www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 885-889

www.thepharmajournal.com
Received: 22-08-2022
Accepted: 28-09-2022

Shaik Rehana
Department of Floriculture and Landscape Architecture, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Andhra Pradesh, India

M Madhavi
Department of Fruit Science, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Andhra Pradesh, India

AVD Dorajee Rao
Department of Floriculture and Landscape Architecture, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Andhra Pradesh, India

P Subbaramamma
Department of Plant Physiology, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Andhra Pradesh, India

Corresponding Author:
Shaik Rehana
Department of Floriculture and Landscape Architecture, College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Andhra Pradesh, India

Floral yield and quality attributes of *Crossandra* (*Crossandra infundibuliformis* L.) var. Arka Shravya affected by cutting types and IBA pretreatments

Shaik Rehana, M Madhavi, AVD Dorajee Rao and P Subbaramamma

Abstract
An experiment was conducted to evaluate the effect of cutting types (terminal and semi hardwood cuttings) and IBA pretreatments (100, 200, 300 ppm as prolonged dip for 24h and 1000, 2000 and 3000 ppm as quick dip for 10 sec and 0 ppm as control) on the success of vegetative propagation and field performance of *Crossandra* (*Crossandra infundibuliformis* L.) var. Arka Shravya. The terminal and Semi hardwood cuttings of *Crossandra* were treated with different IBA concentrations (100, 200, 300 ppm as prolonged dip for 24h and 1000, 2000 and 3000 ppm as quick dip for 10 sec and 0 ppm as control) and planted in a factorial randomized block design with two replications. The data collected on account of all the yield and quality attributing traits *viz*., spike length (cm), spike number, flower yield (g), flower size (cm^2) and weight of 100 flowers (g) were significantly influenced by both the cutting types and IBA pretreatments and recorded higher values with the terminal cuttings treated with IBA quick dip @ 3000 ppm for 10 sec. However, non-significant results were recorded in terms of flower longevity on the plant and shelf life after harvest, indicating the non-influence of cutting types and IBA pretreatments in extending the shelf life of *Crossandra* flowers.

Keywords: *Crossandra*, cutting types, IBA pretreatments, flower yield, quality attributes, shelf life

Introduction
In India, loose flowers are grown in an area of 3.39 lakh hectares with a production of 19.91 lakh metric tons among which *Crossandra* is an important commercial flower crop mainly grown in southern states like Andhra Pradesh, Tamil Nadu and Karnataka. In Andhra Pradesh loose flowers are grown in an area of 22.43 thousand hectares with a production of 397.38 thousand metric tonnes (National Horticulture Board, 2018-19) [7] out of which *Crossandra* occupies an area of 1,158 hectares with a production of 2,352 tons with an average yield of 2,029 kg/ha (Directorate of Economics and Statistics, 2017-18) [3]. *Crossandra* botanically called *Crossandra infundibuliformis* L. (Nees) belonging to family Acanthaceae is native to the Arabian Peninsula, tropical Africa, Madagascar, India and Sri Lanka (Brickell, 1996) [2]. It is commonly called as fire cracker plant, which is an evergreen shrub that produces profuse flowers on dense sessile spikes throughout the year with an economic life of 3 years. The *Crossandra* plant bears reddish orange flowers that are used as loose flowers and have a high value in the Indian flower market accounting for Rs.300-400/Kg. Although *Crossandra* flowers are non-fragrant, they are very popular because of their attractive bright orange colour, less weight and good keeping quality. The flowers are offered to temple deities and mostly used as loose flowers for hair adornment and making garlands, gajras and venis. As *Crossandra* flowers are not fragrant, they are used in combination with jasmine to produce a charming colour contrast in making floral ornaments. It is commonly cultivated as a loose flower in India and it is also grown as an ornamental pot flower in Sweden, Denmark and Hungary (Ottosen and Christensen, 1986) [9].

Materials and Methods
The present investigation was conducted during the year 2018-19 at the College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, West Godavari District, Andhra Pradesh, India. The experimental design adopted was factorial randomized block design with two replications comprising fourteen treatments from two factors i.e., cutting types and IBA pretreatments which are listed hereunder:

T_1: Terminal cutting + Prolonged dip in IBA solution @ 100 ppm for 24 h
T_2: Terminal cutting + Prolonged dip in IBA solution @ 200 ppm for 24 h

T_3: Terminal cutting + Prolonged dip in IBA solution @ 300 ppm for 24 h
T_4: Terminal cutting + Quick dip in IBA solution @ 1000 ppm for 10 sec
T_5: Terminal cutting + Quick dip in IBA solution @ 2000 ppm for 10 sec
T_6: Terminal cutting + Quick dip in IBA solution @ 3000 ppm for 10 sec
T_7: Terminal cutting + No IBA treatment
T_8: Semi hardwood cutting + Prolonged dip in IBA solution @ 100 ppm for 24 h
T_9: Semi hardwood cutting + Prolonged dip in IBA solution @ 200 ppm for 24 h
T_{10}: Semi hardwood cutting + Prolonged dip in IBA solution @ 300 ppm for 24 h
T_{11}: Semi hardwood cutting + Quick dip in IBA solution @ 1000 ppm for 10 sec
T_{12}: Semi hardwood cutting + Quick dip in IBA solution @ 2000 ppm for 10 sec
T_{13}: Semi hardwood cutting + Quick dip in IBA solution @ 3000 ppm for 10 sec
T_{14}: Semi hardwood cutting + No IBA treatment

Terminal cuttings were taken from the top portion of shoots and semi hardwood cuttings from one-year old branches and pretreated with respective IBA concentrations and planted in polybags containing cocopeat, vermicompost, soil and FYM (2:2:2:1 ratio) as rooting media. Properly rooted healthy cuttings of 75 days old were transplanted into a well-prepared experimental field at a spacing of 45 x 45 cm and 10-15 cm deep. Light irrigation was given immediately after planting. The standard cultural practices were followed throughout the study and five plants were selected at random and tagged in each replication of respective treatments for the purpose of recording observations on flower yield and quality traits. The data collected was statistically analyzed by adopting the procedure described by Panse and Sukhatme (1985) [10].

Results and Discussion

1) Yield attributes

Various yield attributes like spike length (cm), number of spikes per plant, number of spikes per square meter, number of flowers per spike, flower yield per plant (g) and flower yield per square meter (g) were significantly influenced by both the cutting types and IBA pretreatments which were discussed hereunder-

Table 1: Yield attributes of *Crossandra* var. Arka Shravya affected by cutting types and IBA pretreatments

Treatments	Spike length (cm)	Number of spikes per plant	Number of spikes per square meter	Number of flowers per spike	Flower yield per plant (g)	Flower yield per square meter (g)
T_1	26.00	34.55 (5.96)	172.25 (13.16)	50.40 (7.16)	122.04	585.00
T_2	26.40	37.70 (6.22)	188.00 (13.74)	51.80 (7.26)	136.65	662.50
T_3	26.50	39.90 (6.39)	199.00 (14.14)	51.95 (7.27)	145.09	707.50
T_4	26.80	42.30 (6.58)	211.00 (14.56)	52.65 (7.32)	155.87	762.50
T_5	28.20	44.30 (6.73)	221.00 (14.89)	53.00 (7.34)	164.34	797.50
T_6	29.90	48.20 (7.01)	240.50 (15.53)	53.80 (7.40)	181.52	880.00
T_7	23.50	25.10 (5.10)	124.75 (11.21)	48.00 (7.00)	84.33	395.00
T_8	25.90	31.45 (5.69)	156.75 (12.56)	50.15 (7.15)	110.40	530.00
T_9	26.20	33.10 (5.83)	165.00 (12.88)	51.50 (7.24)	117.16	565.00
T_{10}	26.20	36.40 (6.11)	181.50 (13.50)	51.70 (7.25)	126.67	610.00
T_{11}	26.70	40.00 (6.40)	199.50 (14.16)	52.30 (7.30)	146.43	707.50
T_{12}	27.00	42.80 (6.61)	213.50 (14.64)	52.85 (7.33)	158.33	770.00
T_{13}	28.20	46.70 (6.90)	232.75 (15.28)	53.25 (7.36)	174.07	847.50
T_{14}	22.50	19.65 (4.54)	97.75 (9.93)	46.50 (6.89)	63.95	305.00
Mean	26.42	37.29 (6.14)	185.94 (13.58)	51.41 (7.23)	134.77	651.78
S.E(m) ±	0.18	0.03	0.08	0.012	2.28	8.68
CD at 5%	0.58	0.11	0.25	0.039	7.05	26.80

* The figures in parenthesis indicate square root transformed values

1. Spike length (cm)

Spike length was measured for five labelled spikes in each tagged plant of a treatment and the average was worked out in centimeters. Maximum spike length (29.90) was recorded in terminal cuttings pretreated with IBA quick dip @ 3000 ppm (T_6) followed by 28.20 in both semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}) and terminal cuttings treated with IBA quick dip @ 2000 ppm (T_5) whereas minimum spike length (22.50) was recorded with IBA @ 0 ppm in semi hardwood cuttings (T_{14}). Early establishment with enhanced enzymatic activity and faster mobilization of photosynthates which were diverted towards the sink resulting in strength of sink was the reason for the increase in spike length in the well-established terminal cuttings of *Crossandra* (Ullah *et al*., 2013) [11].

2. Number of spikes per plant

The number of spikes produced per plant was counted for all the tagged plants in a treatment for up to 90 days after transplanting and the average was worked out. The maximum number of spikes per plant (48.20) was highest in terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}) which produced 46.70 spikes per plant. The minimum number of spikes (25.10 and 19.65) were recorded with IBA @ 0 ppm in both types of cuttings *viz.*, terminal (T_7) and semi hardwood (T_{14}) respectively. Promotion of lateral branches with respect to plant height may be one of the factors that contributed to an increase in the number of branches per plant which in turn significantly produced a greater number of spikes per plant in terminal cuttings. Another reason may be an increase in metabolic rate with the effect of auxins in plants increased the photosynthetic activity and enhanced food accumulation which might have resulted in better growth and subsequently higher number of spikes per plant (Girisha *et al*., 2012) [5].

3. Number of spikes per square meter

The number of spikes produced by plants in one square meter of area was counted up to 90 days from transplanting and the average was worked out. The maximum number of spikes produced per square meter (240.50) were highest in terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}) recorded 232.75 spikes per square meter. Whereas minimum number of spikes per square meter (124.75 and 97.75) was noticed with IBA @ 0 ppm in both the types of cuttings *viz.,* terminal (T_7) and semi hardwood (T_{14}) respectively. Promotion of lateral branches with respect to plant height (cm) contributed to an increase in primary branches per plant giving rise to secondary and tertiary branches that produced a greater number of spikes per plant and ultimately resulted in increased spike yield per square meter in *Crossandra*.

4. Number of flowers per spike

The number of flowers produced per spike was counted for all the labelled spikes of the tagged plants and the average was worked out. Significantly maximum number of flowers per spike (53.80) was recorded in the terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by (53.25) semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}). The minimum number of flowers (48.00 and 46.50) per spike was recorded with treatment IBA @ 0 ppm in both types of cuttings *viz.,* terminal (T_7) and semi hardwood (T_{14}) respectively. Use of auxin as a rooting hormone enhanced several physiological and metabolic processes that led to an increase in enzymatic activity and cellular changes. The advancement of these activities caused a significant difference in vegetative and reproductive growth of plants (Nickel, 1990) [8]. Increased concentration of IBA as a growth promoting chemical supported the advancement in the physiology of plants and pronounced the maximum effect in terms of flower yield. The results of Bharmal *et al.* (2005) [1] in chrysanthemum, Girisha *et al.* (2012) [5] in daisy and Ullah *et al.* (2013) [11] in marigold are close to the present findings.

5. Flower yield per plant (g)

Flower yield per plant was recorded by taking the fresh weight of flowers in each picking and summing up the fresh weight of flowers in all pickings. The average flower yield of plants up to 90 days was calculated and expressed in grams. Highest flower yield per plant (181.52 g) was achieved in terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by (174.07 g) semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}). The minimum (84.33 g and 63.95 g) flower yields were recorded with IBA @ 0 ppm (T_7) in both types of cuttings *viz.,* terminal (T_{13}) and semi hardwood (T_{14}) respectively. Increase in flower yield may be due to an increase in the number of branches per plant which produced a greater number of spikes giving rise to flowers with maximum size resulting in increased weight of single flower. The increased metabolic activity of plant may have led to better production of photosynthates in source and accumulation of food materials in the sink caused an increase in flower yield per plant (Girisha *et al.*, 2012) [5].

6. Flower yield per square meter (g)

The flower yield per square meter area was worked out by adding the yield obtained in each picking from a square meter area and the average flower yield per square meter was expressed in grams. Maximum flower yield per square meter (880.00 g) was significant in terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by (847.50 g) semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}). The minimum flower yield per meter square (395.00 g and 305.00 g) was recorded with IBA @ 0 ppm in both types of cuttings *viz.,* terminal (T_7) and semi hardwood (T_{14}) respectively. An increase in the number of primary branches, number of spikes, flower number per spike and size of flowers resulted in the maximum flower yield per plant, which ultimately resulted in increase of flower yield per square meter (Kishan *et al.*, 2007) [6].

2) Flower quality parameters

The cutting types (terminal and semi hardwood) and IBA pretreatments significantly influenced various yield attributes like flower size (cm^2) and weight of flowers (g) but longevity and shelf life of flowers were not affected by both the treatments.

Table 2: Effect of cutting types and IBA pretreatments on quality traits of *Crossandra* var. Arka Shravya

	Flower size (cm^2)	Weight of 100 flowers (g)	Longevity of flower on plant (days)	Shelf life of flowers (days)
T_1	6.52	6.680	3.55 (2.13)	2.30 (1.81)
T_2	6.55	6.705	3.57 (2.13)	2.62 (1.90)
T_3	6.56	6.720	3.61 (2.14)	2.62 (1.90)
T_4	6.64	6.750	3.67 (2.16)	2.70 (1.92)
T_5	6.62	6.845	3.85 (2.20)	2.70 (1.92)
T_6	6.72	7.000	4.00 (2.23)	2.75 (1.93)
T_7	6.25	6.635	3.37 (2.09)	2.25 (1.80)
T_8	6.34	6.660	3.47 (2.11)	2.25 (1.80)
T_9	6.39	6.660	3.50 (2.11)	2.30 (1.81)
T_{10}	6.45	6.730	3.56 (2.13)	2.50 (1.86)
T_{11}	6.55	6.735	3.63 (2.15)	2.62 (1.90)
T_{12}	6.60	6.740	3.71 (2.17)	2.70 (1.92)
T_{13}	6.66	6.895	3.87 (2.20)	2.75 (1.93)
T_{14}	6.20	6.560	3.37 (2.09)	2.20 (1.78)
Mean	6.50	6.736	3.62 (2.14)	2.51 (1.87)
S.E(m) ±	0.009	0.014	0.04	0.04
CD at 5%	0.027	0.043	NS	NS

* The figures in parenthesis indicate square root transformed values

1. Flower size (cm^2)

The length and breadth of each flower were measured for five flowers produced on tagged spikes in each treatment and the flower size was calculated by multiplying length and breadth. The average flower size was worked out and expressed in cm^2. The maximum (6.72) flower size (cm^2) was significant in terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by (6.66 cm^2) semi hardwood cuttings with IBA quick dip @ 3000 ppm (T_{13}) while the minimum flower size (cm^2) 6.25 and 6.20 was observed with the treatment of IBA @ 0 ppm in both terminal (T_7) and semi hardwood cuttings (T_{14}) respectively. Rapid mobilization and accumulation of metabolites influenced the floral morphogenesis and resulted in bigger sized flowers as reported by Doddagoudar *et al.* (2004) [4] in China aster. Also, better translocation of food materials to the flowers increased the sink strength might have influenced flower diameter (Girisha *et al.*, 2012 and Ullah *et al.*, 2013) [5, 11].

2. Weight of 100 flowers (g)

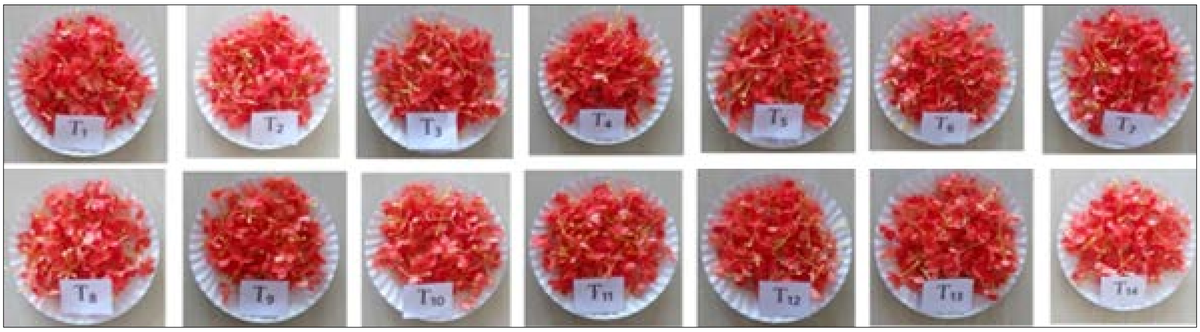
Five samples each of hundred flowers were collected from five tagged plants in each treatment at full bloom stage and the fresh weight of flowers was recorded with the help of an electronic balance. The average weight of 100 flowers was worked out and expressed in grams. Weight of 100 flowers was found maximum (7.00 g) in terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by (6.89 g) semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}). Whereas, it was recorded minimum (6.63 g and 6.56 g) with treatment of IBA @ 0 ppm in both the types of cuttings *viz.*, terminal (T_7) and semi hardwood (T_{14}) respectively. Rapid mobilization and accumulation of metabolites influenced the floral morphogenesis resulting in bigger sized flowers with maximum length and breadth which increases flower weight ultimately led to increased weight of 100 flowers (g).

3. Longevity of flower on plant

Number of days the flowers remained in a marketable condition on a plant from the day of opening in a spike was counted in each treatment and the average was worked out. The interaction between cutting types and IBA treatments for longevity of flower on plant was non-significant. However highest flower longevity on plant of about 4.00 days was found in terminal cuttings treated with IBA quick dip @ 3000 ppm (T_6) followed by (3.87 days) semi hardwood cuttings treated with IBA quick dip @ 3000 ppm (T_{13}), whereas the minimum in situ flower longevity of about 3.37 days was observed in both the types of cuttings *viz.*, terminal (T_7) and semi hardwood (T_{14}) respectively treated with IBA @ 0 ppm. The variations observed among cutting types, IBA treatments and their interactions were non-significant for longevity of flower on plant (d) as both the cutting types and IBA pretreatments to the cuttings did not influence the longevity of flower on plant.

4. Shelf life of flowers

Hundred flowers were collected from the tagged plants in each treatment and considered as a unit. The shelf life of flowers was measured in terms of number of days from the date of harvest to until 50 per cent the flowers in each sample turn unfit for use (browning of the corolla). There were no significant differences among the shelf life (d) of harvested flowers. However, flowers survived for longer period with a good mean shelf life (2.75 days) in the treatment of IBA quick dip @ 3000 ppm in both terminal (T_6) and semi hardwood cuttings (T_{13}) whereas the minimum mean days (2.20) of freshness of flowers were recorded with IBA @ 0 ppm (T_{14}) in semi hardwood cuttings. There was a non-significant interaction between cutting types and IBA treatments for the shelf life of flowers. Since, there was no promotive effect in increasing the shelf life of flowers after harvest by both cutting types and IBA pretreatments.



i. Freshly harvested flowers

ii. Flowers on third day after harvest

Picture 1: Flowers of *Crossandra* var. Arka Shravya harvested from different treatments for shelf-life studies

Conclusion

Both terminal and semi hardwood cuttings can be used for propagation of *Crossandra*. Pretreatment of terminal cuttings with IBA quick dip @ 3000 ppm for 10 sec was proved to be effective in achieving maximum yield with good quality flowers in the *Crossandra* var. Arka Shravya.

References

1. Bharmal VS, Ranpise SA, Darwade RT. Effect of different levels of Indole Butyric Acid (IBA) on rooting, growth and flower yield of chrysanthemum cv. Sonali Tara. Orissa Journal of Horticulture. 2005;33(2):36-41.
2. Brickell. A-Z Encyclopedia of Garden Plant. Dorling Kindersley, London; c1996. p. 319.
3. Directorate of Economics and Statistics; c2017-18. Agricultural Statistics at a Glance, Government of Andhra Pradesh. https://core.ap.gov.in/cmdashboard.
4. Doddagoudar SR, Vyakaranahal BS, Shekhargouda M. Effect of chemical sprays on seed quality parameters of China aster. Journal of Ornamental Horticulture.

2004;7(3-4):135-137.
5. Girisha R, Shirol AM, Reddy S, Patil VK, Krishnamurthy GH. Growth, quality and yield characteristics of daisy (*Aster amellus* L.) cultivar Dwarf Pink as influenced by different plant growth regulators. Karnataka Journal of Agricultural Sciences. 2012;25(1):163-165.
6. Kishan S, Singh KP, Raju DVS. Vegetative growth, flowering and seed characters of African marigold (*Tagetes erecta* L.) as influenced by different growth substances during mild off seasons. Journal of Ornamental Horticulture. 2007;10(4):268-270.
7. National Horticulture Board. Ministry of Agriculture and Farmers welfare. 1st Advance Estimates; c2018-19, Government of India, Gurgaon, New Delhi. http://www.nhb.gov.in.
8. Nickel LG. Plant growth regulators. Agricultural uses. Springer, New York; c1990. p. 4-5.
9. Ottosen CO, Christensen OU. Gartenbauwissenschaft. 1986;51(4):156-159.
10. Panse V, Sukhatme P. Statical methods for Agricultural workers. ICAR, New Delhi; c1985.
11. Ullah Z, Abbas SJ, Naeem N, Lutfullah G, Malik T, Khan MAU, Khan I. Effect of Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) plant growth regulators on marigold (*Tagetes erecta* L.). African Journal of Agricultural Research. 2013;8(29):4015-4019.