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Effect of soaking of seeds in bioregulators on germination of Kokum seeds

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Abstract
The field experiment was carried out to study the effect of soaking of seeds in bioregulators on germination of Kokum seeds, during year 2013 at fruit crop nursery, Department of Horticulture, College of Agriculture, Dapoli, Dist. Ratnagiri (M.S.). The experiment was conducted in RBD with ten pre-sowing seed treatments and replicate in thrice. The results regarding effect of pre-soaking of seeds in bioregulators on germination parameters indicated that the treatment T_5 showed the best results for days required for commencement of germination (17.67 days), which was at par with T_4 (19.33 days). The treatment T_5 (96.00) had significantly highest germination percentage at 90 DAS.

Keywords: *Garcinia indica*, kokum, bioregulators, pre-soaking, germination etc.

Introduction
Kokum (*Garcinia indica* Choisy) is a member of family Guttiferae, mainly found along West Cost of Konkan, Goa, Karnataka and North Malabar. It is also known as *Brindon* to the Portuguese in Goa, *Bhirand* or *Amsul* in Konkani and Marathi, *Murgal* in Kannada and *Punampuli* in Malaylam. French botanists Laurence Garcin collected and studied the tree of this genus during his stay in India and name this tree as *Garcina*. It occurs from the sea level plains upto an elevation of about 800 m along the westward slopes of the Western Ghats (Muhammed *et al.*1994) [6].
As per a base line survey (Anon., 2010) [1] conducted by Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra around 1000 ha area is occupied by kokum in Konkan region with production of 4500 MT fruits. According to survey conducted earlier by Chief Conservator of Forest in 2010 out of the total 46600 Kokum trees in the state of Maharashtra; 43000 trees existed in Ratnagiri and Sindhudurg Districts. It was also reported that in South Konkan 1674 MT of Kokum fruits were used for dried Kokum rind, 757 MT for preparation of Kokum syrup and 40 MT for Kokum butter. In Sindhudurg district, estimated area under Kokum is about 108 hectares scattered along riverbanks, streams, valleys, roadsides and backyard wastelands. Trees are also observed in coconut and arecanut gardens. In India, kokum trees are endemic to Konkan belt and the estimated production is 10,200 tons, of which 9000 tons are processed (Sawant, 2005) [9].
There is great scope for cultivation of kokum in the Konkan region, since the soil and climatic condition are ideal for its growth; however, its cultivation has not extended because of its dioecious nature. The sex of plant is known only after completion of juvenile period; fifty percent plants being male are unproductive.
Besides low seed viability, poor seed germination and slow seedling growth etc. are the major problems in seedling raising and producing and planting material of elite kokum. Hence, it is essential to standardize proper germination media and their proportions, use of plant growth regulators to improve kokum seed further germination at nursery stage. Therefore, the importance of crop and information on seed treatment with bioregulators and effect on germination was scanty in Konkan region. Hence, the present investigation were undertaken with to study the effect of soaking of seeds in bioregulators on germination of Kokum seeds.

Materials and methods
The field experiment was carried out at Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.

Experimental details
1. Crop: Kokum
2. Design: Randomized Block Design
3. Replications: Three
4. No. of treatments: Ten
5. No. of plants per treatment: Fifty

Collection of seed material
The seed material of kokum required for the present studies was collected from the bearing trees of kokum planted in orchard of Department of Horticulture. The seed material was collected during the fruiting season. The seeds were extracted from pulp with hand and were washed thoroughly with water to remove all adhering pulp and used for carrying out different experiment

Treatments Details
Pre sowing seeds treatments
T_1: Control (seeds without any treatment)
T_2: Soaking of seeds in 10 ppm BA solution for 24 hrs.
T_3: Soaking of seeds in 20 ppm BA solution for 24 hrs.
T_4: Soaking of seeds in 25 ppm GA solution for 24 hrs.
T_5: Soaking of seeds in 50 ppm GA solution for 24 hrs.
T_6: Soaking of seeds in 10 ppm IBA solution for 24 hrs.
T_7: Soaking of seeds in 20 ppm IBA solution for 24 hrs.
T_8: Soaking of seeds in 5 ppm BA + 15 ppm GA solution for 24 hrs.
T_9: Soaking of seeds in 10 ppm BA + 30 ppm GA solution for 24 hrs.
T_{10}: Soaking of seeds in 5 ppm BA + 15 ppm GA + 5 ppm IBA solution for 24 hrs.

Preparation of Growth Regulator
The stock solution of 100 ppm GA_3 was prepared by dissolving 100 mg of pure GA_3 in 10 ml alcohol and making volume to one liter with distilled water. The working solution of desired strength was prepared by taking appropriate quantities of stock solution and then diluting the same with distilled water to get required concentration of GA_3 solution *i.e.* 25 ppm and 50 ppm.
The stock solution of 100 ppm BA was prepared by dissolving 100 mg of pure BA in 10 ml alcohol and making volume to one liter with distilled water. The working solution of desired strength was prepared by taking appropriate quantities of stock solution and then diluting the same with distilled water to get required concentration of BA solution *i.e.* 10 ppm and 20 ppm.
The working solution of treatment T_8, T_9 and T_{10} was prepared by taking required quantity of stock solution of GA, BA and IBA respectively and then diluted with distilled water to get required concentration of 5 ppm BA+ 15 ppm GA, 10 ppm BA+ 30 ppm GA, 5 ppm BA+ 15 ppm GA+ 5 ppm IBA solutions.

Soaking of seeds
The required number of seeds was soaked in 1000 ml solution of BA,GA, IBA solution at the concentration of given ppm solution separately for 24 hrs.

Preparation of potting mixture, filling of polythene bags and sowing of treated seeds
Potting mixture was prepared by using three parts of soil and one part of well decomposed FYM. Then the mixture was filled in polythene bags of size (8cm x 20cm). The treated seeds were sown in polythene bags and placed in rows. The proper care was taken, while sowing that the seeds will not be placed too deep. The depth of sowing was maintained up to 2 cm. The care was also taken to cover these seeds with thin layer of potting mixture.

Intercultural operation
The intercultural operation like irrigation, weeding was done as per the requirement. The irrigation was given with the help of watering can and proper care was taken to maintain the optimum soil moisture in polythene bags. Weeding was done to remove weeds germinating in polythene bags in order to avoid competition of weeds with seedling for nutrient and moisture. The following observations were recorded.

Observations recorded
Germination
1. Days required for germination
The treatment wise seed sown in polythene bag were observed daily for recording the germination, from the date of sowing up to 90 days. The date of first plumule emergence was recorded and days required for initiation of germination after sowing were computed and recorded.

2. Germination percentage (%)
The count of germinated seeds was taken at an interval of fifteen days after sowing of seeds. The percentage of germination was calculated from the number of seeds germinated in each treatment and recorded as percent germination.

Statistical method
The data in the present investigation was statistically analyzed by the method suggested by Panse and Sukhatme (1995) [7].

Results and Discussion
Effect of pre-sowing bioregulators seed treatment on germination in kokum
1. Days required for germination
The data regarding number of days required for initiation of germination are given in Table 1.

Table 1: Effect of pre-sowing bioregulators seed treatment on days required for commencement of germination in kokum

Treatments		Days required for germination
T_1	Control	30.67
T_2	10 ppm BA	28.00
T_3	20 ppm BA	27.33
T_4	25 ppm GA	19.33
T_5	50 ppm GA	17.67
T_6	10 ppm IBA	23.00
T_7	20 ppm IBA	21.33
T_8	5 ppm BA + 15 ppm GA	22.67
T_9	10 ppm BA + 30 ppm GA	23.33
T_{10}	5ppm BA+15 ppm GA+ 5 ppm IBA	23.67
	Range	17.67-30.67
	Mean	23.70
	Result	SIG
	S.Em±	0.92
	CD at 5%	2.17

Commencement of germination as affected by different bioregulators treatments in descending order is as follows,
$\underline{T_1 > T_2} > T_3 > \underline{T_{10} > T_9 > T_6 > T_8 > T_7} > \underline{T_4 > T_5}$
The perusal of data presented in Table 1 revealed that effect of various seed treatments on commencement of germination

in kokum was significant. The lowest number of days required for commencement of germination of kokum seed was recorded in T_5 (17.67 days), which was at par with T_4 (19.33 days) only. T_1 without any treatment took the highest number of days (30.67 days) for initiation of germination and was at par with T_2 (28 days) and significantly inferior to all other treatments.

In present investigation, the higher and early germination in GA presoaking seeds might be due to the exogenous application of GA antagonizes the effect of inhibitors (Wareing *et al.* 1968) [11] and increase endogenous gibberellin like substance (Mathur *et al.* 1971) [5]. The higher and early germination due to GA might be attributed primarily to ethylene production from the applied etherl and that the application of GA might have further enhanced its synthesis, thus causing synergistic effect.

Effect of GA in improving seed germination is well known, as it controls the food mobilizing system during the digestion and translocation of reserved food material. Further GA act as aleuron layer and enhance the production of α- amylase enzyme having key role in hydrolysis of starch to sugar which is trans located to the growing point of the embryo to provide energy for the growth.

Thus, from present investigation it was observed that the days required for germination showed significant results. The treatment T5 had required lowest days for germination, followed by T_4 as compared to untreated treatment (control). The results are in confirmation with Gawade (2008) [3] in custard apple.

2. Germination percentages

The germination percentage of seed is an important character in obtaining the maximum good quality seedlings and subsequent growth of plant.

The data regarding germination percentage as affected by different plant growth regulators are presented in Table 2.

It was recorded that germination percentage of kokum seeds affected by different concentrations of bioregulators and their combinations was significantly affected up to 90 days after sowing.

Table 2: Effect of pre-sowing bioregulators seed treatment on germination percentage in kokum

Treatments		30-DAS	45-DAS	60-DAS	75-DAS	90-DAS
T_1	Control	4.00 (11.28)	38.00 (38.01)	46.67 (43.08)	56.67 (48.85)	76.00 (60.75)
T_2	10 ppm BA	3.33 (10.40)	41.33 (39.94)	56.67 (48.86)	76.67 (61.29)	85.33 (67.55)
T_3	20 ppm BA	2.00 (6.56)	34.67 (36.05)	52.00 (46.15)	73.33 (59.08)	84.00 (66.53)
T_4	25 ppm GA	4.67 (12.03)	49.33 (44.62)	66.00 (54.62)	80.67 (64.42)	88.67 (70.97)
T_5	50 ppm GA	26.67 (30.99)	68.67 (56.03)	80.67 (63.99)	88.67 (70.68)	96.00 (80.68)
T_6	10 ppm IBA	4.67 (12.42)	36.00 (36.70)	58.67 (50.03)	78.67 (62.58)	90.67 (72.23)
T_7	20 ppm IBA	9.33 (17.53)	50.67 (45.39)	72.67 (58.67)	82.00 (65.45)	90.67 (73.45)
T_8	5 ppm BA + 15 ppm GA	2.00 (6.56)	38.67 (38.43)	60.67 (51.26)	75.33 (61.15)	88.67 (71.60)
T_9	10 ppm BA + 30 ppm GA	14.67 (22.37)	70.67 (57.21)	82.00 (64.97)	90.67 (72.37)	91.33 (73.25)
T_{10}	5 ppm BA+ 15 ppm GA+ 5 ppm IBA	20.67 (27.00)	61.33 (51.62)	78.67 (62.82)	89.33 (71.43)	90.00 (72.15)
	Range	6.56-30.98	36.04-57.21	43.08-64.96	48.84-72.37	60.75-80.68
	Mean	15.72	44.40	54.45	63.73	70.92
	Result	SIG	SIG	SIG	SIG	SIG
	S.Em±	2.28	2.40	2.52	3.18	3.01
	CD at 5%	6.78	7.13	7.48	9.45	8.94

DAS – Days After Sowing

At 30 DAS the highest germination percentage was recorded in the T_5 (26.67) and It was lowest in the treatment T_8 (2.00) and it was at par with T_3 (2.00), T_2 (3.33), T_1 (4.00), T_4 (4.67) and T_6 (4.67).

At 45 DAS the highest germination percentage was recorded in the T_9 (70.67) which was at par with T_5 (68.67) and T_{10} (61.33). It was lowest in the treatment T_3 (34.67) it was at par with T_6 (36.00), T_1 (38.00), T_8 (38.67) and T_2 (41.33).

Similarly at 60 DAS the highest germination percentage was recorded in the T_9 (82) which was at par with T_5 (80.67), T_{10} (78.67) and T_7 (72.67). It was lowest in the treatment T_1 (46.67) it was at par with T_3 (52.00), T_2 (56.67) and T_6 (58.67).

At 75 DAS the highest germination percentage was recorded in the T_9 (90.67) which was at par with T_{10} (89.33), T_5 (88.67), T_7 (82.00), T4 (80.67) and T_6 (78.67) and It was lowest in the treatment T_1 (56.67).

At 90 DAS the highest germination percentage was recorded in the T_5 (96.00) which was at par with T_9 (91.33), T_6 (90.67) and T_7 (90.67), T_{10} (90.00), T_4 (88.67) and T_8 (88.67) and It was lowest in the treatment T_1 (76.00) it was at par with T_3 (84.00).

The perusal of data presented in Table 2 revealed that effect of various seed treatments on germination percentage in kokum was significant.

30 DAS	$T_5 > T_{10} > T_9 > T_7 > T_4 > T_6 > T_1 > T_2 > T_3 > T_8$
45 DAS	$T_9 > T_5 > T_{10} > T_7 > T_4 > T_2 > T_8 > T_1 > T_6 > T_3$
60 DAS	$T_9 > T_5 > T_{10} > T_7 > T_4 > T_8 > T_6 > T_2 > T_3 > T_1$
75 DAS	$T_9 > T_{10} > T_5 > T_7 > T_4 > T_6 > T_2 > T_8 > T_3 > T_1$
90 DAS	$T_5 > T_9 > T_6 > T_7 > T_{10} > T_4 > T_8 > T_2 > T_3 > T_1$

Gibberellin action in some physiological processes like stimulation of growth, delay in senescence and stimulation of

α- amylase production. It shows similar effect in breaking seed dormancy rather than antagonistic effect (Burdett and Videver 1971) [2].

The data indicate that the all germination percentage improved than control. The treatment T_5 had significantly highest germination percentage at 90 DAS. The effect of presoaking of kokum seeds in growth regulators on seed germination and growth seedling Jadhav (1999) [4]. Similar results were obtained by Tendolkar (1978) [10] in sapota, Ratan and Reddy (2004) [8] and Gawade (2008) [3] in custard apple.

Conclusion

From the present study, it can be concluded that the bioregulators play vital role in seed germination. The results regarding effect of pre-soaking of seeds in bioregulators on germination parameters indicated that the treatment T_5 *i.e.* soaking of seeds in 50 ppm GA solution for 24 hrs. showed the best results for days required for commencement of germination (17.67 days) and had significantly highest (96.00) germination percentage at 90 DAS.

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