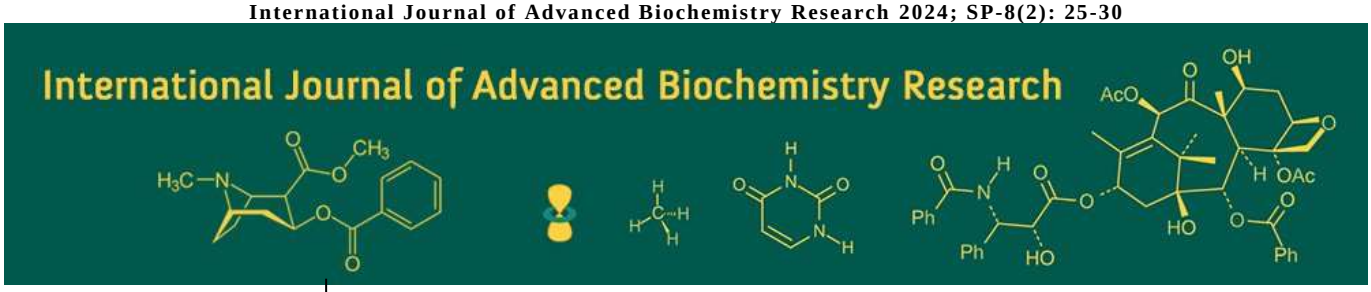

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Influence of growth regulators on growth, flowering, yield and quality attributes of Crossandra [*Crossandra infundibuliformis* (L.) Nees.] under the northern dry zone of Karnataka

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Abstract
The study was carried out to determine the effect of growth regulators on growth, flowering, yield, and quality parameters of Crossandra [*Crossandra infundibuliformis* (L.) Nees.]. Randomised Completely Block Design (RCBD) was used to conduct the experiment with 9 treatments of plant growth regulators *viz*., GA_3 (150, 200 ppm), NAA (150, 200 ppm), BAP (10, 20 ppm) and Humic acid (150, 200 ppm). The application of growth regulators influenced significantly for growth, flowering, and yield parameters among the treatments. Among the growth parameters at 60, 90 and 120 DAT, the highest plant height was observed with the application of GA_3 at 200 ppm (32.31 cm, 43.85 cm and 51.85 cm), which was on par with the application of GA_3 at 150 ppm (31.35 cm, 41.43 cm and 48.35 cm). In contrast, minimum plant height was recorded with untreated control plants (19.35 cm, 25.83 cm and 38.83 cm). The application of GA_3 at 200 ppm recorded the maximum number of primary (16.21) and secondary branches per plant (27.33). Plant spread NS (35.92), EW (48.86), and it was on par with GA_3 at 150 ppm number of branches primary (15.38), secondary (24.15) and plant spread in NS (32.62) and EW direction (46.92). Similarly, for flowering and yield traits, the first spike initiation occurred as early as 80.25 days, days taken for 50% flowering (90.15), days taken to first harvest (83.25) were significantly lower and duration of flowering (30.40), number of flowers per spike (29.65), number of spikes per plant (117.25), spike length (8.58 cm), weight of 100 flowers (6.89 g), flower yield per plant (136.45 g), flower yield per plot (2.28 kg) and flower yield per hectare (3164.64 kg) were found to be significantly higher with the application of GA_3 @ 200 ppm. For quality parameters, maximum corolla length (28.32 mm) and flower diameter (28.64 mm) were observed with GA_3 @ 200 ppm. From the results, the application of GA_3 @ 200 ppm was superior in growth, flowering, yield and quality attributing parameters compared to other treatments used in the study.

Keywords: Growth regulators, growth, flowering, yield, *Crossandra infundibuliformis* (L.) Nees.

1. Introduction
Crossandra [*Crossandra infundibuliformis* (L.) Nees.] is an important commercial loose flower crop. It belongs to the family Acanthaceae. It is a small evergreen shrub that is quite hardy. In contrast, in South India, temples use flowers to offer to the deities and make *gajras*, and *venis* are used to adorn the hair. In recent days area under commercial cultivation is increasing and has reached up to 4,700 ha in Karnataka, Tamil Nadu and Andhra Pradesh (Anon., 2016) [1]. In Karnataka, Koppal district is popular for cultivation of Crossandra with an area of 223 ha and placed next to Chikkaballapura, with an area of 229 ha. It is an economically important flower crop in the country, particularly in the southern region. Usage of growth regulators is common nowadays to enhance the yield. These growth regulators play an important role in modifying the growth and development process of the plant. The growth-regulating substances improve the physiological processes by regulating the rate of photosynthesis, photorespiration, transpiration, nutrient and water uptake, and leaf senescence. It imparts the resistance to biotic and abiotic stresses and leads to increase in the harvest index. The levels of naturally occurring hormones are altered by exogenously applied growth substances to produce their effects. The phenomenon varies with the concentrations, method of application, varieties, time of application, plant species, frequency of application,

and other factors that influence the absorption and translocation of these chemicals. Thus commonly used growth regulators GA3, NAA, BA were considered for altering the growth and development of plants.

2. Material and Methods

The study was conducted at the College of Horticulture, Munirabad of Koppal District, during the year 2020-21. A local genotype of orange-red was collected from the farmer's field of Irkalghada, Koppal district and has been mentioned as 'Koppal Local'. The required quantity of growth regulator was dissolved in 1000 ml of distilled water using suitable solvents wherever necessary. The final volume was made up to 1000 ml using distilled water by using growth regulator α-Naphthalene acetic acid (NAA) which was dissolved in two to three pellets of sodium hydroxide solution. The Gibberellic acid (GA_3) and Benzyl adenine purine (BAP) were dissolved in an organic solvent, whereas humic acid was directly dissolved in neutral P^H distilled water. Growth regulators (Himedia Laboratory Grade) were applied as foliar spray 45 and 90 days after transplanting. The experiment was laid out in a Completely Randomized Block Design with three replications and nine treatments. All recommended packages of practices were followed to raise a good crop. Different plant growth regulators and their concentrations used for the study are given below.

Different plant growth regulators and their concentrations used for the study are given below

Name of the growth promoters	Quantity of growth regulator used per 1000 ml of final solution	Final concentration (ppm)
Gibberellic acid (GA_3)	150 mg	150 ppm
	200 mg	200 ppm
α- Naphthalene acetic acid (NAA)	150 mg	200 ppm
	150 mg	150 ppm
BAP	10 mg 20 mg	10 ppm 20 ppm
Humic Acid	150 mg 200 mg	150 ppm 200 ppm
Control	Water spray	Water spray

3. Results and Discussion

The observations on the growth parameters of Crossandra, *viz.*, plant height, number of branches, leaf area, and plant spread (NS and EW), were analyzed and presented here.

The data about plant height (cm) recorded at 60, 90 and 120 days after transplanting (DAT), as influenced by treatments, including different growth regulators, are depicted in Table 1. Results of the analysis indicated a significant difference among treatments concerning the plant height (cm) due to growth regulators. At 60 DAT, plant height varied from 19.35 cm to 32.31 cm. The treatment GA_3 at 200 ppm (T_2) recorded the highest plant height (32.31 cm) which was on par with treatments T_1 - GA_3 @ 150 ppm (31.35 cm), T_8 - Humic acid @ 200 ppm (28.89), T_4- NAA @ 200 ppm (28.26 cm), T_6 - BAP @ 20 ppm (28.3 cm) T_7 - Humic acid @ 150 ppm (28.23 cm), T_5 - BAP @ 10 ppm (27.66 cm) and T_3 - NAA @ 150 ppm (27.36 cm), and the lowest plant height (19.35 cm) was observed in water sprayed control (T_9). At 90 DAT, the plant height was recorded from 25.83cm to 43.85 cm. Among the treatments, T_2 recorded the highest plant height of 43.85 cm, whereas the minimum plant height of 25.83 cm was recorded with water-sprayed control (T_9). Similarly, at 120 DAT, the plant height recorded maximum (51.85 cm) with GA_3 @ 200 ppm (T_2). The water sprayed control (T_9) recorded a minimum plant height of 38.83 cm.

This study showed that, there were significant differences among plant height with different growth promoter treatments at different Crossandra growth stages. The maximum plant height was observed by the application of GA_3 at 200 ppm and it also influenced to accelerate cell division and enlargement as per the study conducted by Mandava (1988) [9] in Crossandra. The exogenous application of GA_3 might have enhanced enhanced cell division, cell enlargement and promotion of protein synthesis which resulted in favourable vegetative growth (Girish, 2012) [6].

Table 1: Influence of different plant growth regulators on plant height at different growth stages of Crossandra cv. Koppal Local

Treatments	Plant height (cm) at different growth stages		
	60 DAT	90 DAT	120 DAT
T_1- GA3 @ 150 ppm	31.35	41.43	48.35
T_2- GA3 @ 200 ppm	32.31	43.85	51.85
T_3- NAA @ 150 ppm	27.36	38.69	45.69
T_4- NAA @ 200 ppm	28.26	39.62	48.62
T_5- BAP @ 10 ppm	27.66	35.73	41.23
T_6- BAP @ 20 ppm	28.30	36.87	41.87
T_7- Humic acid @ 150 ppm	28.23	36.56	42.56
T_8- Humic acid @ 200 ppm	28.89	36.93	41.93
T_9- Control (Water spray)	19.35	25.83	38.83
S. Em. ±	1.58	2.44	2.58
CD @ 5%	4.75	7.32	7.74

DAT- Days After Transplanting

The Table 2 represents the data about number of primary branches per plant as influenced by different treatments. The number of primary branches per plant at 60 DAT was significantly superior to other treatments. A maximum number of primary branches per plant (5.96) was recorded with the treatment, including T_2 - GA_3 @ 200 ppm, which was found to be on par with T_1 - GA_3 @ 150 ppm (5.83), T_3 - NAA @ 150 ppm (4.92) and T_8 - Humic acid @ 200 ppm (4.98). The minimum number of primary branches per plant (3.12) was recorded with water-sprayed control (T_9). Further, the number of primary branches per plant at 90 DAT varied significantly among the different growth regulator treatments. It was found to be maximum (10.38) in treatment T_2- GA_3 @ 200 ppm, whereas the lowest (5.54) was observed in water sprayed control (T_9).

Significant differences for the said trait also continued to be noticed at 120 DAT. The highest number of secondary branches was recorded with treatment T_2 including spray of GA_3 @ 200 ppm (16.21) which was on par with T_1 - GA_3 @ 150 ppm (15.38), while NAA @ 150 ppm (13.21), NAA @ 200 ppm (13.63) and BAP @ 10 ppm (13.56), BAP @ 20

ppm (13.89), humic acid @ 150 ppm (13.63) and humic acid @ 200 ppm (13.87) were on par with each other. In contrast, water sprayed control recorded the lowest number of branches per plant (10.78). Significant differences for the said trait also continued to be noticed at 120 DAT. The highest number of secondary branches per plant was recorded with treatment T_2, including spray of GA_3 @ 200 ppm (27.33), which was on par with T_1 - GA_3 @ 150 ppm (24.15). In contrast, the control recorded the lowest number of secondary branches per plant (20.12). This stimulation of branches may be attributed due to the breakage of apical dominance. Similar results were reported by Binisundar *et al*. (2008) [13] in Crossandra, Lal and Mishra (1986) [8] in Aster and Marigold, Shetty (1995) [14] and Doddagoudar (2002) [15] in China Aster and Padmapriya and Chezhiyan (2003) [11] in chrysanthemum and Amit *et al*. (2011) [16] in African marigold.

Table 2: Influence of plant growth regulators on number of branches per plant at different growth stages of Crossandra cv. Koppal Local

Treatments	Number of primary branches per plant at different growth stages			Number of secondary branches per plant
	60 DAT	90 DAT	120 DAT	120 DAT
T_1- GA_3 @ 150 ppm	5.83	9.89	15.38	24.15
T_2- GA_3 @ 200 ppm	5.96	10.38	16.21	27.33
T_3- NAA @ 150 ppm	4.92	8.59	13.21	23.33
T_4- NAA @ 200 ppm	4.78	8.63	13.63	24.66
T_5- BAP @ 10 ppm	4.62	8.97	13.56	22.46
T_6- BAP @ 20 ppm	4.87	9.23	13.89	23.13
T_7- Humic acid @ 150 ppm	4.75	8.68	13.63	22.66
T_8- Humic acid @ 200 ppm	4.98	8.96	13.87	24.16
T_9- Control (Water spray)	3.12	5.54	10.78	20.12
S. Em. $\pm$	0.36	0.70	0.64	0.97
CD @ 5%	1.08	2.11	1.92	2.92

DAT- Days After Planting

Data about the plant spread East-West (cm) as influenced by growth regulator treatments has been presented in Table 3. The treatments differed significantly for plant spread at 90 DAT, which ranged from 18.63 cm to 28.98 cm. The treatment, including T_2 - GA_3 @ 200 ppm, exhibited the widest canopy spread of 28.98 cm in the East-West direction, which was on par with the rest of the treatments. Meanwhile, the least plant spread of 18.63 cm was observed in water-sprayed control (T_9). Significant variation was also observed among the treatments at 90 days after transplanting for differences in the plant spread in the East-West direction. Plant spread ranged from 22.86 cm to 33.89 cm. The treatments differed significantly for plant spread East-West at 120 days after transplanting, and it was observed in the range from 39.32 cm to 48.86 cm. The treatment T_2 (GA_3@ 200 ppm) showed the widest spread of canopy of 48.86 cm, which was on par with all the other treatments used in the study except water sprayed control (T_9), which recorded a minimum plant spread of 39.32 cm.

Data about plant spread at different stages of crop growth under the influence of the application of different growth regulators has been presented in Table 3. The treatments differed significantly for plant spread at 60 days after transplantation, and it was observed in the range from 13.13 cm to 23.87 cm. The canopy spread in the north-south direction was at its maximum (23.87 cm) with T_2 - GA_3 @ 200 ppm, which was on par with GA_3 @ 150 ppm (21.46 cm). The least plant spread of 13.13 cm was observed in the North-South direction in water sprayed control (T_9). A significant difference was observed concerning plant spread in the North-South direction among the different treatments at 90 DAT. Plant spread in the North-South direction ranged from 18.63 cm to 28.98 cm. The treatment GA_3 @ 200 ppm (T_2) had the maximum plant spread (28.98 cm), which was on par with all the other treatments. The least plant spread (18.63 cm) was observed with water sprayed control (T_9). A continued significant difference was observed among the treatments at 120 DAT concerning plant spread in the North-South direction. Plant spread in the North-South direction was recorded from 23.86 cm to 35.92 cm. The treatment GA_3 @ 200 ppm (35.92 cm) had the maximum plant spread, whereas the least plant spread of 23.86 cm was recorded with water sprayed control (T_9) treatment.

Table 3: Influence of plant growth regulators on the plant spread at different stages of crop growth cv. Koppal Local

Treatments	Plant Spread East-West (cm) at different growth stages			Plants spread North-South (cm) at different growth stages		
	60 DAT	90 DAT	120 DAT	60 DAT	90 DAT	120 DAT
T_1- GA_3 @ 150 ppm	28.36	31.62	46.13	21.46	28.36	32.62
T_2- GA_3 @ 200 ppm	28.98	33.89	48.86	23.87	28.98	35.92
T_3- NAA @ 150 ppm	26.53	29.34	46.67	20.12	26.23	29.00
T_4- NAA @ 200 ppm	26.23	31.13	45.65	21.48	26.53	28.79
T_5- BAP @ 10 ppm	25.86	28.69	45.86	21.35	25.86	28.69
T_6- BAP @ 20 ppm	26.23	29.31	46.78	22.76	26.23	29.31
T_7- Humic acid @ 150 ppm	26.68	29.43	46.43	21.36	26.68	29.43
T_8- Humic acid @ 200 ppm	26.89	29.89	46.92	22.40	26.89	31.22
T_9- Control (Water spray)	18.63	22.86	39.32	13.13	18.63	23.86
S. Em. $\pm$	1.81	1.79	1.5	1.51	1.83	1.62
CD @ 5%	5.43	5.30	4.52	4.55	5.50	4.86

DAT-Days After Transplanting

The Table 4 comprises data on flowering parameters like days for flower spike initiation, days to 50 percent flowering, days taken to first harvest and duration of flowering (days) after transplanting. Treatments differed significantly for the parameter days taken for the first flower initiation. The treatment GA_3 @ 200 ppm (T_2) was early to flower at 80.25 DAT, which was on par with T_1 - GA_3 @ 150 ppm (83.67 days), T_8 - Humic acid @ 200 ppm (85.45 days) and T_7 - Humic acid @ 150 ppm (84.61 days) and T_3 - NAA @ 150 ppm (84.67 days). The treatment T_9 - water sprayed control was late to initiate the floral spike (89.33 days). The treatments differed significantly for days taken to 50 percent flowering. The treatment GA_3 @ 200 ppm (T_2) was early to attain 50 percent flowering in 90.12 DAT, whereas the sprayed control treatment (T_9) was late to reach 50 percent flowering (102.35 days). In general, the plants treated with GA_3 showed early flowering than untreated plants. This is attributed due to the effect of gibberellins, as gibberellins influenced florigen harmone. It acts as catalyst for the formation of flowers, leading to early harvesting of flowers and enhancing flowering duration. These results are on par with the study conducted by Binisundar *et al*. (2008) [13] in Crossandra, Girish *et al*. (2012) [6] in Daisy and Doddagoudar *et al*. (2004) [4] in China aster.

Table 4: Influence of plant growth regulators on flowering parameters in crossandra cv. Koppal Local

Treatments	Days for flower initiation	Days to 50 percent flowering	Days taken to first harvest	Duration of flowering (days)
T_1- GA_3 @ 150 ppm	83.67	95.67	86.75	28.19
T_2- GA_3 @ 200 ppm	80.25	90.12	83.25	30.40
T_3- NAA @ 150 ppm	84.67	95.67	88.33	28.15
T_4- NAA @ 200 ppm	86.67	96.93	90.54	26.35
T_5- BAP @ 10 ppm	86.33	98.33	89.85	25.61
T_6- BAP @ 20 ppm	86.61	98.67	90.15	25.45
T_7- Humic acid @ 150 ppm	85.45	96.45	88.59	27.41
T_8- Humic acid @ 200 ppm	84.61	95.61	87.67	26.61
T_9- Control (Water spray)	89.33	102.35	93.45	24.57
S. Em. ±	1.93	0.49	1.98	0.95
CD @ 5 %	5.99	5.48	5.92	2.85

The treatments differed significantly for days taken to record the first harvest. The treatment GA_3 @ 200 ppm (T_2) was early to harvest at 83.25 days after transplanting, which was statistically on par with T_1 - GA_3 @ 150 ppm (86.75 days), T_8 – Humic acid @ 200 ppm (87.67 days), T_3 - NAA@ 150 ppm (88.33 days) and T_7 - Humic acid @ 150 ppm (88.59 days). The water sprayed control (T_9) treatment was late in recording the first harvest of flowers (93.45 DAT). Results revealed a significant variation among different growth regulator treatments on the duration of flowering in spike. Flowering duration was maximum in the treatment, including GA_3 @ 200 ppm (30.40 days) and minimum in water sprayed control (24.57 days).

The data about yield parameters like number of flowers per spike, number of spikes per plant, spike length (cm), 100 flowers weight (g), flower yield per plant (g), flower yield per plot (kg) and flower yield per hectare are presented in Table 5. Results revealed a significant difference among the different growth regulators for the parameter number of flowers per spike. The production of flowers per spike was at its maximum (29.65) with the treatment T_2 - GA_3 @ 200 ppm and was found to be on par with all remaining treatments. Meanwhile, the production of flowers per spike was significantly minimal (20.34) in the water-sprayed control (T_9). Data about the number of spikes per plant as influenced by different growth regulators are presented in Table 19. Among the treatments, there was a significant difference in the number of spikes per plant. Number of spikes per plant ranged from 68.68 to 117.25. The treatment GA_3 @ 200 ppm had the maximum spikes per plant (117.25). The least number of spikes per plant was observed with water-sprayed control treatment (68.68).

Results revealed a significant variation among the different growth regulators for the spike length trait. Spike length recorded maximum (8.58 cm) with T_2 GA_3 @ 200 ppm and was found superior over T_1- GA_3 @ 150 ppm (8.26 cm) and T_4 - NAA @ 200 ppm (7.62 cm). A minimum spike length (4.85) was observed in the sprayed control treatment (T_9). The parameters, like the weight of 100 flowers, varied significantly among the treatments, including different growth regulators used in the study. The maximum 100 flower weight of 6.89 g was observed with treatment T_2- GA_3 @ 200 ppm and was on par with the remaining treatments. The weight of 100 flowers was the lowest (3.58 g) in the sprayed control treatment (T_9). Treatments differed significantly for flower yield per plant. The treatment T_2 - GA_3 @ 200 ppm recorded maximum flower yield per plant (136.45 g) and was on par with T_1 - GA_3 @ 150 ppm (128.75 g), T_4 – NAA @ 200 ppm (120.52 g), T_8 - Humic acid @ 200 ppm (119.22 g) and T_3 – NAA @ 150 ppm (118.25 g). Meanwhile, the treatment T_9 - water sprayed control recorded a minimum (79.18 g).

There was a significant difference observed for the trait flower yield per plant. The treatment T_2 - GA_3 @ 200 ppm recorded maximum flower yield per plot (2.28 kg) and was on par with other treatments except treatments including humic acid at both 150 and 200 ppm. The minimum flower yield per plot of 1.75 kg was recorded with water-sprayed control treatment (T_9). Application of different growth regulators influenced the trait flower yield per hectare. The treatment T_2 - GA_3 at 200 ppm noticed maximum flower yield per hectare (3164.64 kg per ha) and was significantly superior over all other treatments. The minimum flower yield per hectare (2429 kg/ha) was recorded with water-sprayed control treatment. The data about the B:C ratio in different treatments is presented in Table 15. Among the different treatments, GA_3 at 200 ppm was given the maximum B: C ratio (2.46) and NAA (2.46), followed by GA_3 at 150 ppm (2.35) and minimum B: C ratio (2.07) was in control (Table 5). This might be due to the optimum plant stature, increased number of primary and secondary branches, leaf area and plant spread, which enables increased amount of photosynthesis. It ultimately leads to accumulation of maximum dry matter, increases flower duration, yield, and quality parameters. This outcome of the study is similar with the findings of Kulkarni (2004) [7], in chrysanthemum by using GA_3.

Table 5: Influence of plant growth regulators on yield parameters in crossandra cv. Koppal Local

Treatments	No. of flowers Per spike	No. of spikes per plant	Spike length (cm)	Weight of 100 flowers (g)	Flower yield (g/plant)	Flower yield (kg/plot)	Flower yield (kg/ha)	B:C ratio
T_1- GA_3 @ 150 ppm	28.65	115.30	8.26	6.21	128.75	2.12	2942.56	2.35
T_2- GA_3 @ 200 ppm	29.65	117.25	8.58	6.89	136.45	2.28	3164.64	2.46
T_3- NAA @ 150 ppm	26.87	105.24	7.20	5.88	118.25	1.96	2720.48	2.24
T_4- NAA @ 200 ppm	27.63	107.36	7.62	5.98	120.52	2.24	3109.12	2.46
T_5- BAP @ 10 ppm	26.45	101.56	6.82	5.78	96.51	1.96	2720.48	2.24
T_6- BAP @ 20 ppm	25.35	103.25	6.87	5.95	94.68	1.98	2748.24	2.26
T_7- Humic acid @ 150 ppm	26.43	105.25	6.96	5.75	110.98	2.01	2789.88	2.28
T_8- Humic acid @ 200 ppm	26.68	107.62	6.98	5.81	119.22	2.06	2859.28	2.32
T_9- Control (Water spray)	20.34	68.68	4.85	3.58	79.18	1.75	2429.00	2.07
S. Em. ±	1.59	6.20	0.44	0.54	7.00	0.02	7.20	
CD @ 5%	4.76	18.60	1.31	1.63	20.98	0.05	21.39	

Spraying of GA_3 at 200 ppm increased the yield and quality parameters by enhancing reproductive efficiency and photosynthesis in restructured plant types. The treatment influenced to produce more flowers per plant and ultimately increased the flower yield per plot. This can be endorsed to the translocation from source to sink. Similar outcomes were reported by Binisundar *et al*. (2008) [13] in Crossandra, Shetty (1995) [14], Doddagoudar *et al.* (2004) [4] in China aster.

The results related to quality parameters are presented in Table 6. The parameter flower diameter (mm) differed significantly due to growth regulators ranging from 19.62 mm to 28.64 mm. Among the treatments induced, maximum flower diameter (28.64 mm) was recorded with T_2- GA_3 @ 200 ppm and was found to be on par with T_1- GA_3 @ 150 ppm (27.58 mm), T_4- NAA@ 200 ppm (26.45 mm) and T_7- Humic acid @ 150 ppm (26.11 mm), whereas, the minimum flower diameter (19.62 mm) was recorded with water sprayed control (T_9). Corolla length differed significantly due to growth regulators ranging from 17.35 mm to 28.32 mm. Among treatments, T_2 - GA_3 @ 200 ppm recorded a significant maximum corolla length (28.32mm), which was on par with T1 – GA_3 @ 150 ppm (27.63 mm), T8 – (26.95 mm), T_4 – NAA @ 200 ppm (26.87 mm) and T6 – BAP @ 20 ppm (26.89 mm). The lowest corolla length was observed with water-sprayed control (17.35 mm). This might be due to the production of good quality and quantity parameters of flowers. Similar findings were also reported by Kulkarni (2004) [7] in chrysanthemum.

Table 6: Influence of different plant growth regulators on quality parameters of crossandra cv. Koppal Local

Treatments	Corolla length (mm)	Flower diameter (mm)
T_1- GA3 @ 150 ppm	27.63	27.58
T_2- GA3 @ 200 ppm	28.32	28.64
T_3- NAA @ 150 ppm	26.25	25.32
T_4- NAA @ 200 ppm	26.87	26.45
T_5- BAP @ 10 ppm	25.38	24.53
T_6- BAP @ 20 ppm	25.89	25.13
T_7- Humic acid @ 150 ppm	26.38	26.11
T_8- Humic acid @ 200 ppm	26.95	25.87
T_9- Control (Water spray)	17.35	19.62
S. Em. ±	0.82	0.87
CD @ 5 %	2.46	2.62

4. Conclusion

Based on the results of the present investigation, the application of growth regulators significantly influenced the growth, flowering, yield, and quality attributes of Crossandra. Application of GA_3 @ 200 ppm was ideal for maximizing plant growth, flowering, yield, and quality parameters. Thus, using growth regulators Gibberlic acid (GA_3) @ 200 ppm as foliar spray can be recommended for achieving maximum sustainable flower yield in Crossandra.

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