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## Evaluation of crossandra (*Crossandra undulaefolia* Salisb.) genotypes under Eastern dry zone of Karnataka

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### Abstract

An experiment was carried out to evaluate eight genotypes of crossandra for growth flowering behaviour, yield and quality traits at floriculture section, College of Horticulture, UHS campus, Gandhi Krishi Vignana Kendra post, Bengaluru, Karnataka during 2016-17. Significantly wide variation was recorded in vegetative and floral traits. The maximum plant height was observed with the genotype 'Arka Shrivya' (56.95 cm). The plant spread in north – south direction and east – west direction was maximum in 'Arka Shrivya' (60.09 cm & 60.21 cm, respectively). The genotype 'Arka Shreeya' induced maximum number of primary branches (9.00) and secondary branches (29.73) per plant while the leaf area was maximum (25.90 cm<sup>2</sup>) in the genotype 'Arka Ambara'. As regards to flowering parameters viz., days to flower initiation (102.00 days), days to 50 per cent flowering (109.33 days) and days to first harvest (105.33 days) were recorded early in the genotype 'Arka Shreeya' while maximum duration of flowering was recorded in 'Arka Shrivya' (45.00 days). Quality parameters viz., flower diameter (3.87 cm) and corolla length (2.58 cm) were recorded maximum in the genotype 'Arka Shreeya' with the color intensity of Orange red 35 B. 'Arka Shrivya' recorded the maximum number of flowers per spike (42.00) and spike length (10.79 cm) while the number of spikes per plant (131.73) and hundred flowers weight (8.40 g) recorded maximum in the genotype 'Arka Shreeya'. The flower yield per plant (232.60 g) and flower yield per hectare (12.79 t) was maximum in 'Arka Shrivya'. On basis of these observations, the genotype Arka Agni is found promising for commercial cultivation under Eastern dry zone of Karnataka.

**Keywords:** Crossandra, genotypes, growth, flowering, quality and yield

### Introduction

Flower cultivation has a great potential to spin money, hence grown all over the country in approximately 2,43,000 ha area (loose flowers) with production of 22,36,000 metric tonnes of loose flowers and 6,91,000 metric tonnes of cut flowers (Anon., 2015-16) [2]. Out of this total floricultural area, 2/3<sup>rd</sup> area is under traditional flower cultivation. Cultivation of traditional flowers has been practiced in our country from time immemorial. Among the traditional flowers, marigold is one among them which is commercially cultivated in India.

Crossandra (*Crossandra undulaefolia* Salisb.), commonly known as 'Fire cracker flower', is an important commercial traditional flower crop belonging to the family Acanthaceae. The word 'crossandra' is derived from Greek word 'krossi' means 'fringe', 'Aner' means, male', i.e., 'fringed anthers'. It is believed to be native to South India and Sri Lanka. It is an economically important ornamental crop in the country, more particularly in the southern region. Its flowers are very popular due to their attractive bright color and light weight. It has a very high market demand, fetching a high price in the Indian flower market. This flower is also a valuable ornamental pot flower in Sweden, Denmark and Hungary.

Many public/private varieties have been released for commercial cultivation, however their performance is not assessed for their suitability in this region, hence an investigation on evaluation of crossandra genotypes to assess their performance with respect to growth, flowering, yield and quality was carried out.

### Material and Methods

The experiment was conducted at Department of Floriculture and Landscape Architecture, College of Horticulture, UHS campus, Bengaluru with an objective to find out the suitable crossandra genotype for the commercial cultivation under Eastern dry zone of Karnataka.

Statistical design used for this experiment was RCBD (Randomized Completely Block Design) with eight treatments with three replications. The treatments in each replication were allotted randomly. The genotypes include, Arka Shrivya, Arka Shreeya, Arka Kanaka, Arka Ambara, Pondicherry Local, Kengeri Local, Mandya Local and Bengaluru Local. The land was brought to a fine tilth by repeated ploughing and harrowing. Thirty days old healthy and uniformly grown seedlings were used for transplanting with a spacing of 60 cm x 30 cm. The crop was raised by standard cultural practices. Fertilizer application, weeding, plant protection etc. were carried out as per the package of practice (Anon, 2016) [3]

The observations on vegetative, flowering, yield and quality parameters were recorded from five randomly selected tagged plants in each plot.

## Results and Discussion

### Vegetative parameters

Significant differences were found with respect to plant height at 30, 60, 90, 120 and 150 days after transplanting as shown in the Table 1. Among the eight genotypes, 'Bengaluru Local' (16.21 cm) recorded maximum plant height at 30 DAT, while it was minimum in 'Arka Shrivya' (7.22 cm). At 60 DAT, 'Arka Shreeya' recorded maximum height (24.90 cm) followed by 'Bengaluru Local' (22.87 cm) while minimum plant height was recorded in the genotype 'Pondicherry Local' (18.26 cm). 'Arka Shrivya' recorded the maximum plant height at 90 DAT (39.47 cm) followed by 'Arka Shreeya' (33.96 cm) and minimum was plant height found with 'Pondicherry Local' (25.89 cm).

**Table 1:** Plant height (cm) of different genotypes of crossandra at different stages of growth

Treatments / varieties	Days after transplanting				
	30 DAT	60DAT	90DAT	120DAT	150DAT
T <sub>1</sub> - Arka Shrivya	7.22	22.59	39.47	47.94	56.95
T <sub>2</sub> - Arka Shreeya	15.59	24.90	33.96	39.47	45.40
T <sub>3</sub> - Arka Kanaka	11.71	21.25	33.88	44.27	51.86
T <sub>4</sub> - Arka Ambara	11.85	19.83	27.73	34.11	41.83
T <sub>5</sub> - Pondicherry Local	10.57	18.26	25.89	35.82	43.42
T <sub>6</sub> - Kengeri Local	13.88	20.01	27.81	33.60	38.85
T <sub>7</sub> - Mandya Local	10.56	22.05	32.90	41.97	49.61
T <sub>8</sub> - Bengaluru Local	16.21	22.87	32.46	40.02	46.06
S.Em ±	0.84	1.14	1.92	1.95	2.22
CD @ 5%	2.56	3.45	5.82	5.93	6.74
F test	*	*	*	*	*

At 120 DAT and 150 DAT, the genotype 'Arka Shrivya' recorded the maximum plant height (47.94 cm & 56.95 cm, respectively) while the minimum plant height was recorded with the genotype 'Kengeri Local' (33.60 cm & 38.85 cm, respectively). These variations in the plant height is due to the fact that the plant height being a genetically controlled factor. Similar variation in plant height among different accessions and germplasm was also observed previously by Ramachandrudu *et al.* (2010) [15], Ashwath *et al.* (2007) [4] and Ashwath *et al.* (2009) [5] in crossandra.

Significant differences were found among the genotypes with respect to number of primary and secondary branches at grand growth stage (150 days after planting) as shown in Table 2. Number of primary branches was higher in 'Arka Shreeya' (9.00) and it was on par with 'Arka Kanaka' (8.40). Secondary branches were found significantly higher in 'Arka Shreeya' (29.73) which was superior to the other genotypes.

**Table 2:** Study on vegetative characters of different crossandra genotypes at grand growth stage (150 DAT)

Treatments / varieties	Number of branches at 150 DAT		Plant spread at 150 DAT		Leaf area (cm <sup>2</sup> ) at 150DAT
	Primary branches	Secondary braches	North – south (cm)	East – west (cm)	
T <sub>1</sub> - Arka Shrivya	4.60	18.13	60.09	60.21	18.89
T <sub>2</sub> - Arka Shreeya	9.00	29.73	40.67	46.35	19.40
T <sub>3</sub> - Arka Kanaka	8.40	26.67	47.82	59.58	23.74
T <sub>4</sub> - Arka Ambara	5.87	19.07	45.11	50.61	25.90
T <sub>5</sub> - Pondicherry Local	6.00	23.80	36.60	42.31	22.20
T <sub>6</sub> - Kengeri Local	5.53	15.33	27.61	30.59	18.00
T <sub>7</sub> - Mandya Local	6.60	21.20	42.01	47.01	22.53
T <sub>8</sub> - Bengaluru Local	5.67	16.13	37.85	43.44	21.70
S.Em ±	0.43	1.03	2.86	3.67	1.03
CD @ 5%	1.29	3.13	11.72	11.14	3.11
F test	*	*	*	*	*

The difference in branches among the varieties could be due to the influence of the genetical makeup of the varieties. Similar variation for number of branches were also observed previously by Ramachandrudu *et al.* (2010) [15], Ashwath *et al.* (2007) [4] and Ashwath *et al.* (2009) [5] in crossandra, Poornima *et al.*, (2006) [14] in China aster and by Baskaran *et al.* (2004) in chrysanthemum.

'Arka Shrivya' showed the maximum plant spread in North to South directions (60.09 cm) which is significantly higher than the other genotypes followed by 'Arka Kanaka' (47.82 cm). 'Arka Shrivya' recorded the maximum spread in East to West directions (60.21 cm) and it was on par with 'Arka kanaka' (59.58 cm) and 'Arka Ambara' (50.61 cm). The difference in plant spread is a varietal trait and is probably

governed by the genetic makeup. Varietal differences in plant spread were reported by Kulkarni and Reddy (2006) [8] in China aster and Rao *et al.* (2005) [16], Singh and Singh (2006) [18] in marigold (Table 2).

Leaf area per plant was maximum in 'Arka Ambara' (25.90 cm<sup>2</sup>) and 'Arka Kanaka' (23.74 cm<sup>2</sup>). Higher leaf area in these cultivars was due to the increased number of leaves. Lesser number of leaves resulted in minimum leaf area per plant (18.00 cm<sup>2</sup>) in 'Kengeri Local'. Since cultivars varied for their number of leaves accordingly their leaf area also varied. Variation in leaf area in different genotypes was also recorded previously by Suma (2003) [19] in daisy, Metha *et al.* (1995) in marigold and Sankaret *et al.* (2003) in gerbera (Table 2).

### Flowering attributes

Significant differences were observed among the crossandra genotypes for the time taken for first flowering. The genotype 'Arka Shreeya' was first to show its visible flowers (102.00 Days after planting) which was on par with 'Arka Kanaka', 'Arka Ambara', 'Arka Shravya' and 'Bengaluru Local' (102.67 DAT, 102.67 DAT, 103.67 DAT & 104.00 DAT respectively) whereas 'Kengeri Local' took relatively more number of days for first flowering. The genotype 'Arka Shreeya', which was the earliest to initiate the first flowering, was early to reach 50 per cent flowering (109.33 DAT). The varieties 'Kengeri Local' and 'Pondicherry Local' took more number of days (132.00 and 121.33, respectively) to reach 50% flowering. The variations in first flowering may be due to genetic trait and maybe influence of solar radiation and

temperature (Table 3).

With respect to days to first harvest, 'Arka Shreeya' (105.33 days) was recorded minimum number of days as it was early to initiate flowers. 'Kengeri Local' took 116.67 days to first harvest as it was late to initiate flowers. Similar variations due to varietal trends were also observed China aster by Agandi (2000) and in marigold by Vijayalaxmi (1998) [20] (Table 3).

With respect to flower duration concerned, the genotype 'Arka Shravya' (45.00 days) recorded the maximum duration of flower per spike, this is because the length of spike was maximum in 'Arka Shravya', while 'Kengeri Local' (23.00 days) recorded minimum duration of flower as it recorded the shortest spike. Similar variations in flowering duration were reported by Poornima *et al.* (2006) [14] in China aster and by Kumar and Yadav (2005) [9] in gerbera (Table 3).

**Table 3:** Floral characteristics of different genotypes of crossandra

Treatments / varieties	Parameters			
	Days for flower initiation	Days to 50 per cent flowering	Days taken to first harvest	Duration of flowering (days)
T <sub>1</sub> - Arka Shravya	103.67	115.33	106.67	45.00
T <sub>2</sub> - Arka Shreeya	102.00	109.33	105.33	35.67
T <sub>3</sub> - Arka Kanaka	102.67	114.33	106.00	35.00
T <sub>4</sub> - Arka Ambara	102.67	115.00	105.33	37.00
T <sub>5</sub> - Pondicherry Local	107.33	121.33	109.33	29.00
T <sub>6</sub> - Kengeri Local	114.00	132.00	116.67	23.00
T <sub>7</sub> - Mandya Local	111.67	120.00	114.67	25.33
T <sub>8</sub> - Bengaluru Local	104.00	110.67	108.00	26.33
S.Em ±	1.30	1.20	1.36	1.52
CD @ 5%	3.95	3.64	4.13	4.60
F test	*	*	*	*

### Quantitative, quality and yield parameters

The genotype 'Arka Shravya' recorded the maximum number of flowers per spike (42.32) which is due to maximum length of spike (10.79 cm) compared to all other genotypes. Number of spikes per plant were recorded maximum in the genotype 'Arka Shreeya' (131.73) while the minimum number of spikes per plant (42.07), spike length (5.20 cm) and minimum number of flowers per spike (25.44) were recorded in the genotype 'Kengeri Local'. Minimum number of spikes in a plant might be due to less number of primary and secondary branches whereas, spike length and number of flowers per spike is genetically controlled. A similar variation was also observed in crossandra accessions (Ramachandrudu *et al.*, 2010) [15] and Poornima *et al.* (2006) [14] in China aster (Table

5).

The genotype 'Arka Shreeya' (3.87 cm) recorded maximum flower diameter while the genotype 'Bengaluru Local' (2.51 cm) recorded the minimum flower diameter. With regard to corolla tube length, it was maximum in 'Arka Shravya', 'Arka Shreeya' and 'Arka Kanaka' (2.58 cm) closely followed by 'Arka Ambara' (2.57 cm) and the genotype 'Bengaluru Local' (2.48 cm) recorded the minimum length (Table 4). This variation may be due to differences in the genetic makeup of varieties. The variations in flower diameter and stalk length among the varieties were also reported earlier in different crossandra accessions (Ramachandrudu *et al.*, 2010) [15] and also in different germplasm of crossandra (Ashwath *et al.*, 2009) [5].

**Table 4:** Qualitative characters of different genotypes of crossandra

Treatments / varieties	Parameters	
	Flower diameter (cm)	Corolla tube length (cm)
T <sub>1</sub> - Arka Shravya	3.04	2.58
T <sub>2</sub> - Arka Shreeya	3.87	2.58
T <sub>3</sub> - Arka Kanaka	3.32	2.58
T <sub>4</sub> - Arka Ambara	3.49	2.57
T <sub>5</sub> - Pondicherry Local	2.77	2.55
T <sub>6</sub> - Kengeri Local	2.54	2.54
T <sub>7</sub> - Mandya Local	2.58	2.45
T <sub>8</sub> - Bengaluru Local	2.51	2.48
S.Em ±	0.05	0.03
CD @ 5%	0.14	0.08
F test	*	*

The maximum weight of hundred flowers (8.40 g) was recorded in 'Arka Shreeya' followed by 'Arka Ambara' (8.20 g) which were statistically on par with each other for individual flower weight (Table 5). Crossandra genotypes differed significantly for

flower yield per plant. Flower production was significantly maximum (232.60 g/plant) in the genotype 'Arka Shravya' while the genotype 'Kengeri Local' recorded minimum (98.33 g/plant) flower yield per plant (Table 5).

**Table 5:** Quantitative and yield parameters of different genotypes of crossandra

Treatments	Quantitative parameters			Yield parameters			
	No. of flowers Per spike	No. of spikes per plant	Spike length (cm)	100 flower weight (g)	Flower yield (g/plant)	Flower yield (kg/plot)	Flower yield (t/ha)
T <sub>1</sub> - Arka Shrivya	42.32	119.53	10.79	6.33	232.60	3.15	12.79
T <sub>2</sub> - Arka Shreeya	26.45	131.73	5.84	8.40	181.73	3.09	9.99
T <sub>3</sub> - Arka Kanaka	26.24	127.20	6.04	7.07	157.47	2.36	8.65
T <sub>4</sub> - Arka Ambara	28.59	112.53	6.43	8.20	140.73	2.50	7.74
T <sub>5</sub> - Pondicherry Local	25.60	109.4	6.09	6.50	125.87	2.10	6.92
T <sub>6</sub> - Kengeri Local	25.44	42.07	5.20	4.63	98.33	1.44	5.41
T <sub>7</sub> - Mandya Local	26.13	113.80	6.77	4.93	128.87	2.38	7.08
T <sub>8</sub> - Bengaluru Local	28.19	98.87	6.83	4.50	113.40	2.04	6.23
S.Em ±	1.10	5.09	0.22	0.16	7.11	0.11	0.39
CD @ 5%	3.33	15.45	0.66	0.49	21.56	0.33	1.19
F test	*	*	*	*	*	*	*

There was significant difference among the genotypes with respect to flower yield per plot and per hectare. Maximum flower yield per hectare was recorded in the genotype 'Arka Shrivya' (12.79 t/ha) while it was lowest (5.41 t/ha) in the genotype 'Kengeri Local' (Table 5). Flower yield per plant is directly related to flower yield per plot and per hectare. These findings are similar with the findings reported earlier in crossandra by Ramachandrudu *et al.* (2010) [15], in marigold by Narsude *et al.* (2010) [13], Naik *et al.* (2005) [11], Nandakishor and Raghava (2001) [12] and Bhanupratap *et al.*

(1999) [7].

### Economics of crossandra production

Significant difference was observed among the genotypes for benefit to cost ratio. The maximum benefit to cost ratio was recorded in the genotype Arka Shrivya whereas, the lowest was recorded in the genotype Kengeri Local. It is clear that higher the yields, higher would be the returns. In addition, the total cost of cultivation and the market price for the produce plays a vital role on the net returns (Table 6).

**Table 6:** Economics of crossandra cultivation of different genotypes

Treatments	Yield (t/ha)	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B: C ratio
T <sub>1</sub> - Arka Shrivya	12.79	4,58,008.00	25,58,000.00	20,99,992.00	5.58
T <sub>2</sub> - Arka Shreeya	9.99	4,41,508.00	19,98,000.00	15,56,492.00	4.52
T <sub>3</sub> - Arka Kanaka	8.65	4,71,208.00	17,30,000.00	12,58,792.00	3.67
T <sub>4</sub> - Arka Ambara	7.74	4,61,308.00	15,48,000.00	10,86,692.00	3.35
T <sub>5</sub> - Pondicherry Local	6.92	4,51,408.00	13,84,000.00	9,32,592.00	3.06
T <sub>6</sub> - Kengeri Local	5.41	6,09,808.00	10,82,000.00	4,72,192.00	1.77
T <sub>7</sub> - Mandya Local	7.08	5,30,608.00	14,16,000.00	8,85,392.00	2.66
T <sub>8</sub> - Bengaluru Local	6.23	3,84,308.00	12,46,000.00	8,61,692.00	3.24

### References

- AGANDI SM. Studies on the performance of China aster (*Callistephus chinensis* Ness.) cultivars. M.Sc. Thesis, University of Agricultural Sciences, Dharwad. 2000.
- Anonymous. National Horticulture Board, 2016, Area and production of Horticulture crops 2015-2016 (3<sup>rd</sup> Advance estimate).
- Anonymous. University of Horticultural Sciences, Bagalkot, Package of practice. 2016.
- Ashwath T, Rao M, Ramachandran N. Promising crossandra (*Crossandra undulaefolia* Salisb.)F<sub>1</sub> hybrids IHR 2004-09 and 2004-11.J.Orn. Hort. 2007;10(1):64-66.
- Ashwath T, Rao M, Ramachandran N. Promising crossandra F<sub>1</sub>hybrids IHR 2005-1 and 2005-2. J. Orn. Hort. 2009;12(3):211-212.
- Baskaran V, Janakiram T, Jayanthi R. Varietal evaluation in chrysanthemum. Karnataka J Hort. 2004;1(1):23-27.
- Bhanupratap Tewari GN, Mishra LN, Pratap B. Correlation studies in marigold J Orn. Hort. 1999;2(2):84-88.
- Kulkarni BS, Reddy BS. Vegetative growth and flower yield as influenced by different cultivars of China aster. Haryana J. Hort. Sci. 2006;35:269.
- Kumar R, Yadav DS. Evaluation of gerbera (*Gerbera jamesonii* Bolus ex Hooker F.) cultivars under the tropical hills of Meghalaya J Orn. Hort. 2005;8(3):212-215.
- Mehta SH, Nadkarni HR, Rangawala AD. Performance of African marigold (*Tagetes erecta* L.) in Konkan region of Maharashtra. Indian J. Agric. Sci. 1995;65(11):810-812.
- Naik Hemla B, Patil AA, Basavarj N, Patil VS. Stability analysis for growth, yield and flower color (xanthophyll) in African marigold (*Tagetes erecta* L.). Karnataka. J Hort. 2005;1(3):28-36.
- Nandakishor, Raghava SP. Variability studies in African marigold. J Orn. Hort. 2001;4(2):105-111.
- Narsude PB, Kadamb AS, Patil VK. Studies on the growth and yield attributes of different African marigold genotypes under Marathwada conditions. The Asian J Hort. 2010;5(2):284-286.
- Poornima G, Kumar DP, Seetharam GK. Evaluation of China aster (*Callistephus chinensis* L. Ness) genotypes under hill zone of Karnataka J. Orn. Hort. 2006;9(3):208-211.
- Ramachandrudu K, Thangam M. Characterization and evaluation of local germplasm of crossandra (*Crossandra undulaefolia* Salisb.)J. Orn. Hort. 2010;13(2):138-141.
- Rao CC, Goud PV, Reddy KM, Padmaja G. Screening of African marigold (*Tagetes erecta* L.) cultivars for flower yield and carotenoid pigments. Indian J Hort.

2005;62(3):276-279.

17. Sankar M, Sreelatha U, Rajeevan PK, Bhaskar J, Krishnan S. Varietal evaluation of gerbera (*Gerbera jamesonii* Bolus.) under low cost greenhouse. Nat. Sym. Rec. Adv. Indian Flori, 12<sup>th</sup>-13<sup>th</sup>Nov, Proc. Indian Soc. Orn. Hort, 2003, 172-174pp.
18. Singh D, Singh AK. Characterization of African marigold (*Tagetes erecta* L.) genotypes using morphological characters. J. Orn. Hort. 2006;9(1):40-42.
19. Suma. Evaluation of daisy (*Aster amellus* L.) genotypes M. Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka, India. 2003.
20. Vijayalaxmi P. Evaluation of dwarf marigold (*Tagetes patula* L.) varieties under Northern traditional tract of Karnataka. M.Sc.(Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka, India.