Effect of GA_3 and nutrient spray on growth of Kokum (*Garcinia indica* Choisy) seedlings

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 T_1- GA_3 @ 250 ppm, T_2- GA_3 @ 300 ppm, T_3-GA_3 @350ppm, T_4-19:19:19@0.5%, T_5-19:19:19@1%, T_6-19:19:19@2%, T_7-19:19:19 @ 2.5% and T_8- Control with the aim to evaluate the influence of GA_3 and nutrient spray on the growth of kokum seedlings and to identify the optimal concentrations that would enhance growth and grafting success. The highest seedling height (28.53cm), number of leaves (19.87), number of nodes (8.07), internodal length (2.09 cm) and girth at collar region (3.44mm) were recorded in treatment T_3 i.e. spraying with GA_3 @ 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 T_3.

Keywords: Kokum, GA_3, 19:19:19, graftable seedlings

1. INTRODUCTION

Kokum(*Garciniaindica*Choisy)isoneoftheunderexploitedtreespicebelongstofamilyClusiaceaeandnativetoIndia.Kokumwasalsoreferredbyvariouscommonnamessuchas Goabuttertree,kokumbuttertree,bheranda,ratamba,kokamba,bhirandandamlashaka.Kokumisprimarilyfoundin KonkanregionofMaharashtra,Goa,KarnatakaandKerala.Additionally,itgrowsintheSuratdistrictofGujaratandtosomeextentinNorthEasternstatesofAssam,MeghalayaandWestBengal.Thistreespicehavingtremendousimportance not only for its culinary purpose but also for its medicinal properties.The kokumfruitcontainsgarcinol,hydroxycitricacid,mallicacid,ascorbicacidandanthocyaninpigment.Thetropicalclimateandconsistentrainfallof theKonkanregionprovideidealconditionsforkokumcultivation.Expandingthisareaunderkokumcultivationcanbringsmultiplebenefitstofarmersduetoitsculinaryandmedicinalapplications.However,kokumisprimarily propagatedby seeds,whicharerecalcitrant,meaning they loseviability quickly,leading to challengesinpropagation. Sincekokumisacross-pollinated crop, theresultingseedlingsoftenexhibitsignificantvariability.Additionally,kokumisdioecious,meaningthatmaleandfemaleflowersareonseparateplants,whichfurthercomplicateslarge-scalepropagation,makingsoftwoodgraftingthepreferredmethod.Theincreasingdemandforkokum grafts necessitates the rapid multiplication of good quality planting material. However,theslowgrowthrateofkokumseedlings,oftentakinguptoayeartoreachthesizesuitableforgrafting,presentsamajorobstacletocommercialcultivation.Toaddressthechallengesofslowgrowthofkokumseedling,theapplicationofGA_3and19:19:19nutrientspraysisinvaluableinhorticulturefo renhancingseedlinggrowthandproductivity.Thisstudyaimstoidentifytheoptimal concentrations of GA_3 and nutrient sprays to accelerate kokum seedling development.Bydoingso,thestudyseekstoenablefasterproductionofqualityrootstocks,therebyimprovingtheefficiencyofcommercialpropagationunderthespecificconditionsoftheKonkanregion.

2. MATERIALSANDMETHODOLOGY

The experiment was conducted at Nursery No. 4, College of Horticulture, Dr. BalasahebSawant Konkan KrishiVidyapeeth, Dapoli 415 712 during the 2023-24 period.Fresh kokumseeds, collected during the fruiting season in May, were soaked in water for 24 hours beforesowing.The seeds were first sown in raised beds measuring 3 m × 1 m, filled with mixture ofsoilandfarm yardmanure andwateredlightlyonregularbasis.Germinationwasoccurred
30 days after sowing. One month old seedlings were then transplanted into 6'' × 8'' sizepolybags containing a soil and FYM mixture (3:1). The GA_3 and nutrient were sprayed atmonthlyintervalwhilefirstsprayingwasgivenwhenseedlingsreachedthefourleafstage*i.e.*,onemonthaftertransplanting,followedbytwoadditionalspraysat30dayintervals.Forcontrol(T_8), the kokum seedlings were transplanted in polybags without treatment.The experimentwas designed in a Randomized Block Design (RBD) with eight treatments replicated thrice.The softwood grafting was done when seedlings are reached to graftable size. T_1- GA_3 @ 250ppm,T_2-GA_3@300ppm,T_3-GA_3@350ppm,T_4-19:19:19@0.5%,T_5-19:19:19@1%,
T_6- 19:19:19 @ 2%, T_7- 19:19:19 @ 2.5% and T_8- Control. Each replication consisted of 50seedlings, with data averaged from ten labelled seedlings per replication. Observations onseedlingheight(cm),numberofleaves,girthatcollarregion(mm),numberofnodes,internodallength (cm), survival percentage of seedlings (%), minimum number of days for obtaining 80percentgraftableseedlings(days),overallpercentageofgraftableseedlings(%)andpercentage

of graft success (%) were recorded. The data were analysed statistically using the methodsoutlined byPanseand Sukhatme[7].

3. RESULTS AND DISCUSSION

Seedlingheight(cm)

The maximum seedling height was recorded in treatment (T_3) GA_3 @ 350 ppm concentration(28.53 cm) which was statistically at par with T_2 - GA_3 @ 300 ppm (26.81 cm) and T_1 - GA_3@250ppm(26.58cm).Theminimumseedlingheightwasrecordedin(T_8)control(19.10cm)whichwasatparwithT_4-19:19:19@0.5%andT_5-19:19:19@1%recordingheightsof20.13cmand21.27cm,respectively.ThemaximumseedlingheightwasrecordedinGA_3 mightduetoasitpromotescelldivisionandcellelongationandthusfacilitatesrapidseedlinggrowthanddevelopment. The present findings are in line with the findings of Malshe et al. [13] in Khirnirootstock,Gholapet al.[4] inaonlaandDeshmukh [3]inkokum seedlings.

Numberofleaves

Leaves are the essential organs primarily responsible for photosynthesis, transpiration and gasexchange.Themaximumnumberofleaves(19.87)wasrecordedintreatment(T_3)GA_3@350ppm which was found significantly superior over the other treatments. The minimum numberof leaves (13.13) was recorded in (T_8) control, which was at par with T_4- 19:19:19 @ 0.5%(14.23). The study revealed that increase in concentration of GA_3 results in increases thenumber of leaves per seedlings this might due to GA_3 promotes both cell division and cellelongation in plant tissues, this leads to increased growth rates, including production of newleaves, by stimulating the growth of meristematic tissues. The results confirmative with thefindings of Chiranjeevi et al. [2] in aonla, Surve [9] in kokum and Patil et al. [11] in Jamunseedlings.

Girthatcollarregion(mm)

Girth of seedling is an important factor which provide better support to the seedling. Themaximum girth of seedling (3.44 mm) was recorded in T_3- GA_3 @ 350 ppm which was foundatparwithT_2-GA_3@300ppm(3.35mm)andT_1-GA_3@250ppm(3.36mm).Theminimumgirth was recorded in (T_8) control. This may be due to positive effect of GA_3 in cell divisionand elongation which may promote cell wall extensibility. Similar results were recorded byChiranjeevi et al. [2] in aonla, Deshmukh [3] in kokum and Vasantha et al. [10] in tamarindseedlings.

Numberofnodes

The highest number of nodes (8.07) was recorded in T_3- GA_3 @ 350 ppm which was found atpar with T_1 - GA_3 @ 250 ppm (7.77). The lowest number of nodes (5.67) was recorded incontrol treatment. The increased in number of nodes by application of GA_3 was also reportedearlierworkersbySurve [9]and Deshmukh[3] in kokum seedlings.

Internodallength(cm)

Thehighestinternodallength(3.35cm)wasobservedinT_3-GA_3@350ppmwhichwasfoundat par with T_2 - GA_3 @ 300 ppm (3.00 cm) and T_1 - GA_3 @ 250 ppm (2.57 cm). The lowestinternodallength(1.43cm)wasrecordedincontroltreatmentwhichwasfoundatparwithT_7-19:19:19@2.5%(2.00cm),T_6-19:19:19 @2%(1.90cm),T_5-19:19:19 @1%(1.79cm)and T_4-19:19:19@0.5%(1.75cm).TheresultsareinconfirmativewithSurve[9]andDeshmukh [3]inkokumseedlings.

Survivalpercentageofseedlings(%)

Survivalpercentageofseedlings(96.00%)wasfoundhighestintreatmentT_3-GA_3@350ppmwhich was found at par with T_2 - GA_3 @ 300 ppm (92.67%), T_6 – 19:19:19 @ 2% (90.00%)and T_7 – 19:19:19 @ 2.5% (89.33%). The lowest survival percentage was recorded in T_8(control)treatment.SimilarresultswerenoticedbyPateletal.[12]inkagzilime,Lalithaetal. [14]andDeshmukh[3]inkokumseedlings.

Minimumnumberofdaysforobtaining80percentgraftableseedlings(days)

The data highlights that treatment T_3- GA_3 @ 350 ppm recorded minimum number of days(142.33days)requiredforobtaining80percentgraftableseedlingswhichwasfoundsignificantly 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 findingsare in line with the findings of Chiranjeevi et al. [2] in aonla, Vasantha et al. [10] in tamarind,andSurve[9] in kokum seedlings.

Overallpercentageofgraftableseedlings(%)

The overall percentage of graftable seedlings (90.00%) was found maximum in treatment T_3-GA_3 @ 350 ppm which was found at par with T_2 - GA_3 @ 300 ppm (82.00%) and T_1 - GA_3 @250ppm(81.33%).Theminimumpercentageofgraftableseedlingsrecordedincontroltreatment. ThismaybeduetopositiveeffectofGA_3inenhancinggrowthparameterssuchasseedlingheight,numberofleavesandgirthatcollarregion,therebyenhancingoverallpercentageofgraftableseedlings.Similarresultswererecordedearlierby Murlidharaetal.[6]inmango, Surve[9]and Deshmukh [3] inkokum seedlings.

Percentageofgraftsuccess(%)

The treatment T_3- GA_3 @ 350 ppm recorded the highest percentage of graft success (94.82%)whichwasfoundatparwithT_2-GA_3@300ppm(94.12%)andT_1-GA_3@250ppm(92.64%).The lowest percentage of graft success (85.88%) was recorded in T_8 (control) treatment whichwasfoundatparwithT_6-19:19:19@2%(85.90%),T_7-19:19:19@2.5%(86.77%),T_4-19:19:19 @ 0.5% (87.18%) and T_5- 19:19:19 @ 1% (89.52%). This may be due to the effectof GA_3 as it promotes cell multiplication and elongation in cambium tissues, facilitating bettergraft union and enhancinggraftsuccess.

Table1:EffectofGA3andnutrientonseedlingheight(cm),numberofleaves,girthatcollar region(mm),number ofnodesandinternodallength(cm)ofkokumseedling

Treatments	Seedlingheight(cm)	No.ofleaves	Girthatcollarregion (mm)	No. ofnodes	Internodal length(cm)
	150Daysaftertransplanting				
T_1-GA_3@250ppm	26.58	18.13	3.36	7.77	2.57
T_2-GA_3@300ppm	26.81	17.57	3.35	7.50	3.00
T_3-GA_3@350ppm	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 GA_3 and nutrient on survival percentage of seedlings (%), minimumnumber of days required for obtaining 80% graftable seedlings (days), percentage ofgraftableseedlings(%)andpercentage ofgraftsuccess(%)ofkokumseedlings

Treatments	Survivalpercentageofseedlings(%)	Minimum no. ofdays required forobtaining 80%graftableseedlings(days)	Percentage of graftableseedlings(%)	Percentage of graftsuccess(%)
T_1-GA_3@250ppm	88.00 (69.77)	167.33	81.33 (64.41)	92.64 (74.39)
T_2-GA_3@300ppm	92.67 (75.24)	162.00	82.00 (66.18)	94.12 (76.12)
T_3-GA_3@350ppm	**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**

**Figuresinparenthesisarearcsinetransformedvalues*

4. CONCLUSION

Among different treatments, foliar application of (T_3) gibberellic acid (GA_3) at 350 ppm,administered in three sprays spaced 30 days apart from transplanting, significantly enhancedkokum seedling growth and graft success. This treatment resulted in seedling height (28.53cm), number of leaves (19.87), number of nodes (8.07), internodal length (2.09 cm) and girthat 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), totalpercentageofgraftableseedlings(90.00%)andpercentageofgraftsuccess(94.82%).Thus,onth e basis of results revealed from above investigation, it can be concluded that treatment T_3(GA_3 at a concentration of 350 ppm) gave excellent results for maximizing both seedlinggrowthandgraftsuccessinkokum overrest of treatmentsinthisstudy.

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