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Research Article

Agronomic Performance of Novel China aster Hybrids in F2 Generation

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Abstract

Agronomic evaluation of hybrids in early generations is essential for identifying promising genotypes with desirable traits such as early maturity, high yield potential, and superior adaptability to environmental conditions. This study focused on assessing key growth parameters, including plant height, branching pattern, plant spread, flowering behavior, and yield attributes. The evaluation was conducted at the Floriculture Unit, Department of Horticulture, University of Agricultural Sciences (UAS), Bengaluru, using a Randomized Complete Block Design (RCBD) with 11 treatments and 3 replications. The analysis of growth parameters at different developmental stages revealed significant variations among the hybrids. H1 (Arka Poornima × P.G. Purple) consistently exhibited the tallest plant height across all stages, while H3 (P.G. Pink × A.A.C – 1) produced more branches at early growth stages. H4 (Arka Poornima × A.A.C – 1) demonstrated strong vegetative vigor, with the widest plant spread and the highest number of branches at later stages. Additionally, H5 (P.G. Pink × P.G. Purple) showed notable plant spread in the North-South direction at 60 DAT. Regarding yield potential, H4 emerged as the most promising hybrid for maximizing flower production, while H6 also showed strong productivity. For seed yield, hybrids H7 and H3 exhibited superior performance, whereas early-maturing hybrids like H10, H2, and H4 could be advantageous for shorter cropping cycles and improved production efficiency. These findings underscore the potential of different hybrids for enhancing productivity and adaptability in diverse growing conditions.

Keywords: China Aster; Growth; Flower yield; Seed yield; Germination; Hybrids

Abbreviations

DAT: Days After Transplanting; No: Number; Cm: Centimetre; g: Gram; t: Ton; ha: Hectare; H: Hybrid

Introduction

Flowers have been an integral part of human civilization since ancient times, and floriculture has emerged as a promising sector within horticulture. Beyond its aesthetic appeal, it holds significant social and economic value, offering year-round employment opportunities and contributing to foreign exchange earnings. The growing demand for flowers has positioned floriculture as a key commercial segment of horticulture. Changing lifestyles, corporate culture, and urbanization have further driven its expansion. Additionally, economic liberalization and government incentives have encouraged Indian entrepreneurs to invest in floriculture. Among traditional flower crops grown for loose and cut flowers, China aster has become popular among small and marginal farmers in India due to its ease of cultivation [1].

China aster (*Callistephus chinensis* Nees.) is a commercially significant flower crop belonging to the Asteraceae family. It is a diploid species (2n=18) originating from China. The genus name *Callistephus* is derived from the Greek words *Kalistos* (meaning "most beautiful") and *Stephus* (meaning "a crown" or "flower head"). Initially named *Aster chinensis* by Linnaeus, it was later reclassified as *Callistephus chinensis* by Nees [2]. Introduced to Europe and other tropical regions during the 18th century, China aster has since gained prominence worldwide [3].

As an annual flower crop, China aster exhibits hispid, hairy branches with erect, semi-erect, or spreading growth habits. Its alternately arranged leaves are broadly ovate or triangular-ovate with deep, irregular serrations. Based on height, plants are categorized as short (20–40 cm), medium (40–60 cm), or tall (above 60 cm). The species produces striking, solitary flower heads (capitula) composed of outer ray florets (pistillate) and inner disc florets (hermaphroditic).

Strube explored the floral biology of China aster, noting that the degree of doubleness in flowers depends on the ratio of ray florets to disc florets. The stamens and pistils within a single flower do not mature simultaneously; the stigma unfurls only after pollen release. However, residual pollen within the capitulum enables self-fertilization, classifying China aster as geitonogamous. China aster is a predominantly self-pollinated crop [4].

China aster thrives in open-field conditions, ensuring a consistent year-round flower supply during both *kharif* and *rabi* seasons. Its extensive cultivation is driven by its wide range of vibrant colors and comparatively longer vase life. Due to its popularity, China aster is widely used in garland and bouquet making, floral arrangements, and flower exhibitions. Dwarf branching varieties are particularly favored as bedding plants and are commonly used in herbaceous gardens and border plantings [5]. Additionally, China aster enhances landscape gardening by creating a striking mass effect.

China aster is a globally significant garden plant and a commercial flower crop in Russia, Japan, North America, Switzerland, and Europe. In India, it is primarily cultivated by small and marginal farmers in Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh, and West Bengal. Karnataka is a major producer, with cultivation concentrated in districts such as Bangalore, Tumkur, Kolar, Chikkaballapur, and Belagavi. The state has a cultivation area of 207 hectares, yielding 1,448 metric tons at a productivity rate of 7.01 tons per hectare, generating an annual income of ₹430 lakhs [6]. Flower yield varies based on planting season and cultural practices.

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

The ornamental plant market is highly dynamic, with constant demand for new varieties. Existing commercial China aster cultivars in India generally have semi-double flowers with prominent disks, short flower stalks, and limited vase life. Therefore, breeding efforts aim to improve traits such as plant height, branching, flower yield, color, stalk length, flower size, and vase life to enhance its suitability for both cut and loose flower production.

Effective breeding relies on utilizing genetic variability through appropriate selection procedures. Greater variability is typically observed in early segregating generations. Phenotypic expression of plant traits is influenced by both genetic composition and environmental factors. Genetic variance in quantitative traits consists of additive (heritable) and non-additive components, including dominance and epistasis (non-allelic interaction). To refine selection strategies, it is essential to analyse phenotypic variability in terms of its heritable components using parameters such as phenotypic and genotypic coefficients of variation, heritability, and genetic advance, which help predict selection efficiency. In this context to study the genetic variability in novel China aster hybrids, an experiment on agronomic performance of the newly developed hybrids was carried out as a preliminary study. The results of the study are presented and discussed in this article.

Materials and Methods

The study was conducted 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 assessed for genetic variability and agronomic performance. Based on superior agronomic traits, 10 out of the 27 hybrids were selected for the next generation (F_2). These selected hybrids were further evaluated for growth and yield parameters alongside a check variety.

The experiment followed a randomized complete block design (RCBD) with three replications and 11 treatments. The details of the genotypes are as follows

Sl. 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

Table a

Observations recorded

- **Growth Parameters:** Pertaining to vegetative growth of the plants, Plant height (Cm), number of branches per plant, Plant spread (Cm) both in East – West and North South directions were recorded at 30, 60 and 90 Days after transplanting.
- **Yield Parameters:** with respect to yield, Number of flowers per plant, flower yield per plant (g) and flower yield per hectare (t) were recorded and analysed.
- **Seed Parameters:** with relevance to seed, number of days taken for seed maturity from the day of anthesis, number of seeds per flower head, seed yield per flower (g), seed yield per plant (g) and germination percentage were recorded.

- **Statistical Analysis:** The experimental data obtained were subjected to statistical analysis adopting Fishers method of Analysis of variance as outlined by Gomez and Gomez [7]. 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

- **Growth Parameters**: the data pertaining to vegetative growth of the plant such as Plant height (Cm), number of branches per plant, Plant spread (Cm) both in East-West and North South directions recorded at 30, 60 and 90 Days after transplanting are presented in table 1.

Genotype	Plant height (Cm)			Number of Branches per plant			Plant spread (Cm) (N-S)			Plant spread (Cm) (E-W)		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
H1	13.07	69.00	79.55	5.60	12.67	17.47	16.97	31.33	49.81	16.87	31.47	51.37
H2	12.40	48.97	66.87	5.60	12.80	16.73	16.47	32.10	49.03	16.93	33.53	50.93
H3	12.93	42.33	71.25	6.07	13.73	22.20	19.48	31.67	51.77	18.98	32.87	50.60
H4	10.57	51.27	65.18	5.47	13.20	27.87	17.40	33.83	59.53	17.57	35.03	54.84
H5	11.70	63.67	69.32	5.20	12.13	15.87	15.67	33.87	47.25	15.43	34.23	46.91
H6	12.90	58.23	69.77	6.13	12.67	18.27	15.17	32.43	48.34	15.63	33.40	49.37
H7	12.40	57.70	67.08	5.73	13.47	16.73	18.10	33.10	47.01	18.97	34.97	46.08
H8	10.50	41.73	65.73	4.67	13.20	16.40	16.73	32.07	52.80	16.60	32.67	51.23
H9	12.97	56.83	78.84	5.87	13.47	16.33	17.07	32.83	51.09	16.90	32.93	49.37
H10	11.50	49.07	67.21	5.47	13.47	14.13	15.33	31.90	48.49	16.27	30.83	47.65
C	10.97	44.37	62.39	5.47	12.40	14.67	15.83	28.47	44.51	16.47	28.73	40.94
C.D.	N/A	3.186	4.384	N/A	N/A	0.995	N/A	2.343	3.334	N/A	2.999	2.999
SE(m)	0.881	1.073	1.476	0.293	0.552	0.335	1.199	0.789	1.122	1.242	1.009	1.009
SE(d)	1.246	1.517	2.087	0.414	0.781	0.474	1.695	1.115	1.587	1.757	1.428	1.428
C.V.	12.724	3.504	3.684	9.11	7.346	3.245	12.399	4.25	3.89	12.682	5.332	5.332

Table 1: Growth Performance of novel China aster hybrids in F2 generation.

The data recorded with relevance to growth parameters at different stages of plant growth revealed that, at 30 DAT Maximum plant height (13.07 Cm), highest number of branches per plant (6.07) and plant spread (19.48 Cm N-S and 18.98 Cm E-W) were recorded in H1 (Arka Poornima x P. G. Purple) and H3 (P. G. Pink x A.A.C - 1) respectively.

Similarly at 60 DAT in H1 (Arka Poornima x P. G. Purple) tallest plants (69.00 Cm) were observed, whereas maximum number of branches (13.73) in H3 (P. G. Pink x A.A.C – 1). Wider plant spread in North – South (33.87 Cm) and in East west (35.03 Cm) was observed in H5 (P. G. Pink x P. G. Purple) and H4 (Arka Poornima x A.A.C - 1) respectively.

The same genotypes exhibited maximum growth at 90 DAT, tallest plants (79.55 Cm) were observed in H1 (Arka Poornima x P. G. Purple) and Maximum number of branches per plant was noticed in H4 (Arka Poornima x A.A.C - 1). The highest plant spread in both the directions i.e., North – South (59.53 Cm) and East – West (54.84 Cm) was recorded in H4 (Arka Poornima x A.A.C - 1).

The evaluation of growth parameters at different stages of plant development revealed significant variations among the hybrids. H1 (Arka Poornima × P.G. Purple) consistently exhibited the tallest plant height across all stages, while H3 (P.G. Pink × A.A.C - 1) demonstrated a higher number of branches at earlier growth stages. H4 (Arka Poornima × A.A.C - 1) emerged as a vigorous hybrid, recording the widest plant spread and the highest number of branches at later stages. Additionally, H5 (P.G. Pink × P.G. Purple) showed a notable plant spread in the North-South direction at 60 DAT. These findings indicate that different hybrids possess distinct growth advantages, which can be strategically utilized to enhance productivity and adaptability in diverse growing conditions. These results are in agreement with the results of [8,9] in China aster and [10,11] in marigold.

Yield Parameters

The relevant observations to compute yield such as Number of flowers per plant, flower yield per plant (g) and flower yield per hectare (t) are presented in table 2.

The data pertaining to yield traits of the plant revealed that, maximum number of flowers per plant was observed in H4 (Arka Poornima x A.A.C - 1) followed by H6 (P. G. White x P. G. Purple). The same trend was observed cumulative yield parameters, where H4 (Arka Poornima x A.A.C - 1) recorded highest flower yield per plant (382.74g) which in turn contributed highest yield per hectare (18.90 t) followed by H6 (P. G. White x P. G. Purple) which yielded 338.91 g per plant and 16.74 tons per hectare. These results highlight the superior yield potential of H4, making it a promising hybrid for maximizing flower production, with H6 also demonstrating strong performance in terms of productivity. These findings are similar to [9,12] in China aster,[13] in chrysanthemum and [14] in marigold.

Genotype	Number of flowers per plant	Flower yield per plant(g)	Flower yield per ha. (t)
H1	65.33	300.41	14.83
H2	63.67	245.92	12.14
H3	51.67	223.89	11.06
H4	85.33	382.74	18.90
H5	61.33	316.87	15.65
H6	74.67	338.91	16.74
H7	63.67	306.49	15.13
H8	45.67	199.56	9.85
H9	46.33	221.45	10.93
H10	53.67	193.85	9.57
C	44.33	156.89	7.75
C.D.	4.51	27.09	1.34
SE(m)	1.52	9.12	0.45
SE(d)	2.15	12.90	0.64
C.V.	4.41	6.02	6.02

Table 2: Yield Performance of novel China aster hybrids in F2 generation.

Seed parameters

The data recorded in context to seed parameters like Days taken for seed maturity from anthesis, Number of seeds per flower head, seed weight per flower head (g) and seed yield per plant (g) of selected China aster genotypes are presented in table 3.

From the observations recorded and analysed it is evident that the control genotype i.e., Arka Kamini recorded least number of days (34.33 days) taken for seed maturity from the day of anthesis. Among the hybrids evaluated, H10 (Arka Poornima × Arka Kamini) had the shortest seed maturity period of 36.67 days, followed by H2 (P.G. Pink × Arka Kamini) and H4 (Arka Poornima × A.A.C – 1), both maturing in 38.67 days. Whereas number of seeds per flower head (55.33), seed weight per flower head (0.41 g) and seed yield per plant (6.89 g) were recorded in the hybrid H7 (Miraj Local x A.A.C - 1) followed by H3 (P. G. Pink x A.A.C - 1) which recorded

52.67 seeds per flower head, 0.39 g seeds per flower and 6.64 g seeds per plant. These findings highlight the potential of hybrids H7 and H3 for improved seed productivity, while early-maturing hybrids like H10, H2, and H4 could be advantageous for shorter cropping cycles and enhanced production efficiency. The findings are in similarity with [15,16] in China aster and [17] and [10] in marigold.

Genotype	Days for seed maturity	Number of seeds per flower head	Seed weight per flower head (g)	Seed yield per plant (g)
H1	44.00	39.67	0.27	5.38
H2	38.67	37.67	0.26	4.97
H3	39.33	52.67	0.39	6.64
H4	38.67	47.33	0.38	6.55
H5	44.00	43.67	0.32	6.27
H6	44.00	45.67	0.35	6.44
H7	40.00	55.33	0.41	6.89
H8	43.00	44.67	0.35	6.43
H9	44.00	38.67	0.28	5.31
H10	36.67	41.00	0.28	5.50
C	34.33	41.33	0.32	4.77
C.D.	0.71	1.31	0.01	0.16
SE(m)	0.24	0.44	0.00	0.05
SE(d)	0.34	0.62	0.01	0.08
C.V.	1.02	1.73	2.32	1.57

Table 3: Seed parameters of novel China aster hybrids in F2 generation.

Germination percentage

The seeds collected from F1 plants were used as planting stock for F2 generation. For these seeds germination percentage was computed by observing germination in nursery bed. The results are depicted in the figure 1.

Among the ten hybrids evaluated, H7 (Miraj Local × A.A.C – 1) demonstrated the highest germination percentage, reaching 89.51%. This indicates its strong viability and potential for successful establishment. Following closely, H8 (P.G. White × A.A.C – 1) recorded a germination rate of 86.59%, showcasing its promising growth potential. Similarly, H4 (Arka Poornima × A.A.C – 1) exhibited a germination rate of 86.40%, while H6 (P.G. White × P.G. Purple) achieved 86.21%. These results suggest that these hybrids possess good seed viability and could be well-suited for cultivation under appropriate conditions.

Conclusion

The agronomic evaluation of early-generation hybrids revealed significant variations in growth, flowering, and yield parameters, highlighting their potential for commercial cultivation. H1 (Arka Poornima × P.G. Purple) exhibited the highest plant height across all stages, while H3 (P.G. Pink × A.A.C – 1) demonstrated superior branching at early growth phases. H4 (Arka Poornima × A.A.C – 1)

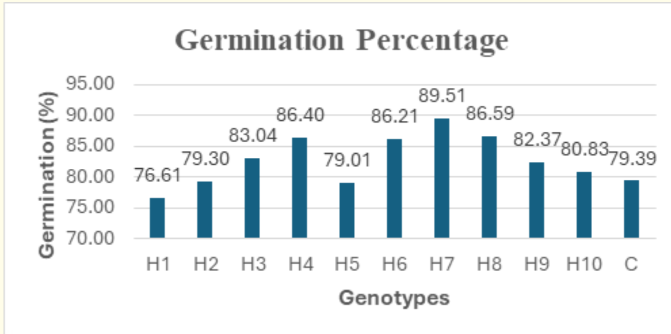

Figure 1: Germination Percentage of Novel China aster Hybrids in F2 Generation.

emerged as a vigorous hybrid with the widest plant spread and highest number of branches in later stages, making it a strong candidate for maximizing flower yield. Additionally, H7 and H3 exhibited superior seed productivity, while early-maturing hybrids like H10, H2, and H4 showed promise for shorter cropping cycles, enhancing production efficiency. These results indicate that different hybrids have distinct advantages, which can be strategically utilized to improve adaptability, yield, and economic viability in floriculture.

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Conflicts of Interest

"I declare there is no conflicts of Interest with respect to this study".

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