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## Effect of different micro nutrients on growth, yield and quality of acid lime (*Citrus aurantifolia* Swingle) cv. Petlur Pulusu Nimma

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### Abstract

Acid lime (*Citrus aurantifolia* Swingle), belongs to the family Rutaceae. Citrus is the third largest fruit crop grown in India, next to mango and banana. It is generally grown under both tropical and subtropical climatic conditions. The present investigation was carried out during 2019 at Citrus research station, Petluru, Dr. YSRHU, A.P. The present experiment consists eight treatments with three replications which was laid out in a Randomized Block Design. Among all the treatments with regard to growth, yield and quality parameters T<sub>4</sub> i.e ZnSO<sub>4</sub> foliar spray + Fe filings mixed in FYM + MgSO<sub>4</sub> foliar spray recorded maximum tree girth (42.70 cm), tree volume (32.10m<sup>3</sup>), fruit weight (58.26 gm), maximum number of fruits (2251.7/plant) and yield (118.49 kg/plant). The treatment T<sub>7</sub> i.e ZnSO<sub>4</sub> foliar spray + FeSO<sub>4</sub> foliar spray + MgSO<sub>4</sub> foliar spray recorded highest juice percentage (45.65%) and vitamin C (33.96 mg/100ml<sup>-1</sup>) as compared to other treatments. While among all the treatments T<sub>1</sub> ZnSO<sub>4</sub> soil application + Fe EDTA soil application + MgSO<sub>4</sub> soil application recorded highest TSS (7.8%) and acidity (7.15%) compared to other treatments. However the lowest growth and yield recorded in T<sub>8</sub> Control (Without any micronutrients) foliar spray.

**Keywords:** Acid lime, micro nutrients, foliar spray and soil application

### Introduction

Citrus is one of the largest and most important groups of fruit crops in tropical and subtropical regions. In India, among the fruit crops citrus species covers an area of major fruit crops is 11.3% with an area of 1098.40 thousand ha, with production of 1,60,69,000 MT, giving rise to Productivity of 14.7 MT per ha estimated data NHB 2021. As per the data available (AP Horticulture online 2021-22), in Andhra Pradesh oranges and Batavia are being cultivated in 1,41,716 hectares with the production of 1,80,78,216 MT. Acid lime (*Citrus aurantifolia* Swingle) is considered as most important fruit crop (Ghosh *et al.*, 1999) [6]. It is considered to be native of Malayan peninsula. It belongs to the family Rutaceae, with chromosome number (2n=18). It is mainly cultivated for its multi - fold nutritional and medicinal values. Which made acid lime more important among the fruits. Its attractive appearance, penetrating aroma of peel and excellent taste gives a remarkable position to acid lime which is grown widely throughout the world (Babu, 2001) [3]. Acid lime fruits have great medicinal value. Being acidic in nature, acid lime fruits have great medicinal value. Acid lime is good appetizer, anti helmentic and it checks biliousness and stomach ache. Lime is used in making candy, chocolate, ice cream, pastries and 100 grams of fruit juice contains 80 percent of water, carotene, 26 IU, Vitamin A, Vitamin B1 20 mg, Riboflavin 0.1 mg, Vitamin C 63 mg, Iron (Fe) 1.83 mg, Copper (Cu) 0.16 mg, Oxalo-acetic acid 0.30%, Malic acid and alkaline salt 8.2% therefore it is very essential for human health (Rangel, 2010) [11]. It is the third most important commercial citrus crops in India next to mandarins (*Citrus reticulata* Blanco) and sweet oranges. In India, acid lime is grown in a variety of agro-climates comprising the northern plains and central highlands having hot semiarid eco-region with black and red soils. Acid limes are grown commercially in Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Bihar and West Bengal. In Andhra Pradesh, the largest area is in semi-arid regions of Nellore, YSR district, West Godavari, East Godavari, Guntur, Prakasam, Ananthapur districts. In Telangana prominent regions are Nalgonda, Mahaboobnagar, Khammam districts. The major constraints faced by the growers of acid lime are the soil of this area is calcareous in nature, the deficiency of iron is very common.

Deficiencies of important elements like zinc, copper, boron, iron, manganese, magnesium are known to occur under field conditions and leads to nutrient disorders in citrus. *In view of the need, the present study was under taken to assess the effect of different micro nutrients on growth, yield and quality of acid lime (Citrus aurantifolia Swingle) cv. Petlur pulusu nimma.*

### Materials and Methods

The present investigation were executed at on Citrus, Citrus Research Station, Petlur, Andhra Pradesh during the year 2015 under Dr. YSR Horticultural University with eight treatments viz, T1: ZnSO<sub>4</sub> Soil application + Fe EDTA Soil application + Mg SO<sub>4</sub> Soil application, T2: ZnSO<sub>4</sub> foliar spray + Fe EDTA foliar spray + Mg SO<sub>4</sub> foliar spray, T3: ZnSO<sub>4</sub>

Soil application + Fe filings mixed in FYM + Mg SO<sub>4</sub> Soil application, T4: ZnSO<sub>4</sub> foliar spray + Fe filings mixed in FYM + Mg SO<sub>4</sub> foliar spray. T5: ZnSO<sub>4</sub> Soil application + FeSO<sub>4</sub> enriched in FYM (Slurry) + Mg SO<sub>4</sub> Soil Application, T6: ZnSO<sub>4</sub> foliar spray + FeSO<sub>4</sub> enriched in FYM (Slurry) + Mg SO<sub>4</sub>, T7: ZnSO<sub>4</sub> foliar spray + FeSO<sub>4</sub> foliar spray + MgSO<sub>4</sub> foliar spray and T8: Control (Without any micronutrients) foliar spray. The experiment was laid out in a randomized block design with three replications. The effect of different treatments was studied on yield parameters (no. of fruits per tree and fruit yield per tree) and quality parameters (Juice percentage, TSS, Acidity % and Ascorbic acid content) on six randomly selected trees. The mean data were subjected to statistical analysis following analysis of variance technique (Panse and Sukhathme 1985)<sup>[9]</sup>.

**Table 1:** Different quantities of micronutrients applied

S. No	Micronutrient	Quantity for soil application	Concentration in %
1	Fe-EDTA	75 kg/ha(270g/plant)	0.25% to 0.5%
2	ZnSO <sub>4</sub>	25kg/ha (90g/plant)	0.25%
3	FeSO <sub>4</sub>	50kg/ha(180g/plant)	0.5% to 1%
4	MnSO <sub>4</sub>	25kg/ha(90g/plant)	0.2%
5	1kg Fe filings mixed in 200 kg FYM for 1 week and applied 20kg/plant		
6	150g FeSO <sub>4</sub> enriched in 25 kg FYM/plant		

**Table 2:** Initial soil analysis of experimental site

S. No	Particulars Depth (cm)	pH	EC (dSm <sup>-1</sup> )	OC %	CaCo <sub>3</sub>	AVAIL N kg/ha	AVAIL P <sub>2</sub> O <sub>5</sub> kg/ha	AVAIL K <sub>2</sub> O kg/ha	Cu ppm	Mn ppm	Fe ppm	Zn ppm
1	H1 (0-30)	6.66(N)	0.110(N)	0.23	29.40	113(L)	31(M)	193(M)	1.36 (S)	16.58 (S)	4.49 (S)	0.25 (D)
2	H2 (30-60)	6.69(N)	0.082(N)	0.27	30.50	100(L)	31(M)	239(M)	1.14 (S)	9.36 (S)	3.46 (D)	0.78 (S)
3	H3 (60-90)	6.90(N)	0.147(N)	0.28	29.63	50(L)	41(M)	119(L)	0.25 (S)	7.23 (S)	3.86 (D)	0.36 (D)

**Table 3:** Effect of micronutrients on growth and yield of Acid lime Petlur Pulusu Nimma

S. No	Treatments	Plant height (m)	Girth (cm)	Tree volume (m <sup>3</sup> )	No Of Fruits/plant	Yield (Kg/Plant)	Yield Kg/ha	Gross returns Rs/ha	Net returns Rs/ha	B:C Ratio
1	T1: ZnSO <sub>4</sub> Soil application + Fe EDTA Soil application + Mg SO <sub>4</sub> Soil application	3.63	34.68	26.62	1868.67	98.35	24489.37	734681.05	644681.05	5.16
2	T2: ZnSO <sub>4</sub> foliar spray + Fe EDTA foliar spray + Mg SO <sub>4</sub> foliar spray	3.97	39.07	27.72	1697.00	89.32	22239.63	667188.95	577188.95	4.41
3	T3: ZnSO <sub>4</sub> Soil application + Fe filings mixed in FYM + Mg SO <sub>4</sub> Soil application	3.53	41.00	24.03	1664.33	87.60	21811.53	654345.79	564345.79	4.27
4	T4: ZnSO <sub>4</sub> foliar spray + Fe filings mixed in FYM + Mg SO <sub>4</sub> foliar spray.	4.17	42.70	32.10	2251.33	118.49	29504.32	885129.47	795129.47	6.83
5	T5: ZnSO <sub>4</sub> Soil application + FeSO <sub>4</sub> enriched in FYM (Slurry) + Mg SO <sub>4</sub> Soil Application.	4.00	40.22	31.76	2121.67	111.67	27805.00	834150.00	744150.00	6.27
6	T6: ZnSO <sub>4</sub> foliar spray + FeSO <sub>4</sub> enriched in FYM (Slurry) + Mg SO <sub>4</sub> foliar spray	3.47	38.33	29.04	1819.00	95.74	23838.47	715154.21	625154.21	4.95
7	T7: ZnSO <sub>4</sub> foliar spray + FeSO <sub>4</sub> foliar spray + MgSO <sub>4</sub> foliar spray	3.80	41.11	23.21	1394.33	73.39	18273.11	548193.16	458193.16	3.09
8	T8: Control (Without any micronutrients)	3.43	33.54	22.62	1154.24	58.10	13838.24	345678.15	215678.22	2.66
	S.Em.±	2.9106	0.39	0.39	12.75	0.67	167.11	5013.43	5013.43	0.06
	C.D. at 5%	NS	1.19	1.19	39.30	2.07	514.97	15449.25	15449.25	0.17
	C.V. %	132.83	1.69	2.42	1.21	1.21	1.21	1.21	1.38	1.21

**Table 4:** Effect of micronutrients on quality parameters

S. No	Treatments	Fruit weight (gm)	Fruit diameter (cm)	Juice (%)	Vit-C (mg 100 ml <sup>-1</sup> )	TSS (° Brix)	Acidity (%)
1	T1: ZnSO <sub>4</sub> Soil application + Fe EDTA Soil application + Mg SO <sub>4</sub> Soil application	50.55	43.70	39.09	31.23	7.80	7.15
2	T2: ZnSO <sub>4</sub> foliar spray + Fe EDTA foliar spray + Mg SO <sub>4</sub> foliar spray	54.47	44.40	40.53	32.51	7.49	7.04
3	T3: ZnSO <sub>4</sub> Soil application + Fe filings mixed in FYM + Mg SO <sub>4</sub> Soil application	42.45	40.47	35.91	30.66	6.49	6.97
4	T4: ZnSO <sub>4</sub> foliar spray + Fe filings mixed in FYM + Mg SO <sub>4</sub> foliar spray.	58.26	49.67	42.41	30.22	7.14	6.94

5	T5: ZnSO <sub>4</sub> Soil application + FeSO <sub>4</sub> enriched in FYM (Slurry) + Mg SO <sub>4</sub> Soil Application.	45.88	39.77	36.60	30.55	6.47	6.85
6	T6: ZnSO <sub>4</sub> foliar spray + FeSO <sub>4</sub> enriched in FYM (Slurry) + Mg SO <sub>4</sub> foliar spray	47.41	40.37	39.37	31.66	6.93	6.75
7	T7: ZnSO <sub>4</sub> foliar spray + FeSO <sub>4</sub> foliar spray + MgSO <sub>4</sub> foliar spray	49.67	43.90	45.63	33.96	6.84	6.87
8	T8: Control (Without any micronutrients)	44.61	37.73	33.68	30.06	6.39	6.27
	S.Em.±	0.3224	0.166	0.0568	0.1827	0.0782	0.0038
	C.D. at 5%	0.978	0.5036	0.1723	0.5542	0.2372	0.0115
	C.V. %	1.14	0.68	0.25	1.01	1.95	0.1

## Results and Discussion

Observations were recorded on parameter viz., plant height, plant spread, tree girth, number of fruits/tree, fruit weight, fruit diameter, yield kg/tree, juice percentage and TSS, acidity. Among all the treatments T<sub>4</sub> i.e ZnSO<sub>4</sub> foliar spray + Fe filings mixed in FYM + MgSO<sub>4</sub> foliar spray recorded maximum tree girth (42.70 cm), tree volume (32.10m<sup>3</sup>, fruit weight (58.26 gm), maximum number of fruits (2251.7/plant) and yield (118.49 kg/plant) Regarding quality parameters the treatment T<sub>7</sub> i.e ZnSO<sub>4</sub> foliar spray + FeSO<sub>4</sub> foliar spray + MgSO<sub>4</sub> foliar spray recorded highest juice percentage (45.65%) and vitamin C (33.96 mg/100ml<sup>-1</sup>) as compared to other treatments. While among all the treatments T<sub>1</sub> ZnSO<sub>4</sub> soil application + Fe EDTA soil application + MgSO<sub>4</sub> soil application recorded highest TSS (7.8%) and acidity (7.15%) compared to other treatments. However the lowest among all growth and quality parameters were recorded in T<sub>8</sub> Control (Without any micronutrients) foliar spray.

## Growth and Yield

The treatment T<sub>4</sub> i.e ZnSO<sub>4</sub> foliar spray + Fe filings mixed in FYM + MgSO<sub>4</sub> foliar spray recorded maximum tree girth (42.70 cm), tree volume (32.10m<sup>3</sup>, fruit weight (58.26 gm), maximum number of fruits (2251.7/plant) and yield (118.49 kg/plant) were recorded with treatment fruit diameter (49.67 cm).

## Number of fruits per tree

Among the various treatments evaluated, number of fruits per tree was found significantly (2251.7/tree) with the treatment T<sub>4</sub> ZnSO<sub>4</sub> foliar spray + Fe filings mixed in FYM + MgSO<sub>4</sub> foliar spray. Highest fruit weight (58.26 g) and fruit diameter (49.67 cm) also found in T<sub>4</sub> ZnSO<sub>4</sub> foliar spray + Fe filings mixed in FYM + MgSO<sub>4</sub> foliar spray. However, lowest number of fruits (1154.24) per tree was recorded with the water spray (control). Maximum number of fruits could be due to increase the hormonal activity by pruning and increase number of perfect flowers, flower set, fruit set and retention by application of zinc and magnesium micronutrients. These findings are supported by the results obtained by Venu *et al.* 2016 [16], Sawale *et al.* 2021 [13] and Rajamanickam *et al.* 2022 [10] in acid lime, Tariq *et al.* 2007 [15] in sweet orange,

## Fruit yield per tree

Significant differences were noticed in the yield of acid lime tree due to the different micro nutrients. Highest fruit yield per hectare was observed (29504.32 kg/ha) in the treatment T<sub>4</sub> ZnSO<sub>4</sub> foliar spray + Fe filings mixed in FYM + MgSO<sub>4</sub> foliar spray. Plant growth regulators. These results are in confirmation with those of Deshmukh *et al.* 2015 [5], Venu *et al.* 2016 [16], Yadav *et al.* 2014 [17], Deshlehra *et al.* 2022 [4] and Rajamanickam *et al.* 2022 [10] in acid lime, Sajid *et al.* 2010 [12] in sweet orange, Ilyas *et al.* 2015 [8] in kinnow mandarin, Gurjar *et al.* 2015 [7] in mango, Suman *et al.* 2016

[14] in guava and Abhijith *et al.* 2018 [11] in aonla.

## Juice percent and Vit C

Highest juice percentage (45.65%) and vitamin C (33.96 mg/100ml<sup>-1</sup>) recorded in the treatment T<sub>7</sub> ZnSO<sub>4</sub> foliar spray + FeSO<sub>4</sub> foliar spray + MgSO<sub>4</sub> foliar spray recorded as compared to other treatments whereas, lowest juice (33.68) and Vit C (30.06 mg 100 ml<sup>-1</sup>) percentage was recorded in T<sub>8</sub>: control treatment.

## Acidity and TSS

From the results it is observed that the differences for acidity and TSS among the treatments were significant. The lowest (6.27) percent of acidity was observed with the control treatment. However, the treatment i.e. T<sub>1</sub> ZnSO<sub>4</sub> soil application + Fe EDTA soil application + MgSO<sub>4</sub> soil application recorded highest TSS (7.8 °Brix) and acidity (7.15%) compared to other treatments.

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