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RESEARCH ARTICLE

Evaluation of China Aster [*Callistephus chinensis* (L.) Nees.] Genotypes for Vegetative, Flowering, Yield and Postharvest Life

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An experiment was carried out with 42 genotypes of China aster to evaluate the performance for vegetative, flowering, yield and postharvest life, in RBD with two replications, during two consecutive years 2015-16 and 2016-17 at Division of Floriculture and Medicinal Crops, ICAR-Indian Institute of Horticultural Research, Bengaluru. Significant differences were recorded for all the traits among 42 genotypes. The genotype IIHRG13 recorded maximum plant height (61.80 cm), duration of flowering (34.40 days) and vase life (9.50 days), while, maximum shelf life (4.42 days) was recorded in IIHRH3. The Phule Ganesh Pink recorded maximum plant spread (42.15 cm) and flower diameter (6.74 cm). Maximum number of leaves per plant (32.35) and number of branches per plant (17.60) was recorded in Phule Ganesh Purple and IIHRE10, respectively. Early flowering was recorded in Matsumoto Red (46.85 days), whereas, it was delayed in Phule Ganesh White (100.15 days). Maximum stalk length was recorded in IIHRCC39 (49.10 cm), however, Arka Poornima recorded highest 100 flower weight. Highest number of flowers per plant was recorded in Local White (65.05), while, flower yield per plant was recorded highest in IIHRC42 (235.21 g). On the basis of overall performance genotypes IIHRCC39, IIHRI69-2, IIHRG13 and IIHRJ3 were found promising for cut flower and IIHECC42 for loose flower.

Key Words: China aster, Evaluation, Genotypes, Vase life, Yield

Introduction

China aster [*Callistephus chinensis* (L.) Nees.], a flowering annual belongs to the family Asteraceae and is a native of China (Navalinskien *et al.*, 2005). The genus Callistephus derives its name from two Greek words 'Kalistos' and 'Stephos' meaning 'most beautiful' and 'a crown', respectively. China aster is commercially grown for cut and loose flower, which are used in flower decoration, preparation of bouquets and garlands. In addition to their cultivation, China aster can be used in landscape gardening as a bedding plant to provide mass aesthetic effect. It is gaining popularity in India, because of its easy cultural practices, array of colours and varied uses (Bhargav *et al.*, 2016). In Karnataka, it is grown in an area of 1531 ha with productivity of 9.05 t/ha (Anonymous, 2014).

The performance of a genotype varies with the region, season and growing conditions (Punetha *et al.*, 2011). Therefore, evaluation of genotypes for quality and yield traits becomes necessary to know their performance in a particular locality. The performance of different genotypes from different climatic conditions has been examined by various workers (Munikrishnappa *et al.*, 2013, Zosiamliana *et al.*, 2013, Chowdhuri *et al.*, 2016 and Rai and Chaudhary, 2016). Considering the importance of the crop, the present investigation was carried to evaluate 42 genotypes for vegetative, flowering, yield and postharvest life under Bengaluru conditions.

Materials and Methods

The present study was conducted at the Division of Floriculture and Medicinal Crops, ICAR-Indian Institute of Horticultural Research, Bengaluru during the two consecutive years 2015-16 and 2016-17. The experimental site was geographically located at 13º58' N Latitude, 78ºE Longitude and at an elevation of 890 m above mean sea level. The soil of experimental plot was red loamy with pH 7.35 and E.C. of 0.26 dSm-1. A total of 42 genotypes including 21 named varieties and 21 stabilized lines were evaluated for vegetative growth, flowering, yield and postharvest life in randomized complete block design with two replications. Twenty plants per replication were planted at a spacing of 30×30 cm under open field conditions. The recommended agronomical practices were adopted to raise the crop.

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Five random plants were selected for recording various observations 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), vase life (days) and shelf life (days). The analysis of variance was done by the method suggested by Gomez and Gomez (1984).

Results and Discussion

Vegetative Traits

Vegetative growth is usually a good index of plant vigour, which may contribute towards greater productivity. It also serves as a guide to determine the suitable varieties for obtaining maximum yield. The data presented in Table 1 showed significant differences for vegetative traits among the genotypes. The maximum plant height was recorded in IIHRG13 (61.80 cm) followed by IIHRD5 (58.20 cm), while Milady White recorded the lowest (8.20 cm) height. The variation in plant height may be attributed to the genetic makeup of the plant. Chavan *et al.* (2010), Bhargav *et al.* (2016) and Rai and Chaudhary (2016) also reported similar results with respect to plant height in China aster.

Number of leaves was recorded maximum in Phule Ganesh Purple (32.35), which was statistically at par with Phule Ganesh White (32.30), while, minimum number of leaves was recorded in Milady White (9.20). Variation in leaf production among the genotypes are attributed to the genetic character of the individual genotype which has also been reported by Poornima *et al.* (2006) and Chowdhuri *et al.* (2006) in China aster. Plant spread at flowering stage was recorded maximum in Phule Ganesh Violet (42.65 cm), followed by Phule Ganesh Pink (42.15 cm), whereas minimum recorded in Milady White (8.75 cm). The increase in plant spread might be due to spreading branching pattern of the genotypes controlled by genetic constitution. Variation in plant spread across the genotypes has also been reported by Pandey and Rao (2014) and Rai and Chaudhary (2016) in China aster. Number of branches/plant signifies the architecture of plant and number of flowers per plant. The genotype IIHRE10 produced maximum number of branches per plant (17.60), while minimum was recorded in genotype Milady White (6.65).

Flowering Traits

The genotypes showed significant differences for flowering traits (Table 2). The early or late flowering habit of the genotype signifies by number of days taken to first flower opening which helps in regulating the market. Minimum days to first flowering were recorded in Matsumoto Red (46.85) which was statistically at par with Matsumoto Rose (52.05), whereas, Phule Ganesh White (100.15) took maximum days to first flowering which was statistically at par with Phule Ganesh Purple (90.20). Variation for early or late flowering of a genotype seems to be genetically controlled and have also been reported by Kumar and Patil (2003); Khangjarakpam *et al.* (2014); Rai and Chaudhary (2016).

Flower stalk length is an important character, the genotype having long flower stalk is generally preferred as cut flower. Significantly longest flower stalk (49.10 cm) was recorded in IIHRCC39 followed by Local Pink and IIHRI69-2 (47.50 cm), whereas, shortest stalk was recorded in Milady White (4.65 cm). Significant variation for stalk length was reported by Swaroop *et al.* (2004); Zosiamliana (2013) and Rai *et al.* (2016).

The largest flower head was recorded in Phule Ganesh Pink (6.74 cm), which was at par with IIHRE10 (6.58 cm), while minimum was recorded in Matsumoto Yellow (3.54 cm). Variation in flower head diameter might be due to the interaction among the genetic makeup of the genotypes with prevailing environment. Similar inference was drawn by Poornima *et al.* (2006) and Kaushal *et al.* (2014) in China aster and Punetha *et al.* (2011) in chrysanthemum.

Yield Traits

Maximum 100 flower weight was recorded in Arka Poornima (548.25 g), which is mainly due to the heaviest flower of powder-puff type, followed by Phule Ganesh Pink (464.50 g), whereas, minimum was recorded in Milady White (105 g). Similar variation for 100 flower weight has also been reported in chrysanthemum (Punetha *et al.*, 2011).

Number of flowers per plant was significant among the genotypes. Maximum number of flowers per plant was recorded by Local White (65.05), followed by IIHRC42 (61.00), whereas, Milady White (7.35) produced least flowers per plant. The genotypic variation for number of flowers per plant seems to be the interaction effect of

Table 1. Performance of the China aster genotypes for vegetative characters

Genotype	Plant height (cm)	Number of leaves/plant	Plant spread (cm)	Number of branches/plant
1) Arka Kamini	49.20	18.85	21.35	10.65
2) Arka Poornima	48.48	23.50	29.20	10.40
3) Arka Shashank	44.95	20.95	24.83	11.91
4) Arka Violet cushion	51.88	21.15	23.70	11.00
5) Arka Aadya	36.68	18.65	38.98	14.93
6) Arka Archana	39.28	20.35	39.30	16.65
7) Phule Ganesh Pink	52.85	25.15	42.15	12.40
8) Phule Ganesh Purple	53.80	32.35	33.58	14.34
9) Phule Ganesh White	56.63	32.30	31.05	16.05
10) Phule Ganesh Violet	52.75	21.55	42.65	12.68
11) Matsumoto Yellow	32.20	16.58	15.85	10.92
12) Matsumoto White	35.10	18.15	15.73	8.20
13) Matsumoto Rose	28.22	15.05	13.65	9.40
14) Matsumoto Scarlet	32.80	15.25	13.45	9.58
15) Matsumoto red	33.33	17.60	15.83	9.79
16) Matsumoto Pink	35.40	16.53	14.30	8.55
17) Local Pink	57.73	19.75	27.85	14.23
18) Local White	50.90	20.75	25.60	13.25
19) Local violet	39.40	22.45	21.98	11.65
20) Milady Scarlet	13.60	13.05	11.15	9.53
21) Milady White	8.20	9.20	8.75	6.65
22) IIHRD5	58.20	15.25	17.25	9.60
23) IIHRC5	54.25	16.20	18.95	9.91
24) IIHRC42	53.15	15.15	23.35	13.15
25) IIHRCC39	56.35	16.60	24.03	12.25
26) IIHRCC5-1A	50.80	22.25	25.23	12.51
27) IIHRCC31-2	47.20	19.40	21.03	11.11
28) IIHRJ3	55.45	16.45	26.43	13.29
29) IIHRJ22	41.78	18.55	19.98	9.86
30) IIHRI1	53.05	17.20	21.28	10.99
31) IIHRI66	42.58	22.25	23.90	12.33
32) IIHRCC31A	50.50	14.50	23.35	11.80
33) IIHRG13	61.80	17.40	26.70	13.85
34) IIHRI69-2	53.40	22.10	29.78	14.59
35) IIHRD2	50.52	20.40	25.39	12.70
36) IIHRCC19	46.10	21.40	31.20	15.55
37) IIHRJ3-2	53.55	20.90	29.98	14.95
38) IIHRI69	50.30	21.00	24.45	12.35
39) IIHRI16B	46.70	23.55	20.33	10.06
40) IIHRH3	44.43	17.40	24.28	12.09
41) IIHRE10	36.90	21.15	34.75	17.60
42) IIHRC1	50.70	20.80	28.10	13.93
SEm ±	0.66	0.86	0.72	0.30
C.D. (P=0.05)	1.89	2.47	2.06	0.86
C.V. (%)	2.05	6.26	4.14	3.51

genetic makeup and prevailing environment conditions. Similar variation among the genotypes was reported by Khangjarakpam *et al.* (2014) and Chowdhuri *et al.* (2016) in China aster.

Maximum weight of flowers per plant was recorded in IIHRC42 (235.21 g), followed by Arka Poornima (231.62 g), however, Milady White recorded minimum weight of flowers per plant (7.72 g), which was followed by Milady Scarlet (18.70 g). Weight of flowers per plant is an essential character for loose flower (flower with short stalk), as loose flowers are sold on weight basis in flower market. Even though it is controlled by the genetic makeup of the plant, other characters such as weight of an individual flower and number of flowers per plant also play a significant role. The results are supported from the findings of Zosiamliana *et al.* (2013), Tirakannanavar *et al.* (2015) and Rai *et al.* (2016).

Table 2. Performance of the China aster genotypes for flowering, yield and postharvest characters

Genotype	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)	Vase life (days)	Shelf life (days)
1) Arka Kamini	75.05	34.30	6.34	231.00	41.50	95.88	28.00	8.25	3.29
2) Arka Poornima	82.05	29.30	6.40	548.25	42.25	231.62	32.40	7.40	3.36
3) Arka Shashank	70.95	41.15	4.10	181.50	56.00	101.66	32.25	7.90	3.97
4) Arka Violet cushion	74.75	42.40	5.48	373.50	55.55	207.73	32.40	7.38	3.74
5) Arka Aadya	55.05	34.25	5.06	267.50	41.62	111.28	28.50	6.70	3.69
6) Arka Archana	56.85	37.60	5.56	302.00	58.55	176.80	31.15	6.70	4.32
7) Phule Ganesh Pink	79.80	46.35	6.74	464.50	26.90	124.98	27.80	8.10	3.08
8) Phule Ganesh Purple	90.20	47.40	6.13	407.50	54.50	222.00	25.25	7.20	3.43
9) Phule Ganesh White	100.15	46.85	6.44	447.50	48.85	218.67	22.20	8.15	3.16
10) Phule Ganesh Violet	75.90	44.70	5.65	404.25	47.60	192.45	32.80	6.45	3.52
11) Matsumoto Yellow	63.30	23.15	3.54	184.00	31.00	57.09	25.05	6.35	3.02
12) Matsumoto White	68.15	27.00	3.85	202.50	29.00	58.75	28.50	5.40	2.92
13) Matsumoto Rose	52.05	19.40	3.99	192.00	22.25	42.76	18.55	6.55	3.56
14) Matsumoto Scarlet	59.20	20.90	3.92	190.75	20.80	39.62	17.60	5.85	3.65
15) Matsumoto red	46.85	23.15	3.93	195.50	25.00	48.89	18.75	5.95	3.22
16) Matsumoto Pink	52.95	19.60	3.70	185.50	18.90	35.07	18.75	6.85	3.70
17) Local Pink	67.35	47.50	5.57	315.00	59.08	186.18	23.65	6.60	2.72
18) Local White	65.70	45.35	5.54	277.00	65.05	180.33	22.60	7.30	3.39
19) Local violet	69.05	33.50	4.91	281.50	55.70	156.85	21.15	5.85	2.43
20) Milady Scarlet	54.00	8.15	4.46	177.00	10.55	18.70	19.03	6.70	2.35
21) Milady White	52.47	4.65	4.10	105.00	7.35	7.72	16.58	5.90	2.36
22) IIHRD5	61.75	46.65	5.60	234.50	58.75	137.80	22.60	7.50	3.52
23) IIHRC5	62.50	45.50	5.47	293.00	52.80	154.80	23.45	7.65	3.58
24) IIHRC42	54.25	43.50	5.75	385.50	61.00	235.21	21.15	6.75	3.24
25) IIHRCC39	63.45	49.10	6.23	331.00	35.75	118.28	27.75	6.20	3.41
26) IIHRCC5-1A	69.45	41.55	5.66	347.00	51.50	178.76	27.45	8.50	3.29
27) IIHRCC31-2	57.75	37.10	5.74	224.50	38.30	85.98	21.70	6.45	3.39
28) IIHRJ3	70.35	37.10	5.85	281.50	41.53	116.98	26.90	9.35	4.37
29) IIHRJ22	53.00	31.15	5.20	245.00	27.00	66.19	20.75	5.65	2.74
30) IIHRI1	62.15	36.50	5.35	233.00	42.30	98.62	20.85	7.45	3.65
31) IIHRI66	59.40	37.25	5.66	404.00	42.05	169.94	21.50	6.60	3.22
32) IIHRCC31A	55.45	40.38	5.76	285.00	50.70	144.52	21.45	7.70	3.15
33) IIHRG13	79.55	41.45	5.39	264.00	44.15	116.59	34.40	9.50	3.94
34) IIHRI69-2	68.85	47.50	5.76	390.00	37.55	146.49	22.35	7.45	3.96
35) IIHRD2	66.30	37.30	5.64	254.00	37.30	94.74	25.00	6.95	3.23
36) IIHRCC19	73.50	36.60	6.38	332.50	53.35	177.38	34.20	5.95	2.96
37) IIHRJ3-2	85.40	38.70	5.67	288.00	38.90	112.10	28.05	9.23	3.92
38) IIHRI69	63.20	32.60	6.10	370.50	19.20	71.14	24.50	7.75	3.79
39) IIHRI16B	75.00	35.90	5.39	218.50	37.25	81.33	21.00	7.50	3.58
40) IIHRH3	63.00	38.65	5.95	304.50	52.95	161.26	25.35	6.85	4.42
41) IIHRE10	71.65	27.95	6.58	402.00	34.90	140.22	22.50	5.65	3.84
42) IIHRC1	74.10	37.00	5.98	243.50	43.25	105.31	30.90	6.50	3.71
SEm ±	0.71	0.72	0.07	2.66	0.46	2.06	0.30	0.12	0.08
C.D. (P=0.05)	2.05	2.06	0.19	7.62	1.31	5.90	0.87	0.35	0.22
C.V. (%)	1.51	2.85	1.74	1.29	1.58	2.34	1.71	2.45	3.17

Flowering duration is an important character, which determines the availability of flowers in the market and suitability for bedding purpose. Maximum duration of flowering was recorded in IIHRG13 (34.40 days) which was statistically at par with IIHRCC19 (34.20 days) and Phule Ganesh Violet (33.30 days), whereas, minimum duration of flowering was recorded in Milady White (16.58 days). The variation observed can be attributed to the genetic makeup of the plant. The results are in concurrence with the findings of Zosiamliana *et al.* (2013), Khangjarakpam *et al.* (2014) and Pandey and Rao (2014).

Vase Life and Shelf Life

Vase life and shelf life are two important flower quality traits. The vase life is generally recorded for cut flower

and shelf life for loose flowers, which decides their longevity in flower vase and in the shelf, respectively. Extended vase life was recorded in IIHRG13 (9.50 days), followed by IIHRJ3 (9.35 days), while least vase life was recorded in Matsumoto White (5.40 days). The variation in vase life of different genotypes may be due to the difference in senescencing behavior of individual genotype. The results are in agreement with Rai *et al.* (2016) in China aster and Kumar *et al.* (2012) in gerbera. The maximum shelf life was recorded in IIHRH3 (4.42 days), which was statistically at par with IIHRJ3 (4.37 days), however, it was recorded minimum in Milady Scarlet (2.35 days). Similar results have been reported by Rai *et al.* (2016) and Pandey and Rao (2014) in China aster.

On the basis of pooled data of two years i.e. 2015-16 to 2016-17 for vegetative growth, flowering, yield and postharvest life of 42 genotypes, it can be concluded that the genotypes evaluated, IIHRCC39 and IIHRI69-2 found promising for long stalk length, whereas, IIHRG13 and IIHRJ3 for vase life. The genotypes IIHRCC42 and Arka Poornima were found promising for loose flower yield under Bengaluru agro-climatic conditions.

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