruit set (%)	Fruit drop (%)	Fruit retention (%)
T ₀ Water	45.00	35.16	64.83
T ₁ FeSO ₄ (0.25%)	54.00	32.00	68.00
T ₂ FeSO ₄ (0.50%)	53.00	30.00	70.00
T ₃ CuSO ₄ (0.25%)	46.67	31.16	68.83
T ₄ CuSO ₄ (0.50%)	60.00	31.20	68.80
T ₅ ZnSO ₄ (0.25%)	62.67	32.30	67.70
T ₆ ZnSO ₄ (0.50%)	56.67	29.00	71.00
T ₇ Borax (0.25%)	58.00	31.00	69.00

T ₈ Borax (0.50%)	61.33	28.00	72.00
S.E.(d)	1.23	1.04	1.43
C.D at 5%	2.61	2.22	3.04

Size of fruit:

Horizontal size:

The horizontal length of fruit was recorded after harvesting of 10 sampled fruits in each treatment and each replication with the help of Vernier callipers is obvious from the data summarised in table-3 that length of fruit was significantly increase by foliar applictioin of ZnSO₄ (0.50%) T₆(4.62cm) followed by ZnSO₄(0.25%) T₅(4.50cm), CuSO₄ (0.50%) T₄ (4.45cm) and CuSO₄(0.25%)T₃(4.40cm) the trees under control showed minimum horizontal length of fruit (3.65cm).

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