



Effect of GA₃ and Nutrient Sprays on Growth of Kokum (*Garcinia indica* Choisy) Seedlings

Shraddha S. Pawar ^{a++*}, M. S. Gawankar ^b, R. C. Gajbhiye ^c,
R. V. Dhopavkar ^d and N. V. Dalvi ^c

^a Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Dapoli, Dr. Balasaheb Sawant Konkarni Krishi Vidyapeeth, Dapoli, Maharashtra, India.

^b AICRP on Fruit (Mango), Regional Fruit Research Station, Vengurla, Sindhudurg, Maharashtra, India.

^c College of Horticulture, Dapoli, Dr. Balasaheb Sawant Konkarni Krishi Vidyapeeth, Dapoli, Maharashtra, India.

^d Department of Agricultural Chemistry and Soil Science, College of Agriculture, Dapoli, Dr. Balasaheb Sawant Konkarni Krishi Vidyapeeth, Dapoli, Maharashtra, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted at the College of Horticulture, Dapoli, during the year 2023 - 2024. The study was conducted using a Randomized Block Design with eight treatments, each replicated three times and the treatments included T₁- GA₃ @ 250 ppm, T₂- GA₃ @ 300 ppm, T₃- GA₃ @ 350 ppm,

⁺⁺ M. Sc. Scholar;

*Corresponding author: E-mail: shraddhapawar470@gmail.com;

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T₄- 19:19:19 @ 0.5%, T₅- 19:19:19 @ 1%, T₆- 19:19:19 @ 2%, T₇- 19:19:19 @ 2.5% and T₈- Control with the aim to evaluate the influence of GA₃ and nutrient sprays on the growth of kokum seedlings and to identify the optimal concentrations that would enhance growth and grafting success. The highest seedling height (28.53 cm), number of leaves (19.87), girth at collar region (3.44 mm) number of nodes (8.07) and internodal length (2.09 cm) were recorded in treatment T₃ i.e. spraying with GA₃ @ 350 ppm. The highest survival percentage of seedlings (96.00%), minimum number of days for obtaining 80 percent graftable seedlings (142.33 days), overall percentage of graftable seedlings (90.00%) and maximum percentage of graft success (94.82%) found in treatment T₃.

Keywords: Kokum; GA₃; 19:19:19; graftable seedlings.

1. INTRODUCTION

Kokum (*Garcinia indica* Choisy) is one of the underexploited tree spice belongs to family Clusiaceae and native to India. Kokum was also referred by various common names such as Goa butter tree, kokum butter tree, bheranda, ratamba, kokamba, bhirand and amlashaka. Kokum is primarily found in Konkan region of Maharashtra, Goa, Karnataka and Kerala. Additionally, it grows in the Surat district of Gujarat and to some extent in North Eastern states of Assam, Meghalaya and West Bengal. This tree spice having tremendous importance not only for its culinary purpose but also for its medicinal properties. The kokum fruit contains g Garcinol, hydroxy citric acid, mallic acid, ascorbic acid and anthocyanin pigment. The tropical climate and consistent rainfall of the Konkan region provide ideal conditions for kokum cultivation. Expanding this area under kokum cultivation can bring multiple benefits to farmers due to its culinary and medicinal applications. However, kokum is primarily propagated by seeds, which are recalcitrant, meaning they lose viability quickly, leading to challenges in propagation. Since kokum is a cross-pollinated crop, the resulting seedlings often exhibit significant variability. Additionally, kokum is dioecious, meaning that male and female flowers are on separate plants, which further complicates large-scale propagation, making softwood grafting the preferred method. The increasing demand for kokum grafts necessitates the rapid multiplication of good quality planting material. However, the slow growth rate of kokum seedlings, often taking up to a year to reach the size suitable for grafting, presents a major obstacle to commercial cultivation. To address the challenges of slow growth of kokum seedling, the application of GA₃ and 19:19:19 nutrient sprays is invaluable in horticulture for enhancing seedling growth and productivity. This study aims to identify the optimal concentrations of GA₃ and nutrient

sprays to accelerate kokum seedling development. By doing so, the study seeks to enable faster production of quality rootstocks, thereby improving the efficiency of commercial propagation under the specific conditions of the Konkan region.

2. MATERIALS AND METHODOLOGY

The experiment was conducted at Nursery No. 4, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli 415 712 during the 2023-24 period. Fresh kokum seeds, collected during the fruiting season in May, were soaked in water for 24 hours before sowing. The seeds were first sown in raised beds measuring 3 m × 1 m, filled with mixture of soil and farm yard manure and watered lightly on regular basis. Germination was occurred 30 days after sowing. One month old seedlings were then transplanted into 6" × 8" size polybags containing a soil and FYM mixture (3:1). The GA₃ and nutrient were sprayed at monthly interval while first spraying was given when seedlings reached the four leaf stage i.e., one month after transplanting, followed by two additional sprays at 30 day intervals. For control (T₈), the kokum seedlings were transplanted in polybags without treatment. The experiment was designed in a Randomized Block Design (RBD) with eight treatments replicated thrice. The softwood grafting was done when seedlings are reached to graftable size. T₁- GA₃ @ 250 ppm, T₂- GA₃ @ 300 ppm, T₃- GA₃ @ 350 ppm, T₄- 19:19:19 @ 0.5%, T₅- 19:19:19 @ 1%, T₆- 19:19:19 @ 2%, T₇- 19:19:19 @ 2.5% and T₈- Control. Each replication consisted of 50 seedlings, with data averaged from ten labelled seedlings per replication. Observations on seedling height (cm), number of leaves, girth at collar region (mm), number of nodes, internodal length (cm), survival percentage of seedlings (%), minimum number of days for obtaining 80 percent graftable seedlings (days), overall percentage of graftable seedlings (%) and percentage of graft success (%) were recorded.

The data were analysed statistically using the methods outlined by Panse and Sukhatme [1].

3. RESULTS AND DISCUSSION

3.1 Seedling Height (cm)

The maximum seedling height was recorded in treatment (T₃) GA₃ @ 350 ppm concentration (28.53 cm) which was statistically at par with T₂ - GA₃ @ 300 ppm (26.81 cm) and T₁ - GA₃ @ 250 ppm (26.58 cm). The minimum seedling height was recorded in (T₈) control (19.10 cm) which was at par with T₄- 19:19:19 @ 0.5% and T₅- 19:19:19 @ 1% recording heights of 20.13 cm and 21.27 cm, respectively. The maximum seedling height was recorded in GA₃ might due to as it promotes cell division and cell elongation and thus facilitates rapid seedling growth and development. The present findings are in line with the findings of Malshe et al. [2] in Khirni rootstock, Gholap et al. [3] in aonla and Deshmukh [4] in kokum seedlings.

3.2 Number of Leaves

Leaves are the essential organs primarily responsible for photosynthesis, transpiration and gas exchange. The maximum number of leaves (19.87) was recorded in treatment (T₃) GA₃ @ 350 ppm which was found significantly superior over the other treatments. The minimum number of leaves (13.13) was recorded in (T₈) control, which was at par with T₄- 19:19:19 @ 0.5% (14.23). The study revealed that increase in concentration of GA₃ results in increases the number of leaves per seedlings this might due to GA₃ promotes both cell division and cell elongation in plant tissues, this leads to increased growth rates, including production of new leaves, by stimulating the growth of meristematic tissues. The results confirmative with the findings of Chiranjeevi et al. [5] in aonla, Surve [6] in kokum and Patil et al. [7] in Jamun seedlings.

3.3 Girth at Collar Region (mm)

Girth of seedling is an important factor which provide better support to the seedling. The maximum girth of seedling (3.44 mm) was recorded in T₃- GA₃ @ 350 ppm which was found at par with T₂ - GA₃ @ 300 ppm (3.35 mm) and T₁ - GA₃ @ 250 ppm (3.36 mm). The minimum girth was recorded in (T₈) control. This may be due to positive effect of GA₃ in cell division and

elongation which may promote cell wall extensibility. Similar results were recorded by Chiranjeevi et al. [5] in aonla, Deshmukh [4] in kokum and Vasantha et al. [8] in tamarind seedlings.

3.4 Number of Nodes

The highest number of nodes (8.07) was recorded in T₃- GA₃ @ 350 ppm which was found at par with T₁ - GA₃ @ 250 ppm (7.77). The lowest number of nodes (5.67) was recorded in control treatment. The increased in number of nodes by application of GA₃ was also reported earlier workers by Surve [6] and Deshmukh [4] in kokum seedlings.

3.5 Internodal Length (cm)

The highest internodal length (3.35 cm) was observed in T₃- GA₃ @ 350 ppm which was found at par with T₂ - GA₃ @ 300 ppm (3.00 cm) and T₁ - GA₃ @ 250 ppm (2.57 cm). The lowest internodal length (1.43 cm) was recorded in control treatment which was found at par with T₇- 19:19:19 @ 2.5% (2.00 cm), T₆- 19:19:19 @ 2% (1.90 cm), T₅- 19:19:19 @ 1% (1.79 cm) and T₄- 19:19:19 @ 0.5% (1.75 cm). The results are in confirmative with Surve [6] and Deshmukh [4] in kokum seedlings.

3.6 Survival Percentage of Seedlings (%)

Survival percentage of seedlings (96.00%) was found highest in treatment T₃- GA₃ @ 350 ppm which was found at par with T₂ - GA₃ @ 300 ppm (92.67%), T₆ - 19:19:19 @ 2% (90.00%) and T₇ - 19:19:19 @ 2.5% (89.33%). The lowest survival percentage was recorded in T₈ (control) treatment. Similar results were noticed by Patel et al. [9] in kagzi lime, Lalitha et al. [10] and Deshmukh [4] in kokum seedlings.

3.7 Minimum Number of Days for Obtaining 80 Percent Graftable Seedlings (days)

The data highlights that treatment T₃- GA₃ @ 350 ppm recorded minimum number of days (142.33 days) required for obtaining 80 percent graftable seedlings which was found significantly superior over all other treatments. In contrast, the maximum number of days (225.00 days) to reach graftable size was recorded in control treatment. The present findings are in line with the findings of Chiranjeevi et al. [5] in aonla, Vasantha et al. [8] in tamarind, and Surve [6] in kokum seedlings.

Table 1. Effect of GA₃ and nutrient on seedling height (cm), number of leaves, girth at collar region (mm), number of nodes and internodal length (cm) of kokum seedling

Treatments	Seedling height (cm)	No. of leaves	Girth at collar region (mm)	No. of nodes	Internodal length (cm)
150 Days after transplanting					
T ₁ - GA ₃ @ 250 ppm	26.58	18.13	3.36	7.77	2.57
T ₂ - GA ₃ @ 300 ppm	26.81	17.57	3.35	7.50	3.00
T ₃ - GA ₃ @ 350 ppm	28.53	19.87	3.44	8.07	3.35
T ₄ - 19:19:19 @ 0.5%	20.13	14.23	3.16	6.63	1.75
T ₅ - 19:19:19 @ 1%	21.27	15.53	3.11	6.97	1.79
T ₆ - 19:19:19 @ 2%	22.35	16.07	3.07	7.27	1.90
T ₇ - 19:19:19 @ 2.5%	23.30	15.07	3.06	6.37	2.00
T ₈ - Control	19.10	13.13	2.56	5.67	1.43
Mean	23.51	16.20	3.14	7.03	2.23
F test	SIG	SIG	SIG	SIG	SIG
S. Em. (±)	1.02	0.47	0.05	0.12	0.30
C. D. @ 5%	3.11	1.43	0.14	0.35	0.92

Table 2. Effect of GA₃ and nutrient on survival percentage of seedlings (%), minimum number of days required for obtaining 80% graftable seedlings (days), percentage of graftable seedlings (%) and percentage of graft success (%) of kokum seedlings

Treatments	Survival percentage of seedlings (%)	Minimum no. of days required for obtaining 80% graftable seedlings (days)	Percentage of graftable seedlings (%)	Percentage of graft success (%)
T ₁ - GA ₃ @ 250 ppm	88.00 (69.77)	167.33	81.33 (64.41)	92.64 (74.39)
T ₂ - GA ₃ @ 300 ppm	92.67 (75.24)	162.00	82.00 (66.18)	94.12 (76.12)
T ₃ - GA ₃ @ 350 ppm	96.00 (78.72)	142.33	90.00 (71.94)	94.82 (76.90)
T ₄ - 19:19:19 @ 0.5%	86.00 (68.30)	185.00	74.00 (59.43)	87.18 (69.27)
T ₅ - 19:19:19 @ 1%	85.33 (67.63)	176.67	76.00 (60.85)	89.52 (71.17)
T ₆ - 19:19:19 @ 2%	90.00 (72.02)	173.33	80.00 (63.60)	85.90 (67.98)
T ₇ - 19:19:19 @ 2.5%	89.33 (70.95)	170.00	80.67 (63.92)	86.77 (68.69)
T ₈ - Control	76.00 (60.72)	225.00	66.00 (54.34)	85.88 (71.56)
Mean	87.92	175.21	78.75	89.61
F test	SIG	SIG	SIG	SIG
S. Em. (±)	2.52	2.95	3.05	1.41
C. D. @ 5%	7.64	8.95	9.26	4.27

*Figures in parenthesis are arcsine transformed values

3.8 Overall Percentage of Graftable Seedlings (%)

The overall percentage of graftable seedlings (90.00%) was found maximum in treatment T₃- GA₃ @ 350 ppm which was found at par with T₂ -

GA₃ @ 300 ppm (82.00%) and T₁ - GA₃ @ 250 ppm (81.33%). The minimum percentage of graftable seedlings recorded in control treatment. This may be due to positive effect of GA₃ in enhancing growth parameters such as seedling height, number of leaves and girth at

collar region, thereby enhancing overall percentage of graftable seedlings. Similar results were recorded earlier by Murlidhara et al. [11] in mango, Surve [6] and Deshmukh [4] in kokum seedlings.

3.9 Percentage of Graft Success (%)

The treatment T₃- GA₃ @ 350 ppm recorded the highest percentage of graft success (94.82%) which was found at par with T₂ - GA₃ @ 300 ppm (94.12%) and T₁ - GA₃ @ 250 ppm (92.64%). The lowest percentage of graft success (85.88%) was recorded in T₈ (control) treatment which was found at par with T₆- 19:19:19 @ 2% (85.90%), T₇- 19:19:19 @ 2.5% (86.77%), T₄- 19:19:19 @ 0.5% (87.18%) and T₅- 19:19:19 @ 1% (89.52%) [12-14]. This may be due to the effect of GA₃ as it promotes cell multiplication and elongation in cambium tissues, facilitating better graft union and enhancing graft success.

4. CONCLUSION

Among different treatments, foliar application of (T₃) gibberellic acid (GA₃) at 350 ppm, administered in three sprays spaced 30 days apart from transplanting, significantly enhanced kokum seedling growth and graft success. This treatment resulted in seedling height (28.53 cm), number of leaves (19.87), number of nodes (8.07), internodal length (2.09 cm) and girth at collar region (3.44 mm). It also resulted in high survival percentage of seedlings (96.00%), minimum number of days for obtaining 80 percent graftable seedlings (142.33 days), total percentage of graftable seedlings (90.00%) and percentage of graft success (94.82%). Thus, on the basis of results revealed from above investigation, it can be concluded that treatment T₃ (GA₃ at a concentration of 350 ppm) gave excellent results for maximizing both seedling growth and graft success in kokum over rest of treatments in this study.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare 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 this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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