

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.702.200>

Evaluation of China Aster [*Callistephus chinensis* (L.) Nees] F₁ Hybrids and their Parents for Qualitative and Quantitative Traits

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ABSTRACT

Keywords

China aster, F₁ hybrids, Evaluation, Flower quality, Yield

Article Info

Accepted:

15 January 2018

Available Online:

10 February 2018

China aster [*Callistephus chinensis* (L.) Nees] belongs to the family Asteraceae and is native of Northern China. It is grown commercially as cut flower for flower arrangement, interior decoration and loose flower for garland making and worshipping. A total of 30 China aster F₁ hybrids developed through line x tester mating design involving 6 female and 5 male parents, were evaluated for qualitative and quantitative characters during 2016-17. All the hybrids showed semi-double type of flower heads. Both spreading and semi-erect plant types were found to be dominant over erect type. The Hybrid-21 (Matsumoto Scarlet x Phule Ganesh Violet) was found best for plant height (55.95 cm) and number of branches per plant (14.09); Hybrid-24 (Matsumoto Scarlet x IIHRG13) for 100 flower weight (231.40 g) and flower yield per plant (55.91 g).

Introduction

Callistephus chinensis (L.) Nees, commonly called as China aster or annual aster belongs to the family Asteraceae and is native of Northern China (Navalinskien *et al.*, 2005). China aster is one of the most popular annual flower crops cultivated widely due to its myriad colours ranging from violet, purple, magenta, pink and white and comparatively longer vase life (Chaitra and Patil, 2007; Dilta *et al.*, 2007). It is grown commercially as cut flower for flower arrangement, interior decoration and loose flower for garland making, worshipping (Munikrishnappa *et al.*, 2013), pot plant and bedding in landscaping

(Bhargav *et al.*, 2016). In India, it is estimated to be grown in an area of 3500 ha. China aster is commercially grown by marginal and small farmers in Karnataka, Tamil Nadu, Telangana, Andhra Pradesh, Maharashtra and West Bengal (Pratiksha *et al.*, 2017). In Karnataka alone it is grown in an area of 1531 ha with a productivity of 9.05 t/ha (Anonymous, 2014) as it being grown throughout the year in and around Bengaluru. Novelty of a flower crop plays an important role in the floriculture industry for its marketing. To meet the increasing demand of the market, creation of new flower colours and forms are required by using various methods of plant breeding (Datta and Misra, 2000).

The varieties grown by farmers are mainly Local Pink, Local White and Local Violet which are inferior in flower quality and yield. Among the various methods of breeding, hybridization is a most viable to improve the genotypes by adding new phenotypes with improved characters. Therefore, the present study was carried out to evaluate the 30 F₁ hybrids and their parents for various qualitative and quantitative traits.

Materials and Methods

The present study was conducted at research block of Division of Floriculture and Medicinal Crops, ICAR-Indian Institute of Horticultural Research, Hesaraghatta Lake Post, Bengaluru, India during 2016-17. The experimental site was geographically located at 13° 58' N Latitude, 78°E Longitude and at an elevation of 890 m above mean sea level. The soil of experimental block was red loamy with pH 7.35 and E.C. 0.26 dSm⁻¹. A total of 30 China aster F₁ hybrids were developed through Line x Tester mating design (Table 1). Six lines *viz.* Matsumoto Pink, Matsumoto Red, Matsumoto Rose, Matsumoto Yellow, Matsumoto Scarlet and Matsumoto White and five testers *viz.* Phule Ganesh Violet, Phule Ganesh Purple, IHRJ3-2, IHRG13 and Local White were used for crossing.

All the 30 F₁ hybrids, along with the parents were evaluated in RCBD with two replications. Twenty plants per genotype/hybrid per replication were planted during January 2016 at a spacing of 25 cm x 25 cm under open field conditions. Five plants per replication were selected for recording observations. Uniform cultural practices were followed to raise the successful crop. The observations were recorded for qualitative traits *viz.* plant type, flower form and colour and quantitative traits *viz.* plant height (cm), number of leaves per plant, plant spread (cm), number of branches per plant, days to first

flowering, flower stalk length (cm), flower head diameter (cm), 100 flowers weight (g), number of flowers per plant, weight of flowers/plant (g), duration of flowering (days) and vase life (days). Data recorded were subjected to analysis of variance (Singh and Chaudhary, 1977). Statistical analysis were done using WINDOSTAT version 8.6.

Results and Discussion

Qualitative characters

All the 30 F₁ hybrids and their parents exhibited variation in plant type, flower form and flower head colour (Table 2). The Hybrid 1, 6, 11, 16, 21 and 26 observed spreading growth, Phule Ganesh Violet semi-erect growth habit, however, remaining hybrids and parents were having erect growth. All the hybrids observed semi-double flower head which is mainly due their parents as they also possess the similar flower head *i.e.* semi-double.

Quantitative characters

The data presented in Table 3 revealed that all 30 F₁ hybrids and their parents showed significant differences for plant height, number of leaves per plant, plant spread and number of branches per plant. Hybrid-21 recorded maximum plant height (55.95 cm) followed by Hybrid-8 (52.92 cm) and Hybrid-30 (52.54 cm), while minimum was recorded in Matsumoto Pink (21.15 cm). The variation in plant height among varieties might be due to genotypic differences in phenotypic expression of plant height (Zosiamliana *et al.*, 2013). Similar genotypic differences for plant height were also reported by Pratiksha *et al.*, (2017). Hybrid-30 and Hybrid- 26 recorded the maximum number of leaves per plant (30.00) and plant spread (45.25 cm) respectively, which may be due to vigorous nature of the hybrid over their parents.

Table.1 Details of cross combinations for development of China aster F₁ hybrids

Sl. No.	Hybrid No.	Notation	Cross combination
1.	Hybrid 1	L1 × T1	Matsumoto Pink x Phule Ganesh Violet
2.	Hybrid 2	L1 × T2	Matsumoto Pink x Phule Ganesh Purple
3.	Hybrid 3	L1 × T3	Matsumoto Pink x IIHRJ3-2
4.	Hybrid 4	L1 × T4	Matsumoto Pink x IIHRG13
5.	Hybrid 5	L1 × T5	Matsumoto Pink x Local White
6.	Hybrid 6	L2 × T1	Matsumoto Red x Phule Ganesh Violet
7.	Hybrid 7	L2 × T2	Matsumoto Red x Phule Ganesh Purple
8.	Hybrid 8	L2 × T3	Matsumoto Red x IIHRJ3-2
9.	Hybrid 9	L2 × T4	Matsumoto Red x IIHRG13
10.	Hybrid 10	L2 × T5	Matsumoto Red x Local White
11.	Hybrid 11	L3 × T1	Matsumoto Rose x Phule Ganesh Violet
12.	Hybrid 12	L3 × T2	Matsumoto Rose x Phule Ganesh Purple
13.	Hybrid 13	L3 × T3	Matsumoto Rose x IIHRJ3-2
14.	Hybrid 14	L3 × T4	Matsumoto Rose x IIHRG13
15.	Hybrid 15	L3 × T5	Matsumoto Rose x Local White
16.	Hybrid 16	L4 × T1	Matsumoto Yellow x Phule Ganesh Violet
17.	Hybrid 17	L4 × T2	Matsumoto Yellow x Phule Ganesh Purple
18.	Hybrid 18	L4 × T3	Matsumoto Yellow x IIHRJ3-2
19.	Hybrid 19	L4 × T4	Matsumoto Yellow x IIHRG13
20.	Hybrid 20	L4 × T5	Matsumoto Yellow x Local White
21.	Hybrid 21	L5 × T1	Matsumoto Scarlet x Phule Ganesh Violet
22.	Hybrid 22	L5 × T2	Matsumoto Scarlet x Phule Ganesh Purple
23.	Hybrid 23	L5 × T3	Matsumoto Scarlet x IIHRJ3-2
24.	Hybrid 24	L5 × T4	Matsumoto Scarlet x IIHRG13
25.	Hybrid 25	L5 × T5	Matsumoto Scarlet x Local White
26.	Hybrid 26	L6 × T1	Matsumoto White x Phule Ganesh Violet
27.	Hybrid 27	L6 × T2	Matsumoto White x Phule Ganesh Purple
28.	Hybrid 28	L6 × T3	Matsumoto White x IIHRJ3-2
29.	Hybrid 29	L6 × T4	Matsumoto White x IIHRG13
30.	Hybrid 30	L6 × T5	Matsumoto White x Local White

Table.2 Flower quality traits of China aster F₁ hybrids and their parents

Hybrid/Parent	Plant type	Flower head form	Flower head colour (RHS Colour Chart)
Hybrid 1	Spreading	Semi-double	Violet group N87B; Fan 2
Hybrid 2	Erect	Semi-double	Violet group N87C; Fan 2
Hybrid 3	Erect	Semi-double	Red purple group 73B; Fan 2
Hybrid 4	Erect	Semi-double	Purple violet N82B; Fan 2
Hybrid 5	Erect	Semi-double	Purple violet group N82 B; Fan 2
Hybrid 6	Spreading	Semi-double	Violet group N87A, Fan 2
Hybrid 7	Erect	Semi-double	Violet group N87A, Fan 2
Hybrid 8	Erect	Semi-double	Red purple group 73A, Fan 2
Hybrid 9	Erect	Semi-double	Violet group N87C, Fan 2
Hybrid 10	Erect	Semi-double	Red Purple group 73A, Fan 2
Hybrid 11	Spreading	Semi-double	Violet group 86A, Fan 2
Hybrid 12	Erect	Semi-double	Purple violet group N82A, Fan 2
Hybrid 13	Erect	Semi-double	Red purple group 73A; Fan 2
Hybrid 14	Erect	Semi-double	Violet group N87A, Fan 2
Hybrid 15	Erect	Semi-double	Red purple group 73A; Fan 2
Hybrid 16	Spreading	Semi-double	Violet group N87B, Fan 2
Hybrid 17	Erect	Semi-double	Violet group N88C, Fan 2
Hybrid 18	Erect	Semi-double	Red purple group N74D, Fan 2
Hybrid 19	Erect	Semi-double	Violet group N87B, Fan 2
Hybrid 20	Erect	Semi-double	Red purple group N74C, Fan 2
Hybrid 21	Spreading	Semi-double	Violet group N87A, Fan 2
Hybrid 22	Erect	Semi-double	Violet group N87A, Fan 2
Hybrid 23	Erect	Semi-double	Red purple group 63C; Fan 2
Hybrid 24	Erect	Semi-double	Violet group 84A, Fan 2
Hybrid 25	Erect	Semi-double	Red purple group 61B; Fan 2
Hybrid 26	Spreading	Semi-double	Violet group 86A, Fan 2
Hybrid 27	Erect	Semi-double	Violet group N87A, Fan 2
Hybrid 28	Erect	Semi-double	Red Purple group N74C, Fan 2
Hybrid 29	Erect	Semi-double	Violet group N87B, Fan 2
Hybrid 30	Erect	Semi-double	White group NN155D, Fan 4
Matsumoto Pink (L1)	Erect	Semi-double	Red Purple group 62 C; Fan 2
Matsumoto Red (L2)	Erect	Semi-double	Red Purple group 71 B; Fan 2
Matsumoto Rose (L3)	Erect	Semi-double	Red Purple group N74 B; Fan 2
Matsumoto Yellow (L4)	Erect	Semi-double	Yellow group 2 D; Fan 1
Matsumoto Scarlet (L5)	Erect	Semi-double	Red group 46 A; Fan 1
Matsumoto White (L6)	Erect	Semi-double	White Group NN155 D; Fan 4
Phule Ganesh Violet (T1)	Semi-erect	Semi-double	Violet group 86 A; Fan 2
Phule Ganesh Purple (T2)	Erect	Semi-double	Violet group N87 A; Fan 2
IIHRJ3-2 (T3)	Erect	Semi-double	Purple group 75 A; Fan 2
IIHR G13 (T4)	Erect	Semi-double	Violet group 84 A; Fan 2
Local White (T5)	Erect	Semi-double	White Group NN155 D; Fan 4

Table.3 Evaluation of China aster F₁ hybrids and their parents for vegetative characters

Hybrid/Parent	Plant height (cm)	Number of leaves/plant	Plant spread (cm)	Number of branches/plant
Hybrid 1	39.17	20.42	26.50	9.00
Hybrid 2	34.34	22.59	23.65	8.34
Hybrid 3	41.92	21.92	20.38	8.92
Hybrid 4	42.09	25.42	20.16	11.59
Hybrid 5	36.54	19.92	26.29	9.59
Hybrid 6	29.92	21.09	26.75	9.59
Hybrid 7	40.34	19.84	24.38	9.50
Hybrid 8	52.92	24.42	22.21	15.50
Hybrid 9	32.17	21.00	15.96	8.75
Hybrid 10	37.09	21.50	18.59	8.67
Hybrid 11	32.09	18.59	27.75	6.50
Hybrid 12	36.84	20.50	26.17	8.59
Hybrid 13	43.34	25.25	22.38	9.75
Hybrid 14	35.34	19.75	17.00	9.09
Hybrid 15	38.00	24.50	20.92	9.00
Hybrid 16	38.75	22.34	34.42	9.25
Hybrid 17	40.34	20.09	26.00	7.84
Hybrid 18	33.84	23.59	19.42	8.67
Hybrid 19	26.75	20.17	18.46	6.59
Hybrid 20	27.67	22.84	18.88	8.42
Hybrid 21	55.95	26.42	34.13	14.09
Hybrid 22	31.00	19.59	18.42	5.59
Hybrid 23	45.34	25.75	21.34	14.92
Hybrid 24	45.25	14.42	19.63	7.09
Hybrid 25	45.59	25.67	22.84	11.00
Hybrid 26	43.75	19.50	45.25	9.67
Hybrid 27	39.90	22.84	20.29	7.42
Hybrid 28	47.59	24.42	20.92	11.67
Hybrid 29	35.09	25.00	15.71	10.84
Hybrid 30	52.54	30.00	25.46	10.34
Matsumoto Pink (L1)	21.15	17.50	12.63	6.84
Matsumoto Red (L2)	24.13	16.50	12.29	7.42
Matsumoto Rose (L3)	22.04	16.75	11.79	7.42
Matsumoto Yellow (L4)	21.84	15.17	11.96	8.92
Matsumoto Scarlet (L5)	21.67	14.92	12.04	8.17
Matsumoto White (L6)	25.25	19.09	13.00	9.25
Phule Ganesh Violet (T1)	42.50	22.17	39.63	9.92
Phule Ganesh Purple (T2)	44.75	29.50	28.21	13.17
IIHRJ3-2 (T3)	44.34	20.92	25.63	12.59
IIHR G13 (T4)	46.09	17.50	22.63	11.00
Local White (T5)	39.25	24.92	16.29	8.34
SEm ±	1.20	1.037	0.86	0.80
C.D. (P=0.05)	3.44	2.975	2.46	2.30
C.V. (%)	4.53	6.8	5.48	11.98

Table.4 Evaluation of China aster F₁ hybrids and their parents for flowering, yield and vase life characters

Hybrid/Parent	Days for first flowering	Flower stalk length (cm)	Flower diameter (cm)	100 flower weight (g)	Number of flowers/plant	Weight of flowers/ plant (g)	Duration of flowering (days)	Flower yield/ hectare (q)	Vase life (days)
Hybrid 1	48.34	24.25	4.78	186.00	25.00	46.52	23.75	39.08	5.00
Hybrid 2	47.25	25.00	5.44	209.65	20.25	42.43	20.25	35.64	5.00
Hybrid 3	42.34	21.42	4.64	178.30	17.50	31.21	17.17	26.21	5.00
Hybrid 4	47.27	27.09	4.79	167.10	19.42	32.45	18.59	27.26	6.67
Hybrid 5	45.17	21.75	4.84	185.75	12.67	23.53	16.17	19.77	4.34
Hybrid 6	58.09	24.96	4.89	188.30	16.42	30.94	19.42	25.99	4.67
Hybrid 7	56.92	30.42	4.79	174.50	26.00	45.35	24.17	38.09	5.34
Hybrid 8	48.17	28.92	4.89	206.55	30.50	62.99	27.17	52.91	6.67
Hybrid 9	67.59	19.63	4.64	185.15	17.67	32.71	19.42	27.48	5.34
Hybrid 10	55.17	22.17	5.04	203.90	16.00	32.64	19.17	27.42	4.67
Hybrid 11	60.00	33.50	4.84	185.30	15.17	28.12	18.25	23.62	5.17
Hybrid 12	52.92	29.50	5.03	191.70	21.25	40.73	20.34	34.22	5.37
Hybrid 13	47.50	27.84	4.77	175.60	22.25	39.07	23.42	32.82	6.67
Hybrid 14	57.92	17.09	4.83	164.35	13.59	22.34	20.50	18.77	7.67
Hybrid 15	50.25	25.17	4.99	173.90	18.92	32.91	22.09	27.65	6.67
Hybrid 16	54.09	33.34	4.94	169.35	25.59	43.28	22.67	36.36	6.00
Hybrid 17	53.84	29.67	5.03	159.20	26.75	42.57	26.34	35.76	4.34
Hybrid 18	48.59	24.42	4.53	168.55	22.09	37.23	19.17	31.28	7.00
Hybrid 19	54.17	23.50	5.26	204.00	13.34	27.22	15.25	22.86	4.67
Hybrid 20	46.09	22.09	4.68	147.60	18.92	27.92	18.34	23.45	5.35
Hybrid 21	51.25	29.09	5.50	204.25	34.50	70.44	29.17	59.17	5.67
Hybrid 22	55.09	24.17	5.02	191.70	9.59	18.36	15.59	15.42	5.00
Hybrid 23	43.75	26.50	5.19	191.10	21.09	40.30	21.75	33.85	7.67
Hybrid 24	74.25	29.75	6.24	231.40	24.17	55.91	23.84	46.96	8.34
Hybrid 25	48.67	32.92	5.56	197.15	26.34	51.90	22.84	43.60	7.34
Hybrid 26	74.84	36.59	5.82	207.95	31.17	64.83	27.84	54.46	8.67
Hybrid 27	78.84	33.25	5.02	197.70	27.50	54.33	27.17	45.64	6.34
Hybrid 28	60.84	29.92	4.89	166.30	24.84	41.32	23.50	34.71	5.67
Hybrid 29	65.50	20.92	4.82	158.00	27.42	43.32	25.50	36.39	6.67
Hybrid 30	61.25	35.34	4.89	156.40	43.59	68.19	33.09	57.28	4.67
Matsumoto Pink (L1)	47.59	14.09	2.63	160.97	11.59	18.65	16.34	15.66	6.34
Matsumoto Red (L2)	45.84	14.67	3.13	165.25	12.84	21.20	16.09	17.81	5.67
Matsumoto Rose (L3)	52.50	13.84	3.42	167.74	13.67	22.93	15.34	19.27	6.67
Matsumoto Yellow (L4)	55.34	13.50	2.50	154.25	22.00	33.94	22.17	28.51	6.34
Matsumoto Scarlet (L5)	53.84	14.09	3.35	161.85	12.59	20.37	15.17	17.11	5.67
Matsumoto White (L6)	56.59	15.90	2.99	181.47	21.67	39.31	22.17	33.03	5.34
Phule Ganesh Violet (T1)	80.59	36.84	5.09	344.70	31.09	107.18	22.92	90.03	6.34
Phule Ganesh Purple (T2)	88.09	32.84	5.38	348.35	36.42	126.83	28.84	106.54	7.34
IHRJ3-2 (T3)	80.50	32.92	5.38	235.50	28.00	65.94	24.34	55.39	7.67
IHR G13 (T4)	79.42	33.25	4.94	223.77	32.42	72.50	27.58	60.90	8.34
Local White (T5)	66.84	20.34	4.82	229.45	20.09	46.11	21.59	38.73	6.00
SEm ±	0.562	1.26	0.11	1.52	1.12	2.276	1.046	1.912	0.15
C.D. (P=0.05)	1.613	3.62	0.32	4.36	3.214	6.53	3	5.485	0.44
C.V. (%)	1.379	6.95	3.33	1.12	7.125	7.308	6.781	7.309	3.54

Flowering, flower yield and vase life traits are presented in Table 4. Earliest first flower opening was recorded in Hybrid-3 (42.34 days), which was statistically at par with Hybrid-23 (43.75 days), whereas, it was delayed in Phule Ganesh Purple (88.09 days). Both early and late flowering genotypes are useful in determining availability of flowers for a longer period. Nevertheless, early flowering is more suitable as farmers can fetch early market. Variation in days to first flower opening in China aster has also been reported (Khangjarakpam *et al.*, 2014 and Rai and Chaudhary, 2016).

Plants with maximum number of branches with long stalks and bigger flowers are suitable for cut flower in China aster. The maximum number of branches per plant (15.50), flower stalk length (36.84 cm) and flower head diameter (6.24 cm) were recorded in Hybrid-8, Phule Ganesh Violet and Hybrid-24, respectively.

The significant differences among genotypes for various traits were also reported by Zosiamlia *et al.*, (2013), Khangjarakpam *et al.*, (2014) and Pandey and Rao (2014) in China aster.

One-hundred flowers weight was recorded maximum in Phule Ganesh Purple (348.35 g), while lowest was recorded in Hybrid-20 (147.60).

Highest number of flowers per plant was recorded in Hybrid-30 (43.59), whereas, lowest was recorded in Hybrid-22 (9.59). Weight of flowers per plant and flower yield per hectare was recorded maximum in Phule Ganesh Purple (126.83 g and 106.54 q, respectively).

The association between number and weight of flowers in China aster was found to be positive and perfect (Patil, 1990). Variations among the hybrids and parents can be attributed to their genetic makeup as reported by Rai and Chaudhary (2016) and Pratiksha *et al.*, (2017). The maximum duration of flowering (33.09 days) was recorded in Hybrid-30, however,

Matsumoto Scarlet recorded minimum duration of flowering (15.17 days). This trait is attributed to genotype and variation in flowering duration. The results are in accordance with the findings of Pandey and Rao (2014) and Pratiksha *et al.*, (2017) in China aster.

The longest vase life was recorded in Hybrid-30 (8.67 days) which was statistically at par with Hybrid-24 and IIHRG-13 (8.34 days). The varietal variation in vase life among genotypes of China aster has also been reported (Chowdhuri *et al.*, 2016).

From the results, it can be concluded that Hybrids and parents performed showed significant variation for various traits. Hybrids recorded best for maximum plant height (Hybrid-21, 55.95 cm), plant spread (Hybrid-26, 45.25 cm), vase life (Hybrid 10, 8.67 days) and Hybrid-30 for number of leaves per plant (30.00), number of flowers per plant (43.59) and flowering duration (33.09).

Among parents, Phule Ganesh Purple found superior for 100 flowers weight (348.35 g), weight of flowers per plant (126.83 g) and flower yield per hectare (106.54 q).

Acknowledgement

We sincerely acknowledge the director, ICAR-IIHR, Bengaluru for providing necessary facilities to conduct this study. The corresponding author is thankful to ICAR-IARI, New Delhi for awarding IARI fellowship during his Ph.D. programme.

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How to cite this article:

Bhargav, V., Rajiv Kumar, T. Manjunatha Rao, T. Usha Bharathi, M.V. Dhananjaya, Sunil Kumar, K. Raja Babu and Pratiksha Kumari. 2018. Evaluation of China Aster [*Callistephus chinensis* (L.) Nees] F₁ Hybrids and their Parents for Qualitative and Quantitative Traits. *Int.J.Curr.Microbiol.App.Sci*. 7(02):1654-1661. doi: <https://doi.org/10.20546/ijcmas.2018.702.200>