

## Effect of Rooting Media and Foliar Application of Micro-Nutrients on the Growth of Acid Lime (*Citrus aurantifolia* Swingle) Seedlings cv. Balaji

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**ABSTRACT:** The present investigation was carried out at Horticultural Research Station, Konda Mallepally (Mndl.), Nalgonda (Dist.), during the period 2023. The experiment was laid out in randomized block design. The research experiment was conducted to evaluate the effect of different growing media and foliar application of Arka Citrus Special on seedlings of acid lime cv. Balaji. The results revealed that T<sub>8</sub> was best for days taken for initiation of germination (28.93 days), germination percent and survival percent (88.08%), growth rate (21.30 and 16.30), height of seedling (7.88 cm, 14.27 cm and 19.16 cm), shoot length (5.98 cm, 9.99 cm and 16.02 cm), number of leaves (10.30, 16.06 and 21.33), leaf area (3.75 cm<sup>2</sup>, 4.65 cm<sup>2</sup> and 5.75 cm<sup>2</sup>), stem diameter (1.79 mm, 2.66 mm and 2.91mm), chlorophyll (SPAD) (56.68 mg, 60.20 mg and 61.00 mg), vigour index (693.75 cm, 1256.33 cm and 1868.84 cm), fresh weight of shoots (1.99 g), dry weight of shoots (0.78 g), fresh weight of roots (1.81 g), dry weight of roots (0.85 g), root length (6.38 cm) and survival percentage (82.62 %).

**Keywords:** Acid lime, Arka Citrus Special, growing media, seedlings.

### INTRODUCTION

The Acid lime, botanically known as *Citrus aurantifolia* Swingle, belonging to the family Rutaceae, with a chromosome count of 18 (2n = 18). It holds a significant position among citrus fruits, ranking third after mandarin and sweet orange. It thrives in the tropical and subtropical regions of India and is widely cultivated all over the world. Acid lime is highly valued and economically lucrative, its unique flavors and medicinal properties contribute to the overall importance of citrus fruits. Moreover, acid lime exhibits excellent antioxidant effects and serves as a rich source of vitamin "C".

Acid lime propagation, which exhibits polyembryony, is multiplied through seeds to ensure true-to-type planting material. The growth rate of acid lime is relatively slow. The seeds are initially sown on raised nursery beds and left to germinate for a period of 30-35 days. After this period, the seedlings are carefully transplanted into poly bags measuring 6 × 8 inches. These poly bags are filled with a standard potting mixture, which consists of equal parts of soil (red earth), vermicompost, and farmyard manure.

Growing media in seed germination, as well as the subsequent growth and development of seedlings, hinges on crucial factors. Among the various growth media available, Vermicompost stands out for its ability to provide a harmonious blend of oxygen and moisture

to nourish roots. It also excels in storing water and essential nutrients, ensuring the plant's hydration and sustenance. Moreover, it strikes a balance in meeting the physical, chemical, and biological prerequisites for robust plant growth. In addition to these advantages, Vermicompost is notably lightweight and fosters consistent and uniform plant development (Atefe *et al.*, 2012). Farmyard manure, composed primarily of cow manure, waste straw, and other by-products, serves as a valuable reservoir of nutrients (Patil *et al.*, 2013). Its application enhances and sustains soil fertility. Moreover, it gives a darker hue, aiding in maintaining soil temperature while promoting the proliferation of beneficial soil microorganisms.

Micronutrients can tremendously boost horticultural crops in yield and quality. Zinc is one of the major micronutrients and an important component of numerous enzymes and proteins that plants need in small quantities. Moreover, it is critical to plant development, as it plays a significant role in a wide range of processes (Al-Musawi and Al-Moussawi 2020). Zinc deficiency has traditionally been the most widespread nutrient deficiency in citrus which is commonly known as "rosette" or "frenching" in Florida (Zekri and Obreza 2013). Zinc plays a crucial role in numerous biological processes. It is indispensable for carbon metabolism, serving as a vital component in various enzyme systems. Zinc also contributes to the regulation of the balance between carbon dioxide, water

and carbonic acid through its involvement in specific enzymes. Additionally, it is a key component of two enzymes crucial for protein metabolism, aids in enhancing water absorption, and is essential for the synthesis of chlorophyll and the formation of auxins. However, these can be corrected through the use of organic matter and a spray of micronutrients during the active germination of seedlings.

Nutritional disorders pose a significant challenge in the cultivation of acid lime seedlings. These issues stem from the deficiency of essential micronutrients like Zinc, Boron, Manganese, Iron, Copper, leading to decreased produce quality and yield. To address this problem, the IIHR has developed a solution called “Arka Citrus Special”, a foliar micronutrient formulation designed for application directly on the leaves. This innovative approach aims to enhance the health and growth of acid lime seedlings, thereby boosting their overall productivity.

## MATERIALS AND METHODS

The experiment was conducted at Horticultural Research Station, Konda Mallepally (Mndl.), Nalgonda (Dist.), during the period 2023. The growing media and foliar application of Arka Citrus Special in different treatments consists of - T<sub>1</sub>: Soil, T<sub>2</sub>: Soil + FYM (1:1:1), T<sub>3</sub>: Soil + Vermicompost (1:1:1), T<sub>4</sub>: Soil + FYM + Vermicompost (1:1:1), T<sub>5</sub>: T<sub>1</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L, T<sub>6</sub>: T<sub>2</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L, T<sub>7</sub>: T<sub>3</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L, T<sub>8</sub>: T<sub>4</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L.

**Preparation of Arka Citrus Special solution for foliar spray.** A solution was prepared by mixing 5 grams of Arka Citrus Special powder with 1 litre of water. The powder was carefully added to the water and stirred until it completely dissolved. The resulting solution was then ready for use in the experiment.

1<sup>st</sup> spray with Arka Citrus Special at a concentration of 5 g/liter was done during 90 days after sowing and 2<sup>nd</sup> spraying was done 120 days after sowing.

## RESULTS AND DISCUSSION

### Growth parameters

**Days taken for initiation of germination.** The number of days taken for initiation of germination were calculated from the date of sowing up to germination of acid lime seeds and average was calculated.

### Seed germination (%)

The total number of seeds germinated for each treatment was counted each day, from the first appearance to the seed until the period of completion of the seed germination (i.e., from 15 days to 45 days after sowing). It was calculated by dividing the total number of seeds sown by the number of seeds germinated and multiplied by 100.

Seed germination (%) =

$$\frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

**Growth rate (cm / 30 days).** Growth rate calculation is used to quantify the speed at which plants increase in

size over a specific period. It helps to monitor and understand the development of plants, which is crucial for studying physiology of the seedlings.

The growth rate was recorded and calculated between 60 to 90 days after sowing and 90 to 120 days after sowing. The formula for calculating the growth rate in plants is as follows:

Growth rate (cm / 30 days) =

$$\frac{\text{Final height (H2)} - \text{Initial height (H1)}}{\text{Final time (t2)} - \text{Initial time (t1)}}$$

### Physical Parameters

**Height of seedling (cm).** Height of seedling was measured from the collar region (ground level) to tip of seedlings using metric scale and average was calculated, recorded at 60, 90 and 120 DAS. Units were expressed in centimetre.

**Shoot length (cm).** The shoot length of five tagged seedlings was measured by metric scale from the base of shoot to the tip of the shoot length of the seedling at 30, 60, 90 and 120 days after sowing and average value was calculated. During 30 days interval no shoots were recorded as germination occurs till 45 DAS.

**Number of shoots per seedling.** However, no shoots were observed till 120 days after sowing.

**Number of leaves per seedling.** Number of leaves was recorded by counting total functional leaves per seedling and the average was calculated and expressed as total number of leaves per plant.

**Leaf area (cm<sup>2</sup>).** Leaf area was calculated using leaf area meter (CI-202 Laser area meter) and the values were expressed in cm<sup>2</sup>. Five (5) leaves were taken from each plant, in each replication for recording leaf area and the average was calculated.

**Stem diameter (mm).** Diameter of stem was measured with “Vernier callipers” at 1cm height from the base of stem and expressed in millimetres. The average stem girth was calculated.

**Root length (cm).** Seedlings were carefully taken out from the poly bags and roots were washed with water. Plants were spread on the table and root length was recorded with scale and units expressed in centimetres. The average length of root was calculated at 120 DAS.

**Survival percentage (%).** The survival percentage of each treatment was recorded at 120 days after seed sowing. The survival percentage was calculated by using formula as given below.

$$\text{Survival (\%)} = \frac{\text{Number of survived seedlings}}{\text{Total number of germinated seeds}} \times 100$$

**Fresh and Dry weight of shoots (g).** The fresh weight of five seedling shoots was weighed on digital weighing balance and average value was calculated at 120 days.

The dry weight of seedling shoots were calculated by drying up rooted seedling under shed for three days and then oven dried at 60°C till the constant weight. The average value was calculated at the end of experiment.

**Fresh and Dry weight of roots (g).** The fresh weight of five seedling roots was weighed on digital weighing balance and average value was calculated at 120 days.

For recording root dry weight five plants were selected in each replication and root regions were separated from the plant with the help of secateur. Separated root

regions were cleaned with water and shade dried in the open for 3 days. Shade dried roots region are oven dried for 48 hr at 60°C. The oven dried weight of roots was recorded using simple balance and the values are expressed in grams.

**Chlorophyll (SPAD).** The SPAD meter (Soil Plant Analytical Development) is a simple hand held equipment that measures leaf transmittance characters which depend on leaf density and chlorophyll content. SPAD chlorophyll meter works on principle of measuring the difference of absorption at maximum photosynthesis occurring at 460 nm and minimum photosynthesis occurring at 760 nm. It is a hand held portable instrument which provides information (unit less values) on the relative amount of leaf chlorophyll. Third leaf from the top of each seedling was used for recording SPAD Chlorophyll Meter readings at 60, 90 and 120 DAS and the average was calculated.

**Vigour Index.** Vigour index for each treatment was calculated by using following formula at 60, 90 and 120 days after seed sowing and average value was calculated (Table 1).

Vigour index = Seed germination percentage (%) × Height of seedling.

## RESULTS AND DISCUSSIONS

The observations are recorded after sowing of acid lime seeds. Germination parameters of seed and growth parameters of seedlings are recorded at 30, 60, 90 and 120 DAS. Seed germination percentages were recorded at 25, 30, 35 and 40 DAS. Growth rate of seedling (cm / 30 days) were recorded at 90 and 120 DAS. Number of

leaves per seedling and height of seedling (cm), shoot length (cm), leaf area (cm<sup>2</sup>), stem diameter (mm), chlorophyll SPAD (mg), and vigour index were recorded at 60, 90 and 120 DAS. Fresh and dry weight of shoots (g), fresh and dry weight of roots (g), root length (cm) and survival percentage (%) of seedlings were recorded at 120 DAS.

Amongst the treatments, T<sub>8</sub> was best for days taken for initiation of germination (28.93 days), germination percent and survival percent (88.08%), growth rate (21.30 and 16.30), height of seedling (7.88 cm, 14.27 cm and 19.16 cm), shoot length (5.98 cm, 9.99 cm and 16.02 cm), number of leaves (10.30, 16.06 and 21.33), leaf area (3.75 cm<sup>2</sup>, 4.65 cm<sup>2</sup> and 5.75 cm<sup>2</sup>), stem diameter (1.79 mm, 2.66 mm and 2.91mm), chlorophyll (SPAD) (56.68 mg, 60.20 mg and 61.00 mg), vigour index (693.75 cm, 1256.33 cm and 1686.84 cm), fresh weight of shoots (1.99 g), dry weight of shoots (0.78 g), fresh weight of roots (1.81 g), dry weight of roots (0.85 g), root length (6.38 cm) and survival percentage (82.62 %).

The treatment, T<sub>4</sub> was on par with T<sub>8</sub> for days taken for initiation of germination (28.02 days), germination percent and survival percent (86.81% and 80.54 %), growth rate (19.53 at 60-90 DAS), height of seedling (7.65 cm and 13.51 cm at 60 and 90 DAS), shoot length (9.72 cm at 90 DAS), number of leaves (9.87, 20.97 at 60 and 120 DAS), leaf area (4.58 cm<sup>2</sup> at 90 DAS), stem diameter (2.80 mm at 120 DAS), chlorophyll (SPAD) (58.02, 60.34 mg at 90 and 120 DAS), fresh weight of shoots (1.94), dry weight of roots (0.84).

**Table 1: Effect of rooting media and foliar application of micro-nutrient spray on vigour index.**

Treatments	Vigour Index		
	60 DAS	90 DAS	120 DAS
T <sub>1</sub> - Soil	433.47	675.75	926.54
T <sub>2</sub> - Soil + FYM (1:1)	574.92	948.10	1334.41
T <sub>3</sub> - Soil + Vermicompost (1:1)	613.96	1064.25	1467.19
T <sub>4</sub> - Soil + FYM + Vermicompost (1:1:1)	664.09	1172.80	1592.09
T <sub>5</sub> - T <sub>1</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L	460.57	740.25	999.24
T <sub>6</sub> - T <sub>2</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L	605.95	1025.58	1427.39
T <sub>7</sub> - T <sub>3</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L	641.06	1145.47	1553.72
T <sub>8</sub> - T <sub>4</sub> + Micro-nutrient spray (Arka Citrus Special) @ 5 g / L	693.75	1256.33	1686.84
SE(m) ±	16.29	46.27	74.90
C.D. at 5%	5.37	15.25	24.69

## CONCLUSIONS

It can be concluded that among the different treatments, the growing media with combination of soil, farm yard manure (FYM) and vermicompost in equal proportions given the best results in T<sub>4</sub>. And also, in this study, the application of micro-nutrient spray Arka Citrus Special at 5 g / L was found to be superior as revealed by the results T<sub>8</sub>: T<sub>4</sub> (Soil + FYM + Vermicompost – 1:1:1) + Micro-nutrient spray (Arka Citrus Special) 5 g / L, and it is followed by the best results in T<sub>7</sub>: T<sub>3</sub> (soil + vermicompost) + micro nutrient spray (Arka Citrus Special) 5 g / L. Thus, it can be recommended to produce vigorous, healthy and superior quality acid lime seedlings.

## FUTURE SCOPE

One of the key factors that significantly effects the improvement of quality of acid lime seedlings. Therefore, the experiment can be done with combination of growth regulators and Arka citrus special for healthy growth of acid lime.

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**Conflict of Interest.** None.

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