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ASSESSMENT OF ELITE CHINA ASTER HYBRIDS FOR FLOWER QUALITY TRAITS IN F_2 GENERATION

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ABSTRACT

The ornamental plant market is highly dynamic, necessitating continuous improvement in floral traits to enhance commercial value. In India, China aster cultivars typically exhibit semi-double flowers, short stalks, and limited vase life, prompting breeding efforts to enhance plant height, branching, flower yield, color diversity, stalk length and post-harvest longevity. This study, conducted at the Floriculture Unit, University of Agricultural Sciences, Bengaluru, during the *Rabi* season of 2023–24, evaluated 27 hybrids developed through the Line × Tester breeding method. The hybrids were assessed for genetic variability, agronomic performance and flower quality traits using a randomized complete block design (RCBD) with three replications.

Among the evaluated hybrids, Hybrid-10 (Arka Poornima × Arka Kamini) exhibited the largest flower diameter (7.20 cm), while Hybrid-5 (P. G. Pink × P. G. Purple) recorded the longest vase life (11.00 days) and highest flower weight (5.17 g). Hybrid-1 (Arka Poornima × P. G. Purple) showed the longest stalk length (62.77 cm), a crucial trait for the cut flower industry. Additionally, Hybrid-4 (Arka Poornima × A.A.C – 1) and Hybrid-5 demonstrated extended shelf lives (5.2 days). These findings highlight significant genetic potential for improving flower quality traits and marketability through targeted breeding programs. The study reinforces the role of genetic variability in optimizing China aster hybrids for commercial floriculture, paving the way for further selection and hybridization efforts to meet industry demands.

Key words : China aster, Hybrids, Flower diameter, Stalk length, Shelf life, Vase life, Quality.

Introduction

Flowers have played an integral role in human civilization since ancient times, with floriculture emerging as a thriving sector within horticulture. Beyond their aesthetic appeal, flowers hold significant social and economic value, providing year-round employment opportunities and contributing to foreign exchange earnings. The rising demand for flowers has positioned floriculture as a key commercial segment of horticulture, driven by shifting lifestyles, corporate culture, and urbanization. Additionally, economic liberalization and government incentives have encouraged Indian entrepreneurs to invest in this sector. Among traditional flower crops cultivated for loose and cut flowers, China aster has gained popularity among small and marginal farmers in India due to its ease of cultivation (Singh, 2006).

China aster (*Callistephus chinensis* Nees.) is a commercially significant flower crop belonging to the Asteraceae family. It is a diploid species (2n=18) native to China. The genus name *Callistephus* originates from the Greek words *Kalistos* (“most beautiful”) and *Stephus* (“crown” or “flower head”). Initially named *Aster chinensis* by Linnaeus, it was later reclassified as *Callistephus chinensis* by Nees (Janakiram, 2006). Introduced to Europe and other tropical regions in the 18th century, China aster has since gained worldwide prominence (Bailey, 1963). As an annual flowering plant, it exhibits hispid, hairy branches with an erect, semi-erect, or spreading growth habit. Its broadly ovate or triangular-ovate leaves have deep, irregular serrations. Based on height, plants are classified as short (20–40 cm), medium

(40–60 cm) or tall (above 60 cm). The plant produces solitary flower heads (capitula) composed of outer ray florets (pistillate) and inner disc florets (hermaphroditic).

Strube (1965) studied the floral biology of China aster, revealing that flower doubleness depends on the ratio of ray florets to disc florets. The species follows a geitonogamous self-pollination mechanism, wherein pollen from one flower fertilizes another within the same plant. This occurs because the stamens and pistils do not mature simultaneously—the stigma unfurls only after pollen release. Residual pollen within the capitulum facilitates self-fertilization, making China aster predominantly self-pollinated.

China aster thrives in open-field conditions, ensuring a consistent supply of flowers throughout the *kharif* and *rabi* seasons. Its wide spectrum of vibrant colors and longer vase life make it a preferred cFkumhoice for garland and bouquet making, floral arrangements and exhibitions. Dwarf branching varieties are particularly favored for landscape gardening, herbaceous gardens, and border plantings (Munikrishnappa *et al*., 2013). It is a commercially important garden and cut-flower crop in Russia, Japan, North America, Switzerland and Europe. In India, it is predominantly cultivated by small and marginal farmers in Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh and West Bengal. Karnataka is a leading producer, with major cultivation areas in Bangalore, Tumkur, Kolar, Chikkaballapur and Belagavi. The state covers 207 hectares, yielding 1,448 metric tons at a productivity rate of 7.01 tons per hectare, generating an annual revenue of ¹ 430 lakhs (Anonymous, 2022–23). Flower yield varies depending on planting season and cultural practices.

China aster breeding in India began in 1990 with the efforts of Negi and Raghava. Institutions like the Indian Institute of Horticultural Research (IIHR), Bengaluru and Ganesh Khind Botanical Garden, Pune have played a pivotal role in developing improved varieties. Notable cultivars from IIHR include Arka Poornima, Arka Kamini, Arka Shashank, Arka Adya, Arka Archana, Arka Advika, Arka Nirali, Arka Shubhi and Violet Cushion. Additionally, MPKV, Rahuri, introduced Phule Ganesh White, Phule Ganesh Pink, Phule Ganesh Violet and Phule Ganesh Purple, while UHS, Bagalkot, developed Krishnaprabha Chinmay.

The ornamental plant market is highly dynamic, with a constant demand for new and improved varieties. Existing China aster cultivars in India typically have semi-double flowers with prominent disks, short flower stalks, and limited vase life. Hence, breeding programs focus on improving plant height, branching, flower yield, color variations, stalk length and vase life for both cut and loose flowers. Effective breeding relies on genetic variability, which is best utilized through systematic selection procedures. Genetic variance in quantitative traits includes additive (heritable) and non-additive (dominance and epistasis) components. To refine selection strategies, it is crucial to analyze phenotypic variability based on parameters such as phenotypic and genotypic coefficients of variation, heritability and genetic advance. These factors help predict selection efficiency. In this context, an experiment was conducted to evaluate the genetic variability of newly developed China aster hybrids by assessing their agronomic performance and flower quality parameters. The results of this preliminary study are presented and discussed in this article.

Materials and Methods

The study was carried out at the Floriculture Unit, Department of Horticulture, University of Agricultural Sciences, GKVK Campus, Bengaluru, during the *Rabi* season of 2023–24. A total of 27 hybrids were developed using the Line × Tester breeding method and evaluated for genetic variability, agronomic performance and Flower quality. Based on superior performance, 10 of these hybrids were selected for the next generation (F_2) and further assessed for flower quality parameters alongside a standard check variety.

The experiment was conducted using a randomized complete block design (RCBD) with three replications and 11 treatments. The details of the genotypes used in the study are as follows:

S. no.	Hybrid	Cross combination (Parentage)
1	Hybrid 1	Arka Poornima x P. G. Purple
2	Hybrid 2	P. G. Pink x Arka Kamini
3	Hybrid 3	P. G. Pink x A.A.C - 1
4	Hybrid 4	Arka Poornima x A.A.C - 1
5	Hybrid 5	P. G. Pink x P. G. Purple
6	Hybrid 6	P. G. White x P. G. Purple
7	Hybrid 7	Miraj Local x A.A.C - 1
8	Hybrid 8	P. G. White x A.A.C - 1
9	Hybrid 9	Miraj local x P. G. Purple
10	Hybrid 10	Arka Poornima x Arka Kamini
11	Check variety	Arka Kamini

Observations recorded

Flower diameter : The flower diameter (cm) was measured at the widest part of the bloom using vernier calipers. The average of five randomly selected flowers was recorded and expressed in centimetres.

Stalk length : The stalk length (cm) was determined by measuring the distance from the bottom cut end of the stalk to the topmost bud of the bloom. The average of five randomly selected plants per treatment was recorded and expressed in centimetres.

Individual flower weight : The individual flower weight (g) was measured by harvesting flowers at the 75% bloom stage. Each flower was weighed individually, and the average of the observations was recorded in grams.

100 flowers weight : The 100-flower weight (g) was determined by harvesting flowers at the 75% bloom stage, counting 100 flowers and weighing them. The average of these measurements was expressed in grams.

Shelf life : The shelf life (days) was assessed by placing freshly harvested flowers at ambient temperature and observing them for the loss of freshness. The duration taken for the flowers to completely lose freshness was recorded and expressed in days.

Vase life : The vase life (days) was evaluated by placing China aster blooms with stalks in a vase containing a 2.5% sucrose solution at room temperature. The flowers were observed for signs of freshness loss, including loss of turgidity and rolling of florets. The duration until complete freshness loss was recorded and expressed in days.

Statistical analysis : The experimental data obtained were subjected to statistical analysis adopting Fishers method of Analysis of variance as outlined by Gomez and Gomez (1984). The level of significance used in "F-test" was given at 5%level of significance, wherever "F-test" was significant at 5 % level.

Results and Discussion

The data collected in relevance to flower quality parameters are presented in Table 1 and discussed below.

Flower diameter : Among the hybrids evaluated, Hybrid-10 (*Arka Poornima* × *Arka Kamini*) exhibited the largest flower diameter at 7.20 cm, which was statistically comparable to Hybrid-9 (Miraj Local × P. G. Purple) and Hybrid-1 (Arka Poornima × P. G. Purple), measuring 7.10 cm and 7.03 cm, respectively. In contrast, the commercial check (Arka Kamini) recorded the smallest flower diameter at 4.93 cm. These results are consistent with the findings of Harish Kumar *et al.* (2017) in China aster, reinforcing the genetic potential of selected hybrids for producing larger blooms, which is a desirable trait in the floriculture industry.

Stalk length : The evaluation of stalk length among the hybrids revealed significant variations, with Hybrid-1 (Arka Poornima × P. G. Purple) recording the longest stalks at 62.77 cm, followed by Hybrid-2 (P. G. Pink × Arka Kamini), which measured 54.23 cm. In contrast, the shortest stalk length of 39.17 cm was observed in Hybrid-9 (Miraj Local × P. G. Purple). Longer stalks are generally preferred in the cut flower industry as they enhance the ornamental value and ease of handling in floral arrangements. These findings align with the results reported by Henny *et al.* (2021) in chrysanthemum and Ramya *et al.* (2019) in China aster, emphasizing the influence of genetic and environmental factors on stalk elongation.

Table 1 : Flower quality of Novel China aster hybrids in F_2 generation.

Hybrid	Flower diameter (cm)	Stalk length (cm)	Individual flower weight (g)	100 flowers weight (g)
H1	7.03	62.77	4.60	336.71
H2	6.47	54.23	3.88	362.35
H3	6.30	51.50	4.34	327.31
H4	5.97	45.60	4.48	352.16
H5	5.77	50.50	5.17	390.86
H6	5.20	53.07	4.55	325.65
H7	6.63	43.43	4.80	376.39
H8	6.17	39.50	4.39	335.06
H9	7.10	39.17	4.78	372.52
H10	7.20	47.73	3.62	348.49
C	4.93	44.93	3.54	317.00
C.D.	0.26	3.34	0.08	3.70
SE(m)	0.09	1.13	0.03	1.24

Individual Flower weight : The observations recorded for individual flower weight showed considerable variation among the evaluated hybrids. The heaviest individual flower was observed in Hybrid-5 (P. G. Pink × P. G. Purple), weighing 5.17 g, followed by Hybrid-7 (Miraj Local × A.A.C-1) and Hybrid-9 (Miraj Local × P. G. Purple), with flower weights of 4.80 g and 4.78 g, respectively. In contrast, the lightest individual flowers were recorded in the commercial check (Arka Kamini), weighing 3.54 g. Larger and heavier blooms are generally preferred in the floriculture industry due to their enhanced visual appeal and commercial value, particularly in the cut flower and loose flower markets. The observed variations in flower weight can be attributed to genetic differences, nutrient availability and environmental factors. These findings align with the results reported by Nataraj *et al.* (2021) in China aster and Patel *et al.* (2019) in marigold, reinforcing the significance of breeding programs in developing hybrids with improved

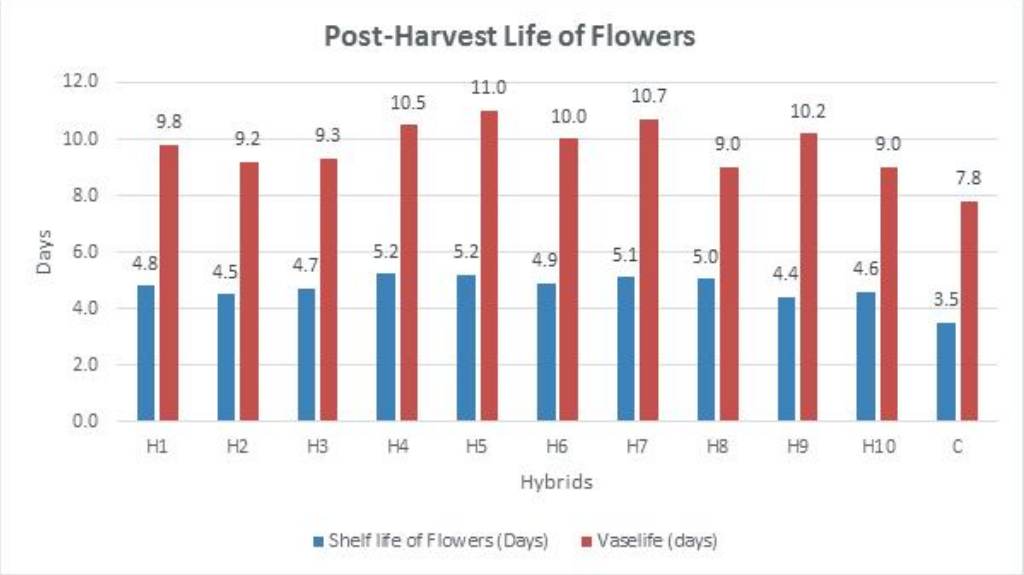

Fig. 1 : Post-harvest life of China aster hybrids in F_2 generation.

floral traits to meet market demands.

100 Flowers weight : The data collected on the weight of 100 flowers among the hybrids revealed significant variation. Hybrid-5 (*P. G. Pink* × *P. G. Purple*) recorded the highest weight at 390.86 g, followed by Hybrid-7 (Miraj Local × A.A.C-1), which measured 376.39 g. In contrast, the lowest value for this trait was observed in the commercial check variety (Arka Kamini), with a weight of 317.00 g. A higher flower weight is often associated with better quality and market preference, making these hybrids more desirable for commercial floriculture. These findings align with the results reported by Hallikeri (2018) and Hosalli *et al.* (2019) in China aster, reinforcing the role of genetic variability in determining flower weight.

Post-Harvest life : The post-harvest quality parameters such as shelf life and vase life of the hybrids were assessed and presented in Fig. 1.

Shelf life : The observations on shelf life among the evaluated hybrids revealed that Hybrid-4 (Arka Poornima × A.A.C – 1) and Hybrid-5 (P. G. Pink × P. G. Purple) recorded the longest shelf life of 5.2 days, followed closely by Hybrid-7 (Miraj Local × A.A.C-1) with a shelf life of 5.1 days. In contrast, the shortest shelf life of 3.5 days was observed in the commercial check variety (Arka Kamini). A longer shelf life is a crucial trait for enhancing the marketability and post-harvest longevity of flowers, making these hybrids more suitable for commercial floriculture. These findings are in agreement with the results of Ramya *et al.* (2019) in China aster and Vishnupriy *et al.* (2015) in marigold, highlighting the genetic influence on flower longevity and the potential for further improvement through breeding programs.

Vase life : The findings of the experiment indicate significant variation in vase life among the evaluated hybrids. Hybrid-5 (P. G. Pink × P. G. Purple) exhibited the longest vase life of 11.00 days, which was statistically on par with Hybrid-7 (Miraj Local × A.A.C-1) and Hybrid-4 (Arka Poornima × A.A.C-1), recording vase lives of 10.7 days and 10.5 days, respectively. In contrast, the shortest vase life of 7.8 days was observed in the commercial check variety (Arka Kamini). A longer vase life is a crucial trait for enhancing the commercial value of cut flowers, as it directly influences their marketability and consumer preference. These findings are consistent with the observations of Ramya *et al.* (2019) and Nataraj *et al.* (2021) in China aster, reinforcing the role of genetic factors in determining post-harvest longevity and highlighting the potential for further improvement through targeted breeding programs.

Conclusion

The study demonstrated significant genetic variability among the evaluated China aster hybrids, highlighting their potential for commercial floriculture. Hybrid-10 (Arka Poornima × Arka Kamini) exhibited the largest flower diameter, while Hybrid-1 (Arka Poornima × P. G. Purple) recorded the longest stalk length, both traits being highly desirable in the cut flower industry. Hybrid-5 (P. G. Pink × P. G. Purple) excelled in individual flower weight, 100-flower weight, and vase life, making it a promising candidate for market adoption. Additionally, Hybrid-4 and Hybrid-5 displayed the longest shelf life, further enhancing their post-harvest value. The observed variations align with previous studies, reinforcing the influence of genetic

factors on floral traits. These results suggest that selective breeding can be effectively utilized to develop superior hybrids with enhanced flower quality, post-harvest longevity, and market appeal, thereby improving the commercial viability of China aster.

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Competing interests

"Authors have declared that no competing interests exist."

Authors' contributions

Karthik, D. R. - Conceptualization of the study, Maintained crop in the field, statistical analysis and wrote the first draft of the manuscript.

Dr. R. Vasantha Kumari - facilitated the resources required and provided technical guidance.

Dr. Chikkalingaiah – technical guidance to develop and Select novel hybrids.

All authors read and approved the final manuscript.

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