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Standardization of type of cuttings and optimization of IBA concentration for rooting in Crossandra (*Crossandra infundibuliformis*)

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Abstract
Three types of cuttings were taken from the crossandra field in the Botanical Garden, TNAU. Terminal, middle and bottom cuttings were taken from already established healthy, flowering crossandra plants. Terminal cuttings indicate the cuttings (10-15cm length with 2 nodes) that were taken from the tip/growing region of the crossandra plant. The tip/growing region is the terminal region of the plant. Middle cuttings (10 to 15cm length with 2 nodes) indicate those cuttings that were taken, leaving the terminal region i.e., 10 to 15 cm from the tip region. Bottom cuttings (10 to 15 cm length with 2 nodes) indicate those cuttings that were taken below the middle region i.e., taken leaving 30 cm from the terminal region. These cuttings were dipped in 100, 200, 300 ppm of IBA along with control prior to planting in portrays. The study revealed that the dipping of middle cuttings in 200 ppm of IBA had a positive influence on the root length, root volume, shoot girth parameters which may be suitable for better field establishment. Among the treatments, treatment of IBA 200 ppm with middle cuttings prior to planting proved superior in respect of root length, root volume, shoot girth and other important growth parameters.

Keywords: Crossandra, cuttings, IBA, growth

Introduction
There are about 20-25 species in the genus crossandra. It belongs to the family Acanthaceae. The species grown for commercial cultivation is *Crossandra infundibuliformis.* The orange type is the only variety commercially grown. Rooted cuttings of *C. infundibuliformis* cv. Delhi have to be treated with gibberellic acid or IBA with or without 1% urea, one month after planting and subsequently at bimonthly intervals for getting increased flower yield. Ascorbic acid spray 1000 ppm (1 g/ litre of water) before flowering also enhances the flower yield. By considering the above parameters, present investigation was carried out to study the effect of plant growth regulator IBA on three types of cuttings in Crossandra- Terminal, Middle and Bottom cuttings of 10 cm length.

Materials and Methods
An experiment was conducted to study the type of cuttings with different IBA concentration for rooting in Crossandra (*Crossandra infundibuliformis*). The experiment was carried out in Randomized block design with 12 treatments each with 2 replications. In crossandra, plants are propagated through seeds and cuttings. The main aim of this experiment was to standardize the type of cuttings and optimize the concentration of growth regulator-IBA (Rooting hormone) for better rooting and healthy establishment in the field. Three types of cuttings were taken from the crossandra field in the Botanical Garden, TNAU. Terminal, middle and bottom cuttings were taken from already established healthy, flowering crossandra plants. Terminal cuttings indicate the cuttings (10-15cm length with 2 nodes) that were taken from the tip/growing region of the Crossandra plant. These cuttings were dipped in 100, 200, 300 ppm of IBA along with control prior to planting in portrays. Two replications were made for each treatment.

Results and Discussion

1. Effect of IBA concentration and the type of cutting on growth parameters

- The crossandra cuttings- Terminal, Middle and Bottom cuttings were planted for rooting in protrays inside the mist chamber by dipping in different concentrations of IBA- 100 ppm, 200 ppm, 300 ppm during February 2017.The results revealed that different IBA concentrations on different cuttings have shown significant difference in the plant growth and physiological characters by improving the root length, root volume, shoot girth, single leaf area, fresh and dry weight of the plant, leaf area ratio, leaf weight ratio, specific leaf area, specific leaf weight, relative growth rate in certain treatments when compared to control.
- IBA concentration of 100 ppm on terminal cuttings followed by IBA concentration of 300 ppm on terminal cuttings showed increased root length of 14.90 cm and 12.90 cm respectively. Terminal cuttings with no IBA dip, IBA concentration of 200 ppm on middle cuttings, IBA concentration of 300 ppm on bottom cuttings recorded reduced root length of 7.60 cm, 7.70 cm, 7.90 cm respectively.
- Root volume was observed maximum (1.40 ml) in IBA concentration of 200 ppm with bottom cuttings followed by IBA 100 ppm with middle cuttings (1.30 ml). The minimum root volume of 0.30 ml was obtained in terminal and middle cuttings without IBA treatment.
- Shoot girth was recorded maximum (4.59 mm) in IBA concentration of 200 ppm on middle cuttings. The lowest shoot girth of 1.58 mm was found in IBA concentration of 300 ppm on bottom cuttings.
- During the entire duration of the study, IBA concentration of 200 ppm on middle cuttings exhibited highest single leaf area of 5.82 cm^2 in comparison to the other treatments. Terminal cuttings with no IBA dip were observed with lowest single leaf area of 2.10 cm^2.

2. Effect of IBA concentration and the type of cutting on physiological parameters

- The highest root fresh weight of 0.49 g was recorded with treatment involving IBA concentration of 200 ppm on bottom cuttings and the minimum was recorded with 0.006 g in the treatment involving terminal cuttings with no IBA dip. The highest leaf fresh weight of 0.49 g was recorded with treatment involving IBA concentration of 300 ppm on bottom cuttings and the minimum was recorded with 0.19 g in the treatment involving terminal cuttings with no IBA dip. Shoot fresh weight of 0.065 g was minimum in the terminal cuttings with no IBA dip and maximum in the IBA concentration of 200 ppm on middle cuttings with 0.23 g.
- Root dry weight of 0.08 g was the highest with the IBA concentration of 200 ppm on bottom cuttings and lowest with 0.006 g in the terminal cuttings with no IBA dip. Leaf dry weight was found maximum of 0.12 g in the treatment involving IBA concentration 300 ppm on the bottom cuttings and it was found minimum of 0.04 g in the treatment involving IBA concentration 100 ppm on terminal cuttings. Shoot dry weight was found maximum of 0.05 g in the treatment involving IBA concentration of 200 ppm on middle cuttings and it was found minimum of 0.01 g in the treatment involving terminal cuttings without IBA application.
- Leaf area ratio was found maximum of 181.99 cm^2/g in the treatment involving IBA concentration of 200 ppm on middle cuttings and it was found minimum of 117.19 cm^2/g in the treatment involving IBA concentration of 100 ppm on terminal cuttings.
- Leaf weight ratio was found maximum of 0.75 g/g in the treatment involving terminal cuttings with no IBA and it was found minimum of 0.33 g/g in the treatment involving IBA concentration 100 ppm on terminal cuttings.
- Specific leaf weight of 0.14 g/cm^2 recorded highest with the IBA concentration of 300 ppm on middle cuttings and the lowest of 0.06 g/cm^2 in the treatment involving IBA concentration 200 ppm on middle cuttings.
- Specific leaf area (17.85 cm^2/g) was found to be highest in the treatment involving IBA concentration of 200 ppm on middle cuttings and the lowest (6.93cm^2/g) in the treatment involving IBA 300 ppm on middle cuttings.

C_1T_1 - Terminal cuttings with 100 ppm IBA dip
C_1T_2 - Terminal cuttings with 200 ppm IBA dip
C_1T_3 - Terminal cuttings with 300 ppm IBA dip
C_1Control - Terminal cuttings with no IBA dip
C_2T_1 - Middle cuttings with 100 ppm IBA dip
C_2T_2 - Middle cuttings with 200 ppm IBA dip
C_2T_3 - Middle cuttings with 300 ppm IBA dip
C_2Control - Middle cuttings with no IBA dip
C_3T_1 - Bottom cuttings with 100 ppm IBA dip
C_3T_2 - Bottom cuttings with 200 ppm IBA dip
C_3T_3 - Bottom cuttings with 300 ppm IBA dip
C_3 Control - Bottom cuttings with no IBA dip

Table 1: Effect of IBA treatment on different types of cuttings on growth parameters

Treatments	Root length (cm)	Root volume (ml)	Root Fresh weight (g)	Root Dry weight (g)
C_1T_1	14.90	0.70	0.32	0.04
C_1T_2	11.40	1.20	0.25	0.05
C_1T_3	12.90	1.10	0.32	0.06
C_1Control	7.60	0.30	0.006	0.006
C_2T_1	12.10	1.30	0.33	0.05
C_2T_2	7.70	1.00	0.22	0.04
C_2T_3	10.90	0.70	0.34	0.03
C_2Control	11.60	0.30	0.20	0.03
C_3T_1	9.30	1.10	0.29	0.04
C_3T_2	10.60	1.40	0.49	0.08
C_3T_3	7.90	0.60	0.19	0.04
C_3Control	10.40	1.30	0.46	0.04
SEd	0.2276	0.0169	0.0072	0.0026
CD (0.05)	0.4721	0.0350	0.0150	0.0053

Table 2: Effect of IBA treatment on different types of cuttings on growth parameters

Treatments	Shoot girth (mm)	Shoot Fresh weight (g)	Shoot Dry weight (g)	Leaf Fresh weight (g)	Leaf Dry weight (g)	No. of leaves per plant	Leaf area (cm^2)	Single leaf area (cm^2)
C_1T_1	2.55	0.12	0.04	0.24	0.04	4	14.06	3.35
C_1T_2	3.05	0.12	0.03	0.37	0.08	8	23.45	2.93
C_1T_3	1.58	0.13	0.03	0.31	0.08	6	20.42	3.40
C_1Control	2.04	0.07	0.01	0.19	0.05	6	12.59	2.10
C_2T_1	3.48	0.16	0.02	0.38	0.08	6	21.90	3.65
C_2T_2	4.59	0.23	0.05	0.33	0.10	6	34.94	5.82
C_2T_3	3.24	0.14	0.03	0.36	0.08	8	20.00	2.50
C_2Control	3.36	0.12	0.03	0.22	0.05	5	12.90	2.58
C_3T_1	3.09	0.15	0.03	0.44	0.09	8	26.25	3.28
C_3T_2	3.25	0.13	0.03	0.40	0.07	6	23.73	3.95
C_3T_3	3.82	0.17	0.03	0.49	0.12	8	30.42	3.80
C_3Control	3.94	0.18	0.03	0.36	0.07	5	18.66	3.73
SEd	0.0802	0.0044	0.0014	0.0075	0.0029		0.5132	0.2026
CD(0.05)	0.1664	0.0090	0.0028	0.0156	0.0061		1.0644	0.4201

Table 3: Effect of IBA treatment on different types of cuttings on physiological parameters

Treatments	RGR (g/g/day)	SLA (cm^2/g)	SLW (g/cm^2)	LAR (cm^2/g)	LWR (g/g)
C_1T_1	0.008	14.49	0.07	117.19	0.33
C_1T_2	0.006	7.94	0.13	151.25	0.53
C_1T_3	0.008	10.98	0.09	118.72	0.48
C_1Control	0.02	10.98	0.09	182.43	0.75
C_2T_1	0.009	9.52	0.11	147.97	0.51
C_2T_2	0.014	17.85	0.06	181.99	0.53
C_2T_3	0.005	6.94	0.14	142.89	0.56
C_2Control	0.007	12.04	0.08	118.37	0.44
C_3T_1	0.006	7.57	0.13	161.06	0.56
C_3T_2	0.01	9.90	0.10	129.69	0.40
C_3T_3	0.02	7.75	0.13	164.43	0.62
C_3Control	0.013	10.41	0.01	138.25	0.48
SEd	0.0003	0.2026	0.0026	3.4430	0.0118
CD (0.05)	0.0006	0.4201	0.0054	7.1404	0.0246

Conclusion

It could be concluded that the IBA concentration of 200 ppm on the middle cuttings can be recommended for commercial propagation in Crossandra.

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