



Effect of Different Growing Media on Establishment of Kagzi Lime (*Citrus aurantifolia* Swingle) in Prayagraj Agroclimatic Condition

Gyanu Sonkar ^{a++*} and Samir E. Topno ^{b#}

^a Department of Horticulture (Fruit Science), SHUATS, Prayagraj, Uttar Pradesh, India.

^b Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/jabb/2024/v27i81172>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/119843>

Original Research Article

Received: 22/05/2024

Accepted: 24/07/2024

Published: 27/07/2024

ABSTRACT

The cultivation of acid lime (*Citrus aurantifolia* Swingle), commonly known as Kagzi lime, is of significant economic importance in many tropical and subtropical regions worldwide. This citrus fruit is esteemed for its tart flavor, aromatic qualities, and versatility in culinary and medicinal applications. Maximizing the yield and quality of acid lime crops is a primary concern for growers, necessitating research into various factors influencing seed germination and plant vigor. *Citrus aurantifolia*, commonly known as acid lime, is a small evergreen tree belonging to the Rutaceae family. An experiment was conducted in the department of horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj during winter (2023-24). The experiment was arranged based on RBD having 7 treatment and 3 replications. The treatment T₆

⁺⁺ M.Sc. Scholar;

[#] Assistant Professor;

^{*}Corresponding author: E-mail: gyanusonkar74@gmail.com;

Cite as: Sonkar, Gyanu, and Samir E. Topno. 2024. "Effect of Different Growing Media on Establishment of Kagzi Lime (*Citrus Aurantifolia* Swingle) in Prayagraj Agroclimatic Condition". *Journal of Advances in Biology & Biotechnology* 27 (8):582-87. <https://doi.org/10.9734/jabb/2024/v27i81172>.

Soil + FYM + Vermicompost + vermiculite (1:2:2:1) was found significant compared to other treatment combinations, which recorded highest mean value of plant height (27.72 cm), number of leaves per plant (19.60), stem girth (7.25 cm), leaf area (4.95 cm²), chlorophyll content SPAD (51.03) were also obtained from treatment T₆ Soil + FYM + Vermicompost + vermiculite (1:2:2:1) followed by T₄ Soil + FYM + Vermicompost + vermiculite (1:1:2:1) and lowest was obtained from T₀ (control).

Keywords: Vermicompost; vermiculite; leaf area; SPAD.

1. INTRODUCTION

Kagzi lime (*Citrus aurantifolia*) typically reaching heights of 6 to 13 feet (2 to 4 meters), it boasts a dense, thorny canopy. Its glossy, dark green leaves are ovate to elliptical and emit a citrusy aroma when crushed [1]. Acid lime bears small, fragrant white flowers with five petals, often appearing singly or in clusters at leaf axils. These hermaphroditic flowers facilitate self-pollination [2-5]. The fruit is spherical to oval, measuring 3 to 6 centimeters in diameter, with a thin, smooth, glossy peel abundant in oil glands. When ripe, it transitions from green to yellow, containing juicy, acidic pulp ranging from pale yellow to green and numerous seeds within. Acid lime thrives in warm, subtropical climates, exhibiting a fast growth rate in well-drained soil and ample sunlight. Its shallow, fibrous root system aids in water and nutrient absorption [6]. Valued for its tart flavor and aromatic qualities, acid lime serves as both a decorative and productive tree in gardens and orchards worldwide.

Lime is well-known across the globe for its sour, acidic juice and unique floral smells. The small fruited kagzi lime, commonly known in the United States as 'Mexican or main lime' and in India as 'Kagzi Lime' is one of the most frequently cultivated lime varieties. Improved kagzi lime cultivars such as Pramalini, Vikram, Sai Sarbati, PhuleSarbati, PKM1, and Balaji have been introduced in Maharashtra and Uttar Pradesh. Moreover, highest TSS content and juice content is recorded in the Vikram cultivar of acid lime. Above all, this cultivar is most suitable and easily grown under the agro-climatic situations of Prayagraj. Kagzi lime juice is a popular and affordable pleasant beverage that is high in Vitamin-C. Lime also contains Vitamin-C (62.9mg/100mL), vitamin B1, vitamin B2, calcium, phosphorus, and iron. However, the fruit is highly valued in Indian cuisine not only for its nutritional and medicinal qualities, but also for its culinary and value-added products such as squash, syrups, cordials, citric acid production, pickles, and cosmetic and nutraceutical

applications. Lime is an acidic fruit that has a high concentration of Vitamin-C, citric acid, starch, and minerals such as calcium and phosphorus. Additionally, it may be used to create beverages such as limeade and lime rickey. It is an essential component of almost all herbal cosmetics. It is used to make lime soda, lime cordial, lime oil, calcium nitrate dehydrated lime extract, lime polish, lime pickle, preserves, jellies, marmalades, as well as alcoholic and non-alcoholic drinks.

"Generally, kagzi lime is regenerated through seeds, but there is a problem of nonuniformity of progeny and high chance of viral disease contamination by this method" [7]. "For overcoming this problem, the vegetative multiplication through cutting is only practicable and widely used option for augmenting natural regeneration and for large scale cultivation programmes. Owing to high intensity of polyembryony (90-100%) and least chance of contamination of viral diseases in Kagzi-lime, the stem cutting is suitable method for regeneration for the species. It is inexpensive, rapid and simple and does not require the special techniques as required in other vegetative methods" [7].

"Under south, central and north Indian conditions, normally kagzi lime produces three distinct bahar (crop) viz., Mrig, Haste and Ambe bahar. The varieties like Kagzi limbu, Pat limbu and Godhadi limbu were cultivated in the Maharashtra State" [8]. "However, there are some types which produce fruit almost throughout the year (Baramsi) and are highly value for summer crop. The citrus industry of Marathwada region have heavy demand for supply of improved kagzi lime seedlings to cultivators. It also indicated great scope for improvement in yield and fruit quality by clone's selection from the innumerable seedlings already available under cultivation" [9,10]. Considering the importance of kagzi lime a survey was undertaken to study growth and yield attributes of various local genotypes.

2. MATERIALS AND METHODS

2.1 Data Analysis

The data was analyzed using STAR.

The details of the various materials used and methods adopted in carrying out the experiment are presented below:

2.2 Experimental Site

The research was carried out during the year 2023-2024 in the Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences Prayagraj in the months of October 2023 to February 2024. The experiment was conducted on Kagzi lime. All the facilities necessary for cultivation, including labour were made in the department.

2.3 Layout and Treatment Combination

Studies on Establishment of Kagzi lime (*Citrus aurantifolia* Swingle) in Prayagraj Agroclimatic Condition was carried out during 2023-24 at Horticulture Research Farm of Naini Agricultural Institute, SHUATS, Prayagraj, (Uttar Pradesh). The experiment was laid out in Randomized Block Design viz. Treatments at 7 levels viz. T₀: control, T₁: Soil + FYM + Vermicompost + vermiculite (1:1:1:1), T₂: Soil + FYM + Vermicompost + vermiculite (2:1:1:1), T₃: Soil + FYM + Vermicompost + vermiculite (1:2:1:1), T₄: Soil + FYM + Vermicompost + vermiculite (1:1:2:1), T₅: Soil + FYM + Vermicompost + vermiculite (1:1:1:2), T₆: Soil + FYM + Vermicompost + vermiculite (1:2:2:1). The transplanting was done on 20/12/2023 in field condition.

2.4 Climate

The prayagraj District comes under subtropical belt in the southeast of U.P. which experience extremely hot summer and fairly cold winter. During the winter months (Dec.-Jan) temperature falls 2-5°C or even low, while in summer months (May-June) it reaches as high as 49°C. Hot blowing winds are regular feature during the summers and an occasional spell of frost may be during winters. Most of the rainfall is received in the middle of July to end of September after which the intensity of rainfall decreases. The mean annual rainfall is about 850-1100mm. However, occasional precipitation is also not uncommon during winter months.

Running Status –

Growth Parameters:

1. Plant height (cm)
2. Number of leaves per plant
3. Stem girth (mm)
4. Leaf area (cm²)
5. Leaf area index
6. Chlorophyll content (SPAD value)
7. Root length
8. No. of secondary roots

Economic Parameters:

1. Cost of cultivation (Rs/ ha)
2. Gross return (Rs/ha)
3. Net return (Rs/ha)
4. B:C ratio

3. RESULTS AND DISCUSSION

The tabulated data were statistically analyzed with a view to find out the significant effect of different factors. The data present in the tabular forms shows the relevant standard error of mean deviation S. (±) and the critical difference (C.D) at 5% level of significance, wherever necessary. The results emanating from the present studies are presented under appropriate heading:

- The maximum plant height of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (27.72) cm followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (27.37) cm and the minimum plant height was recorded in T₀ (control) with (20.38) cm.
- The maximum no. of leaves of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (19.19) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (19.07) and the minimum no. of leaves was recorded in T₀ (control) with (17.13).
- The maximum stem girth (mm) of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (7.25) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (7.05) and the minimum stem girth (mm) was recorded in T₀ (control) with (5.01).
- The maximum leaf area (cm²) of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with

- (4.95) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (4.64) and the minimum leaf area (cm²) was recorded in T₀ (control) with (3.15).
- The maximum leaf area index of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (0.82) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (0.77) and the minimum leaf area index was recorded in T₀ (control) with (0.52).
 - The maximum chlorophyll content of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (51.03) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (50.69) and the minimum chlorophyll content was recorded in T₀ (control) with (44.20).
 - The maximum root length (cm) of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (17.93) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (17.86) and the minimum root length (cm) was recorded in T₀ (control) with (15.05).
 - The maximum no. of secondary roots of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (39.12) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (38.69) and the minimum no. of secondary roots was recorded in T₀ (control) with (34.92).
 - The maximum benefit Cost Ratio of kagzi lime was recorded in treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (2.61) followed by treatment T₄ (Soil + FYM + Vermicompost + vermiculite 1:1:2:1) with (2.25) and the minimum Benefit Cost Ratio was recorded in T₀ (control) with (1.18).

Table 1. Effect of Different Growing Media on plant height, no. of leaves, stem girth, leaf area on Establishment of Kagzi lime (*Citrus aurantifolia* Swingle)

| Treatments | Treatment Combinations | Plant height (cm) | Number of leaves | Stem girth (mm) | Leaf area (cm ²) |
|------------|---|-------------------|------------------|-----------------|------------------------------|
| T0 | Control | 20.38 | 17.13 | 5.01 | 3.15 |
| T1 | Soil + FYM + Vermicompost + vermiculite (1:1:1:1) | 25.73 | 18.09 | 5.82 | 3.9 |
| T2 | Soil + FYM + Vermicompost + vermiculite (2:1:1:1) | 23.53 | 17.48 | 5.41 | 3.73 |
| T3 | Soil + FYM + Vermicompost + vermiculite (1:2:1:1) | 26.24 | 19.07 | 6.48 | 4.07 |
| T4 | Soil + FYM + Vermicompost + vermiculite (1:1:2:1) | 27.37 | 19.19 | 7.05 | 4.64 |
| T5 | Soil + FYM + Vermicompost + vermiculite (1:1:1:2) | 25.86 | 18.47 | 6.3 | 3.97 |
| T6 | Soil + FYM + Vermicompost + vermiculite (1:2:2:1) | 27.72 | 19.6 | 7.25 | 4.95 |
| | F - test | S | S | S | S |
| | C.D. | 0.644 | 1.253 | 0.699 | 0.396 |
| | SE(d) | 0.293 | 0.569 | 0.317 | 0.18 |
| | C.V. | 1.418 | 3.779 | 6.273 | 5.422 |

Table 2. Effect of Different Growing Media on leaf area index, chlorophyll content, root length, number of secondary roots on Establishment of Kagzi lime (*Citrus aurantifolia* Swingle)

| Treatments | Treatment Combinations | Leaf area index | Chlorophyll content (SPAD) value | Root length (cm) | Number of secondary roots |
|------------|---|-----------------|----------------------------------|------------------|---------------------------|
| T0 | Control | 0.52 | 44.2 | 15.05 | 34.92 |
| T1 | Soil + FYM + Vermicompost + vermiculite (1:1:1:1) | 0.65 | 45.92 | 16.14 | 36.67 |
| T2 | Soil + FYM + Vermicompost + vermiculite (2:1:1:1) | 0.62 | 45.42 | 15.35 | 36.12 |
| T3 | Soil + FYM + Vermicompost + vermiculite (1:2:1:1) | 0.67 | 50.15 | 16.69 | 38.53 |
| T4 | Soil + FYM + Vermicompost + vermiculite (1:1:2:1) | 0.77 | 50.69 | 17.86 | 38.69 |
| T5 | Soil + FYM + Vermicompost + vermiculite (1:1:1:2) | 0.66 | 49.9 | 16.34 | 37.1 |
| T6 | Soil + FYM + Vermicompost + vermiculite (1:2:2:1) | 0.82 | 51.03 | 17.93 | 39.12 |
| | F - test | S | S | S | S |
| | C.D. | 0.006 | 0.577 | 1.013 | 0.974 |
| | SE(d) | 0.03 | 0.262 | 0.46 | 0.442 |
| | C.V. | 5.419 | 0.665 | 3.416 | 1.451 |

Table 3. Economics of various treatments

| Treatment No. | Fixed Cost (Rs.) | Variable Cost (Rs.) | Total cost of cultivation (Rs.) | No. of kagzi lime seedlings /10000m | Selling price/plant | Gross return (Rs.) | Net Return (Rs.) | B:C Ratio |
|---------------|------------------|---------------------|---------------------------------|-------------------------------------|---------------------|--------------------|------------------|-----------|
| T0 | 61009.66 | 0 | 61009.66 | 1111 | 120 | 133320 | 72310.34 | 1.18 |
| T1 | 61009.66 | 410 | 61419.66 | 1111 | 130 | 144430 | 83010.34 | 1.35 |
| T2 | 61009.66 | 410 | 61419.66 | 1111 | 125 | 138875 | 77455.34 | 1.26 |
| T3 | 61009.66 | 420 | 61429.66 | 1111 | 150 | 166650 | 105220.3 | 1.71 |
| T4 | 61009.66 | 460 | 61469.66 | 1111 | 180 | 199980 | 138510.3 | 2.25 |
| T5 | 61009.66 | 760 | 61769.66 | 1111 | 140 | 155540 | 93770.34 | 1.51 |
| T6 | 61009.66 | 460 | 61469.66 | 1111 | 200 | 222200 | 160730.3 | 2.61 |

These results were in close agreement with the findings of Prajapati et al. [11], Kumar et al. [12], Ladaniya et al. [13], Das et al. [14], Ladaniya et al. [15], Marak et al. [16], Rajale et al. [17] in kagzi lime and Jareda et al. [18].

4. CONCLUSION

On the basis of the experimental findings it can be concluded that maximum plant height (27.72) cm, no. of leaves (19.19), stem girth (7.25 mm), leaf area (4.95 cm²), leaf area index (0.82), chlorophyll content (51.03), root length (17.93), no. of secondary roots (39.12) and benefit Cost Ratio was found in the treatment T₆ (Soil + FYM + Vermicompost + vermiculite 1:2:2:1) with (2.61) followed by (2.25) and (1.18).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Souci SW, Fachmann W, Kraut H. Food composition and nutrition tables. 6th edn. Medpharm Scientific Publishers, Stuttgart; 2000.
- Anupriya Asati, TR Sharma, Vijay Kumar Singh and Hirdesh Kumar. The effect of nutrients on Physico - Chemical composition yield and economics of acid lime. Journal of Pharmacognosy and Phytochemistry. 2020;9(4):3279-3282.
- Akter MM, Islam MT, Akter N, Amin MF, Bari MA, Uddin MS. Pre-Harvest Fruit Bagging Enhanced Quality and Shelf-Life of Mango (*Mangifera Indica* L.) Cv. Amrapali". Asian Journal of Agricultural and Horticultural Research. 2020;5(3):45-54. Available:https://doi.org/10.9734/ajahr/2020/v5i330055.
- Roussos PA, Denaxa N, Damvakaris T. Strawberry fruit quality attributes after application of plant growth stimulating compounds. Scientia Horticulturae. 2009; 119(2):138-46.
- Guardiola JL, García-Luis A. Increasing fruit size in Citrus. Thinning and stimulation of fruit growth. Plant growth regulation. 2000 May; 31:121-32.
- Singh AK, Singh R. Influence of growth regulating substances on rooting of cuttings of poinsettia cv. Flaming Sphere. Prog. Hort. 2005;37(1):85-88
- Babu R. Lime and LEMONS. Handbook of horticulture, ICAR. New Delhi. 2001;212.
- Cheema GS, Bhat SS, Naik KC. Commercial fruits of India. Macmillan and Co. Ltd., Calcutta, Bombay, Madras, London. 1954;42-146:258-260,278.
- Jature SD, Chakrawar VR. Variability studies on kagzi lime strains. Punjab Hort. J. 1981;2:157-160.
- Jature SD, Chakrawar VR. Studies on certain strains of Kagzi lime (*Citrus aurantifolia* Swingle) fruits for their yield and physic-chemical characters. J. Maharashtra agric. Univ. 1981;6:91-93.
- Prajapati DG, Satodiya BN, Desai AB, Pawan K Nagar. Influence of storage period and growing media on seed germination and growth of acid lime seedlings (*Citrus aurantifolia* Swingle) Cv. Kagzi. Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1641-1645.
- Kumar, Dinesh, Gurdeep Singh, Navdeep Singh, Mahak Rani. Effect of foliar spray of zinc and manganese on vegetative growth, yield and fruit quality of kinnow mandarin (*Citrus reticulata*). Asian Journal of Advances in Agricultural Research. 2024; 24(7):61-69.

- Available:<https://doi.org/10.9734/ajaar/2024/v24i7523>.
13. Ladaniya MS, Marathe RA , Das AK , Rao CN, Huchche AD , Shirgure PS, Murkute AA. High density planting studies in acid lime (*Citrus aurantifolia* Swingle). *Scientia Horticulturae*. 2020;261:108935.
 14. Payel Das, Prasad VM, Vijay Bahadur, Samir E Topno. Effect of foliar application of bio-regulators (GA3 and NAA) on Vegetative Growth characters and Establishment of Lemon Citrus limon (L.) cv. Eureka under Subtropical Prayagraj Agro Climatic Condition. *Biological Forum – An International Journal*. 2021;13(3):159-162.
 15. Ladaniya MS, Marathe RA, Murkute AA, Huchche AD, Das AK, Anjitha George, Jayashree Kolwadkar. Response of Nagpur mandarin (*Citrus reticulata* Blanco) to high density planting systems; 2021. DOI:10.1038/s41598-021-89221-4.
 16. Rikmatchi Ch. Marak, Saket Mishra, Vijay Bahadur, Samir E Topno, Anupriya Paul. Establishment and effect of foliar application of brassinosteroids and salicylic acid on vegetative growth of nagpur orange (*Citrus reticulata* Blanco). *Biological Forum – An International Journal* 2021; 13(3).
 17. Kunal D Rajale, MukeshKumar Maurya DB. Dhangar RS. Dhivare. Kagzi lime orchard's production costing in Dhule District, Maharashtra. *Quest Journals Journal of Research in Agriculture and Animal Science* 2021;8(9):01-08. ISSN(Online):2321-9459.
 18. Jitendra Jareda, Samir E Topno, Annjoe V Joseph. Studies on growth, development and establishment of different varieties of ber (*Ziziphus mauritiana*) under Prayagraj agro climatic condition. *International Journal of Advanced Biochemistry Research*. 2024;8(5):573-575.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/119843>