

EVALUATION OF CHINA ASTER (*CALLISTEPHUS CHINENSIS* (L.) NEES) CULTIVARS UNDER MID HILL CONDITIONS OF HIMACHAL PRADESH

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ABSTRACT

The present experiment was conducted at Department of Floriculture and Landscape Architecture, Dr YS Parmar University of Horticulture and Forestry, Solan to study the performance of ten China aster cultivars under mid-hill conditions of Himachal Pradesh. The results showed high variation in performance of all the ten cultivars for growth and flowering characters. Maximum plant height (102.25 cm) and flower head diameter (6.82 cm) was noted in Phule Ganesh Violet. Arka Shashank recorded maximum number of primary branches (19.00) and stalk length (32.60 cm) and also it took minimum number of days to first flower opening (77.25 days) and days to 50% flowering (92.45 days). Minimum value for number of primary branches (7.25), number of harvests of loose flower (7.25) and number of flowers per plant (19.60) was observed in Phule Ganesh White. Also, Phule Ganesh White took maximum number of days to first flower opening (106.25 days) and days to 50% flowering (123.20 days). Phule Ganesh Purple recorded maximum weight of flowers per plant (174.42 g) and individual flower weight (5.30 g). Based on these findings Phule Ganesh Purple was found to be most suitable for loose flower production and Arka Shaashank most suitable for cut flower production.

INTRODUCTION

China aster (*Callistephus chinensis* (L.) Nees) belongs to the family Asteraceae and is native of China (Navalinskien *et al.*, 2005). The genus *Callistephus* derived its name from two greek words 'Kalistos' and 'Stephos' meaning 'most beautiful' and 'a crown', respectively. Cassini described China aster as *Callistephus hortensis*. It was first named by Linnaeus as *Aster chinensis* and later Nees changed this name to *Callistephus chinensis* (Janakiram, 2006). Among the annuals, China aster is ranked third for popularity, after Chrysanthemum and Marigold (Sheela, 2008). Evaluation studies for promising cultivars have been recently carried out in Karnataka (Munikrishnappa *et al.*, 2013) and Andhra Pradesh (Zosiamlana *et al.*, 2013). Although, cultivars like Arka Kamini, Arka Shashank, Violet Cushion and Arka Poornima have been sparsely cultivated for various purposes in Himachal Pradesh, information on best China aster cultivar for loose flower production and cut flower production was lacking under mid-hill conditions of Himachal Pradesh. Hence, the present investigation was designed to determine the best suitable China aster cultivars for quality cut flower and loose flower production which is important to select cultivars through which maximum benefits can be obtained from the available commercial cultivars.

MATERIALS AND METHODS

The present study was conducted at the Experimental Research Farm of Department of Floriculture and Landscape

Architecture, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan during the year 2015. The experiment was laid out in randomized block design with four replications and ten genotypes of China aster were used as planting material. Fifteen plants per replication were planted at a spacing of 30 x 25 cm. The study was conducted under open field conditions. Five random plants were selected for recording observations for various growth and flowering traits, viz. plant height (cm), plant spread (cm), number of primary branches per plant, stalk length (cm), days to first flower opening, days to 50% flower opening, number of harvests of loose flower, flower head diameter (cm), number of flowers per plant, weight of flowers per plant (g), individual flower weight (g) and flowering duration (days), shelf life (days) and vase life (days). The analysis of variance was done by the method suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Mean performance of cultivars for growth characters

The mean performance of ten China aster cultivars for different growth characters is presented in Table 1. It is evident from the data that maximum plant height was observed in China aster cultivar 'Phule Ganesh Violet' (102.25 cm). On the contrast, minimum plant height was recorded in cultivar 'Kamini' (41.15 cm). It was, however, found to be statistically at par with plant height observed in cultivar 'Arka Archana' (43.16 cm). Plant height varied significantly among the cultivars. Being a varietal trait, variations among the cultivars are

Table 1: Mean performance of cultivars for growth characters

Characters	Plant height (cm)	Plant spread (cm)	Number of primary branches	Stalk length (cm)
Phule Ganesh Purple	93.75	45.29	12.80	24.99
Phule Ganesh Violet	102.25	50.44	11.70	22.83
Phule Ganesh White	63.88	30.58	11.65	32.03
Phule Ganesh Pink	94.78	55.70	13.45	23.25
Arka Aadhya	46.58	54.37	17.30	24.05
Arka Archana	43.16	42.24	18.70	26.13
Poornima	61.05	28.58	12.90	21.93
Kamini	41.15	23.79	16.20	31.15
Shashank	53.82	24.37	19.00	32.60
Violet Cushion	63.13	36.82	15.80	23.55
S.Em \pm	1.69	2.14	0.84	0.91
CD _{0.05}	3.46	4.40	1.72	1.87

Table 2: Mean performance of cultivars for flowering characters

Characters	Days to first flower opening	Days to 50% flower opening	Number of harvests of loose flower	Flower head diameter (cm)	Flowering duration (days)
Phule Ganesh Purple	99.00	111.85	10.50	6.73	32.05
Phule Ganesh Violet	101.75	116.25	9.50	6.82	29.70
Phule Ganesh White	106.25	123.20	7.25	5.46	25.65
Phule Ganesh Pink	97.50	113.35	11.25	5.78	34.10
Arka Aadhya	79.25	94.05	15.75	5.44	41.30
Arka Archana	84.00	99.85	13.25	4.88	37.05
Poornima	104.75	119.45	8.75	4.73	27.05
Kamini	84.75	100.05	14.25	4.54	38.15
Shashank	77.25	92.45	15.00	4.42	40.85
Violet Cushion	94.50	109.90	12.25	5.91	35.70
S.Em \pm	2.08	2.46	0.98	0.17	1.77
CD _{0.05}	4.26	5.04	2.00	0.35	3.64

attributed to the genetic makeup of the plant. Variation in plant height due to varieties and genotypes has also been reported by Chavan *et al.* (2010) in China aster; Chourasia *et al.* (2015) and Bhujbal *et al.* (2013) in gladiolus.

Maximum plant spread recorded in cultivar 'Phule Ganesh Pink' (55.70 cm) was found to be at par with plant spread recorded in 'Arka Aadhya' (54.37 cm). On the other hand, minimum plant spread was observed in cultivar 'Kamini' (23.79 cm) and it was found to be at par with cultivar 'Arka Shashank' (24.37 cm). It is varietal trait and variations among the genotypes are attributed to the genetic makeup of the plant. Variation in plant spread due to varieties has been reported by Pandey and Rao (2014) in China aster; Sharma (2014) in French marigold.

Highest number of primary branches were recorded in 'Arka Shashank' (19.00) which was statistically at par with 'Arka Archana' (18.70) and 'Arka Aadhya' (17.30) whereas minimum number of primary branches were recorded in 'Phule Ganesh White' (11.65), statistically at par with 'Phule Ganesh Violet' (11.70), 'Phule Ganesh Purple' and 'Arka Poornima'. Like other characters, number of primary branches is also a varietal character and its expression depends on the genotype of the plant. Poornima *et al.* (2006) and Munikrishnappa *et al.* (2013) observed significant variation for number of primary branches.

Maximum stalk length was exhibited by 'Arka Shashank' (32.60 cm) which was found to be at par with 'Phule Ganesh White' (32.03 cm) and 'Arka Kamini' (31.15 cm). On the contrary, minimum stalk length was recorded in 'Arka Poornima' (21.93

cm). It was found to be statistically at par with 'Phule Ganesh Violet' (22.83 cm), 'Phule Ganesh Pink' (23.25 cm) and 'Violet Cushion' (23.55 cm). Variations among the cultivars are attributed to the genetic makeup of the plant. Significant variation for stalk length was reported by Kishanswaroop *et al.* (2004) and Zosiamlia (2013). Maynard and David (1987) suggested that availability of congenial environment to express the dominant gene in the genotypes might be the reason for this variation.

Mean performance of cultivars for flowering characters

The ten cultivars evaluated during the study showed significant variation for flowering characters (Table 2). Minimum days to first flower opening were recorded in 'Arka Shashank' (77.25 days) which was statistically at par with 'Arka Aadhya' (79.25 days), whereas, 'Phule Ganesh White' (106.25 days) took maximum days to first flower opening that proved to be statistically at par with 'Arka Poornima' (104.75). Number of days taken to first flower opening signifies the early or late flowering habit of the cultivar. Both habits are helpful in determining the availability of flowers for a longer period (Behera *et al.*, 2002). However, earliness in flowering is more suitable as reduces the flowering duration and increases the profit (Singh *et al.* 2014). Though, the number of days taken to first flower opening is a varietal trait, Dhiman (2003) suggested that more dry matter accumulation during favourable climatic conditions might be the reason for earliness in this trait. Variation in days to first flower opening has also been reported by Kumar and Patil (2003) and Khangjarakpam *et al.* (2014).

Table 3: Mean performance of cultivars for yield characters

Characters	Number of flowers per plant	Individual flower weight (g)	Weight of flowers per plant (g)
Phule Ganesh Purple	33.20	5.30	174.42
Phule Ganesh Violet	21.80	4.33	99.84
Phule Ganesh White	19.60	4.45	88.25
Phule Ganesh Pink	27.40	5.05	139.17
Arka Aadhya	31.90	3.48	111.42
Arka Archana	34.35	3.63	126.25
Poornima	29.25	3.55	107.17
Kamini	22.20	3.98	87.25
Shashank	31.25	3.25	102.92
Violet Cushion	24.50	3.58	84.50
S.Em ±	1.37	0.15	2.10
CD _{0.05}	2.80	0.31	4.30

Table 4: Mean performance of cultivars for storability

Characters	Vase life (days)	Shelf life (days)
Phule Ganesh Purple	9.42	5.85
Phule Ganesh Violet	8.50	5.38
Phule Ganesh White	12.08	6.03
Phule Ganesh Pink	8.34	4.58
Arka Aadhya	14.08	7.83
Arka Archana	14.42	8.30
Poornima	9.67	5.55
Kamini	8.42	5.18
Shashank	8.25	6.38
Violet Cushion	7.42	4.45
S.Em ±	0.48	0.20
CD _{0.05}	0.98	0.41

Minimum number of days to 50% flower opening was recorded in 'Arka Shashank' (92.45), statistically at par with 'Arka Aadhya' (94.05). Whereas, 'Phule Ganesh White' (123.20) took maximum number of days to 50% flower opening, statistically at par with 'Arka Poornima' (119.45). This character is positively correlated to days taken to first flower opening. The genetic constituents of the plant play an important role in this character. A wide variation in number of days to 50% flowering have also been reported by Zosiamlina *et al.* (2013), Khangjarakpam *et al.* (2014) and Tirakannanavar *et al.* (2015).

Out of the 10 cultivars 'Arka Aadhya' has recorded maximum number of harvests of loose flowers (15.75). It was found to be statistically at par with 'Arka Shashank' (15.00) and 'Arka Kamini' (14.250). On the contrast, minimum number of harvests of loose flowers was recorded in 'Phule Ganesh White' (7.25). It was significantly at par with 'Arka Poornima' (8.75). Primarily, it is a varietal trait, but is positively correlated to the number of flowers per plant and flowering duration. More is the flowering duration, there will be more non-synchronous maturity among the flowers i.e. flowers reaching the harvesting stage at the same time will be less. Although, there exist several number of varieties under cultivation, their performance are region specific, which varies with location and climate. In addition, nutritional and climatic conditions that prevail during the growing period also determine the flowering characters (Bodley, 1975).

Largest flower head diameter was observed in 'Phule Ganesh

White' (6.82 cm), found to be statistically at par with 'Phule Ganesh Purple' (6.73 cm). While minimum value for flower head diameter was observed in 'Arka Shashank' (4.42 cm), at par with 'Arka Kamini' (4.54 cm) and 'Arka Poornima' (4.73 cm). The observed variation among cultivars for flower head diameter could be attributed to the inherent genetic and environmental factors. The results are in confirmation with the findings of Poornima *et al.* (2006) and Bhargav (2014) in China aster; Singh *et al.* (2014) in African marigold.

Maximum flowering duration was observed in 'Arka Aadhya' (41.30 days) which was statistically at par with 'Arka Shashank' (40.85 days) and 'Arka Kamini' (38.15 days), whereas minimum flowering duration was recorded in 'Phule Ganesh White' (25.65 days) that was found to be statistically at par with 'Arka Poornima' (27.05 days) and 'Phule Ganesh Violet' (29.70 days). Flowering duration is helpful in determining the availability of flowers for a longer period. The observed variation can be attributed to the genotype of the plant. Variation in flowering duration has been reported by Zosiamlina *et al.* (2013), Khangjarakpam *et al.* (2014) and Pandey and Rao (2014) in China aster; Raghuvanshi (2007) and Singh *et al.* (2014) in African marigold.

Mean performance of cultivars for yield characters

Significant differences for yield parameters were found among the China aster cultivars (Table 3). 'Arka Archana' produced maximum number of flowers per plant (34.35). It was found to be statistically at par with number of flowers produced per plant by 'Phule Ganesh Purple' (33.20) and 'Arka Aadhya' (31.90). Whereas, 'Phule Ganesh White' produced minimum number of flowers per plant (19.60), statistically at par with 'Phule Ganesh Violet' (21.80) and 'Arka Kamini' (22.20). Number of flowers per plant is one of the important factors which contribute to the yield of plant. Such variations among cultivars can be attributed to the genetic factors. Similar results for number of flowers per plant have been reported by Poornima *et al.* (2006) and Chavan *et al.* (2010) in China aster; Sharma (2014) in French marigold.

Maximum weight of flowers per plant was recorded in 'Phule Ganesh Purple' (174.42 g), followed by 'Phule Ganesh Pink' (139.17 g). On the other hand, 'Violet Cushion' recorded minimum weight of flowers per plant (84.50 g). It was found to be statistically at par with 'Arka Kamini' (87.25 g) and 'Phule Ganesh White' (88.25 g). Weight of flowers per plant is the

most important factor to be considered for commercial cultivation. Although it is controlled by the genetic makeup of the plant, a number of other factors like individual flower weight and number of flowers per plant play a significant role. The variation among the cultivars for weight of flowers per plant is supported by the findings of Zosiamlia et al. (2013), Bhargav (2014) and Tirakannanavar et al. (2015).

Maximum individual flower weight was recorded in 'Phule Ganesh Purple' (5.30 g) that was statistically at par with 'Phule Ganesh Pink' (5.05 g). Minimum individual flower weight was recorded in 'Arka Shashank' (3.25 g), statistically at par with 'Arka Aadhya' (3.48 g) and 'Arka Poornima' (3.55 g). Variation in flowering attributes could be due to genetic makeup of the cultivars. A wide variation in individual flower weight has also been reported by Kumar and Patil (2003) and Kishanswaroop et al. (2004) in China aster; Sharma (2014) in African marigold.

Mean performance of cultivars for storability

Cultivars were tested for different storage parameters i.e. vase life in tap water for cut flowers and shelf life for loose flowers at room temperature. Maximum vase life was exhibited by 'Arka Archana' (14.42 days), found to be statistically at par with 'Arka Aadhya' (14.08 days). On the contrast, minimum vase life was found in 'Violet Cushion' (7.42 days). It was statistically at par with 'Arka Shashank' (8.25 days) and 'Phule Ganesh Pink' (8.34 days). Since the vase solution for all cultivars was same (tap water), the observed variation in vase life can be attributed to the genetic makeup of the plant. Similar variations in the vase life of China aster cut flowers have been reported by Zosiamlia et al. (2013) and Pandey and Rao (2014).

Maximum shelf life was recorded in 'Arka Archana' (8.30 days) followed by 'Arka Aadhya' (7.83 days). Minimum shelf life was observed in 'Violet Cushion' (4.45 days) which was statistically at par with 'Phule Ganesh Pink' (4.58 days). Although, all cultivars experienced same temperature and relative humidity for testing of shelf life, variation among cultivars for these characters may be attributed to their genetic makeup. Similar results have been reported by Kishanswaroop et al. (2004) and Pandey and Rao (2014) in China aster; Raghuvanshi (2007) in French marigold.

Phule Ganesh Purple recorded maximum weight of flowers per plant (174.42 g) and individual flower weight (5.30 g), therefore it can be inferred that Phule Ganesh Purple is the most suitable cultivar for loose flower production than other cultivars. For cut flower production, Arka Shashank was found most suitable cultivar having highest number of primary branches (19.00) and stalk length (32.60 cm).

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