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Evaluation of China aster [*Callistephus chinensis* (L.) Nees] F_1 Hybrids and Parents for Growth, Flower quality, Yield and Postharvest life

Pratiksha Kumari*, Rajiv Kumar, T. Manjanatha Rao, T. Usha Bharathi, M.V. Dhananjaya and V. Bhargav

Division of Floriculture and Medicinal Crops, ICAR-Indian Institute of Horticultural Research, Hesaraghatta Lake Post, Bengaluru 560 089, Karnataka, India
**Corresponding author*

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A B S T R A C T

China aster [*Callistephus chinensis* (L.) Nees.] Belongs to the family Asteraceae and is native of China. It is grown as cut flower, loose flower, bedding plant, for flower decoration, for preparation of bouquets and garlands. The objective of this study was to evaluate the performance F_1 hybrids for qualitative and quantitative characters. The experiments were conducted in 2015-17 in the Research Field of the Division of Floriculture and Medicinal Crops, at ICAR- Indian Institute of Horticultural Research, Hesaraghatta Lake Post, Bengaluru. Fifteen F_1 hybrids in Line x Tester involving five female (Arka Kamini, Arka Poornima, Arka Aadya, Arka Archana, Arka Violet Cushion) and three pollen parents (Arka Shashank, Local Violet, Local Pink) were evaluated for vegetative growth, flower quality, yield and postharvest life. Among the hybrids, hybrid-8 was the best performer with highest number of leaves/plant (312.47), number of branches/plant (23.19), number of flowers per plant (93.66), highest weight of flowers/plant (293 g) and flower yield per hectare (24.68 tonne). Hybrid-4 recorded maximum plant height (73.16 cm) and longest (28.92 days) duration of flowering.

Introduction

China aster [*Callistephus chinensis* (L.)Nees.] Belongs to the family Asteraceae and is native of China. The genus *Callistephus* derives its name from two Greek words '*Kalistos*' and '*Stephos*' meaning 'most beautiful' and 'a crown', respectively. China aster is one of the most preferable flower crops cultivated widely due to its wide spectrum of attractive colours and comparatively longer vase life (Chaitra and Patil, 2007). It is an important commercially flower crop grown as cut flower, loose flower, bedding plant, for flower decoration, for preparation of bouquets and garlands. The flowers of China aster are used for flower arrangement, interior decoration, garland making, worshipping (Munikrishnappa, 2013).

In addition to its cultivation, China aster can be used in landscape gardening to provide mass aesthetic effect. It is estimated to be grown in 1,020 ha with a production of flower 800 million tonnes in India. China aster is commercially grown by marginal and small

farmers in Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra and West Bengal (Raghava, 1984). This crop can be grown throughout the year under Bangalore conditions (Rao *et al.,* 1997).

In India, breeding in China aster was first pioneered by S.S. Negi and S.P.S Raghava during 1984-85. Work on this aspect at ICAR-IIHR, Bangalore led to the development of quality and high yielding varieties such as Arka Kamini, Arka Poornima, Arka Shashank and Arka Violet Cushion. Suneetha *et al.,* (2003) estimated genetic diversity of twenty eight varieties of China aster. Khangjarakpam *et al.,* (2014) studied four China aster genotypes released from ICAR-IIHR, Bangalore such as Kamini, Poornima, Shashank and Violet Cushion and their reciprocal cross combinations *viz.*, Kamini x Poornima, Poornima x Kamini, Shashank x Violet Cushion and Violet Cushion x Shashank.

The varieties grown by farmers are mainly Local Pink, Local White and Local Violet which are inferior in yield and flower quality. Hybridization is a breeding method used for developing new F_1 hybrid cultivars and improves the varietal wealth, by adding new types with improved characters.

F_1 hybrids can be developed for cut flower production with long and sturdy stalk with contrasting bigger size flower-heads, extended blooming period and higher vase life. The objective of this study was to evaluate the performance F_1 hybrids for qualitative and quantitative characters.

Materials and Methods

Five genotypes namely Arka Kamini, Arka Poornima, Arka Aadya, Arka Archana and Arka Violet Cushion were selected on the basis of quality flowers, earliness and high yield. These were crossed in L x T fashion to three tester lines Arka Shashank, Local Violet and Local Pink to develop F_1 hybrids superior in terms of cut flower and loose flower traits. The crossing operation includes hand-emasculation followed by hand-pollination.

Emasculation was performed at bud burst stage by removing all the disc florets with the help of surgical blade and forceps. Emasculated flower buds were covered with butter paper bag for two days. On day 2 when stigma was receptive, pollen from the tester (male parent) line were dusted over the emasculated flower.

After pollination, buds were covered with butter paper bags to avoid the contamination with foreign pollen and information regarding female, male parents, date of emasculation and pollination were mentioned on the tag attached with pollinated flower.

The seeds from the crossed flowers were collected after 30-40 days of pollination. The seeds of F_1 hybrid and parents were raised in nursery and thirty days old seedlings (4-5 leaf stage) were transplanted at spacing of 30 cm x 30 cm in RCBD with two replications.

The observations were recorded on plant type (erect, spread, semi-spread), plant height (cm), number of leaves per plant, number of branches per plant, flower form, flower head colour, days to first flowering, flower stalk length (cm), flower head diameter (cm), 100 flowers weight (g), number of ray florets per flower head, number of flowers per plant, weight of flowers/plant (g), duration of flowering (days), flower yield (t/ha), vase life and shelf life. Data collected were averaged and analysed statistically.

Results and Discussion

The F_1 hybrids and their parents exhibit variation in plant type, flower form and flower colour (Table 1).

On the perusal of data presented in table 2 revealed that all the F_1 hybrids and their parents had shown significant differences for quantitative traits. Hybrid-4 recorded maximum plant height (73.16 cm) followed by Hybrid-13 (71.39 cm), while the genotypes Arka Archana recorded the lowest plant height (41.88). Plant height is an important varietal character that depends upon the genetic constitution.

The variation in plant height among the various varieties might be due to genotypic differences in phenotypic expression of plant height (Zosiamliana, 2009). Similar variation in plant height due to genotypic differences was also reported by Poornima *et al.,* (2006) in China aster.

Among the genotypes and F_1 hybrids, Hybrid-8 recorded the maximum number of leaves/plant (312.47), number of branches/plant (23.19) and number of flowers per plant (93.66), whereas Arka Poornima recorded the lowest values (47.82, 9.75 and 40.93, respectively). Since these three characters are inter-related, the plants with the maximum number of branches are expected to have the highest number of leaves and flowers. Moreover, the difference in branches among the genotypes could be due to the influence of genetic makeup of the genotypes (Munikrishnappa, 2013).

Hybrid-8 also recorded the highest weight of flowers/plant (293 g) and flower yield (24.68 t/ha). This can be explained by the fact that the number of flowers per plant determines these characters. The association between number and weight of flowers in China aster was found to be positive and perfect (Patil, 1990). In both these parameters, the lowest value was recorded in genotype Local Violet (98.46 g and 8.27 t/ha, respectively) which had the second lowest number of flowers per plant (43.60).

Hybrid-7 was recorded earliest first flower opening (53.60 days) among all F_1hybrids and parents, while Local Violet recorded delayed flowering (98.80 days). Both earliness and lateness are helpful in determining the market availability of flowers for a longer period. Nevertheless, earliness in flowering is more suitable as farmers to fetch early market.

Though, the number of days taken to first flower opening is a varietal trait, Dhiman (2003) suggested that supplementary dry matter accumulation during favourable climatic conditions might be the reason for earliness. Variation in days to first flower opening in China aster has also been reported by Rai *et al.,* (2016) and Khangjarakpam *et al.,* (2014). Flower stalk length recorded longest in 'Arka Violet Cushion' (56.47 cm), while it was shortest in Hybrid-13 (30.19 cm). Variations among the cultivars are attributed to the genetic makeup of the plant.

Significant variation for stalk length in China aster has been reported by Kishan swaroop *et al.,* (2004) and Zosiamliana (2013). Maximum Flower head diameter (6.10 cm) was recorded in Arka Kamini and the lowest (4.61) in Hybrid-13.

One hundred flowers weight was recorded maximum in Hybrid-15 (385.94 g), while Hybrid-10 recorded lowest (182.23 g). The genotypes Arka Poornima recorded highest (147.10) number of ray florets per flower head, whereas Hybrid-13 recorded lowest (32.78).

The longest (28.92 days) duration of flowering was exhibited by Hybrid-4, however, Local Pink flowers recorded lowest duration of flowering (13.51 days). This trait is attributed on genotype and variation in flowering duration as reported by Zosiamliana (2009), Khangjarakpam *et al.,* (2014) and Pandey and Rao (2014) in China aster.

Table.1 Flower quality traits of China aster F_1 hybrids and their parents

F_1 hybrid/Parent	Plant type	Flower form	Flower head colour (RHS Colour Chart)
Hybrid 1	Erect	Pompon	73A, Red Purple group, Fan 2
Hybrid 2	Erect	Semi-double	N88A, Violet group, Fan 2
Hybrid 3	Erect	Semi-double	73A, Red Purple group, Fan 2
Hybrid 4	Semi-erect	Pompon	NN155D, White group, Fan 4
Hybrid 5	Semi-erect	Partial powderpuff	N82B, Purple Violet group, Fan 2
Hybrid 6	Semi-erect	Partial powderpuff	73B, Red Purple group, Fan 2
Hybrid 7	Spreading	Pompon	N57C, Red Purple group, Fan 2
Hybrid 8	Spreading	Semi-double	N78B, Purple group, Fan 2
Hybrid 9	Spreading	Semi-double	63B, Red Purple group, Fan 2
Hybrid 10	Spreading	Pompon	NN155D, White group, Fan 4
Hybrid 11	Spreading	Semi-double	N88B, Violet group, Fan 2
Hybrid 12	Spreading	Semi-double	N66D, Red Purple group, Fan 2
Hybrid 13	Erect	Pompon	N82A, Purple Violet group, Fan 2
Hybrid 14	Erect	Partial powderpuff	N83B, Violet group, Fan 2
Hybrid 15	Erect	Partial powderpuff	N81A, Purple Violet group, Fan 2
Arka Kamini	Erect	Semi-double	N74B, Red Purple group, Fan 2
Arka Poornima	Semi-erect	Powderpuff	NN155D, White group, Fan 4
Arka Aadya	Spreading	Semi-double	60D, Red Purple group, Fan 2
Arka Archana	Spreading	Semi-double	NN155D, White group, Fan 4
Arka Violet Cushion	Erect	Pompon	N81A, Purple Violet group, Fan 2
Arka Shashank	Erect	Powderpuff	NN155D, White group, Fan 4
Local Violet	Erect	Semi-double	N81A, Purple Violet group, Fan 4
Local Pink	Erect	Semi-double	63A, Red Purple group, Fan 2

Table.2 Evaluation of China aster F_1 hybrids with their parents for vegetative growth, flowering, yield and postharvest life

F_1 Hybrid/ Parent	Plant height (cm)	No. of leaves/ plant	No. of branches/ plant	Days to first flowering	Flower head diameter (cm)	Flower stalk length (cm)	No. of ray floret/ flower head	Duration of flowering (days)	No. of flowers/ plant	Weight of flowers/ Plant (g)	100 flowers weight (g)	Flower yield (t/ha)	Vase life (days)	Shelf life (days)
Hybrid 1	60.06	133.74	19.28	56.23	4.98	38.02	37.40	21.25	65.05	150.84	236.00	12.65	9.84	4.15
Hybrid 2	50.62	172.39	20.14	61.85	5.33	38.11	87.41	17.97	63.42	151.46	243.00	12.69	8.28	3.94
Hybrid 3	51.11	169.54	18.76	60.82	5.28	37.28	84.58	18.79	63.61	191.10	306.00	16.05	11.44	3.45
Hybrid 4	73.16	115.90	19.08	61.35	5.03	41.63	37.55	28.92	81.64	190.50	314.00	15.99	9.83	4.73
Hybrid 5	64.89	214.07	19.20	69.14	5.76	39.26	92.51	21.02	71.98	199.91	281.50	16.79	9.55	4.05
Hybrid 6	65.10	162.77	16.15	67.61	5.73	40.54	88.52	17.91	59.64	151.80	261.00	12.73	7.00	3.75
Hybrid 7	60.88	143.45	18.58	53.60	5.87	40.92	43.31	23.20	90.31	181.28	205.00	15.21	8.59	4.04
Hybrid 8	57.99	312.47	23.19	67.56	5.81	36.51	116.54	21.22	93.66	293.87	318.00	24.68	7.55	3.45
Hybrid 9	52.77	196.23	20.37	62.15	4.99	42.50	71.93	23.06	73.04	156.06	217.50	13.10	9.61	4.55
Hybrid 10	58.93	163.59	20.34	59.49	5.18	32.01	35.91	19.56	85.06	151.80	182.00	12.85	5.05	2.60
Hybrid 11	50.21	240.96	19.19	69.75	5.58	41.81	84.00	26.00	92.63	250.01	274.00	20.97	8.09	4.10
Hybrid 12	56.40	305.33	20.08	67.64	6.00	47.95	84.65	23.52	77.56	235.53	307.50	19.76	6.85	3.95
Hybrid 13	71.39	87.32	12.93	65.08	4.61	30.19	32.78	25.47	61.83	141.02	230.50	11.84	9.53	4.46
Hybrid 14	57.66	135.14	12.27	65.34	5.67	40.34	105.86	21.27	44.77	140.61	316.50	11.81	8.84	4.17
Hybrid 15	69.55	153.39	14.80	62.60	5.48	35.99	83.06	23.17	54.11	205.55	386.00	17.26	7.59	3.73
Arka Kamini	56.95	247.50	14.55	79.96	6.10	38.68	94.95	14.91	61.25	163.35	271.00	13.72	7.09	3.25
Arka Poornima	56.84	47.82	9.75	81.73	5.85	31.97	147.10	15.66	40.93	149.82	369.00	12.57	8.15	4.16
Arka Aadya	45.68	180.91	16.70	61.15	5.66	32.22	112.48	16.18	54.75	199.90	368.00	16.78	7.30	5.15
Arka Archana	41.88	222.67	15.74	66.46	5.50	35.37	121.16	17.64	87.66	260.35	301.50	21.85	7.70	4.15
Arka Violet Cushion	65.71	169.36	10.86	91.28	4.85	56.47	102.89	21.37	55.67	208.77	379.50	17.53	8.17	3.72
Arka Shashank	51.10	171.39	14.58	77.59	4.73	44.49	33.55	14.97	48.51	120.87	252.50	10.15	9.57	3.09
Local Violet	51.33	262.69	12.96	98.80	5.67	45.46	107.52	13.77	43.60	98.46	230.50	8.27	6.05	2.84
Local Pink	60.97	249.52	12.02	76.64	5.29	46.72	92.80	13.51	53.68	159.32	304.50	13.37	7.13	2.90
SEm±	1.15	4.31	0.41	1.13	0.11	1.15	1.94	0.62	1.96	2.26	1.20	0.20	0.18	0.13
C.D. at 5%	3.38	12.63	1.21	3.30	0.32	3.38	5.69	1.83	5.76	6.65	3.55	0.58	0.55	0.37
C.V. (%)	2.80	3.29	3.50	2.34	2.86	4.10	3.33	4.41	4.19	1.78	0.60	1.83	3.24	4.69

The vase life among the genotypes ranged from 5.05 (Hybrid-10) to 11.44 days (Hybrid-3). However, shelf life ranged from 2.60 (Hybrid-10) to 5.15 days (Arka Aadya). The variation in vase life of different genotypes has also been reported by Chowdhuri *et al.*, (2016) in China aster.

Significant differences were observed in all the characters among F_1 hybrids and their parents. Overall performance of F_1 Hybrids was found to be better than the parents. Hybrid-8 was the best performer with the highest number of leaves/plant (312.47), number of branches/plant (23.19), number of flowers per plant (93.66), highest weight of flowers/plant (293 g) and flower yield per hectare (24.68 tonne). Hybrid-4 recorded the highest plant height (73.16 cm) and the longest (28.92 days) duration of flowering.

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