

Varietal performance of China aster on rice bunds in the plains of Chhattisgarh

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ABSTRACT

The present study investigated the growth, flowering and yield performance of China aster *{Callistephus chinensis}* (L) Ness varieties (Arka Archana, Arka Shashank, Arka Kamini and Phule Ganesh Pink) cultivated on rice bunds in Rajnandgaon, Chhattisgarh, over two winter seasons (2018-19 and 2019-20). A randomized block design with four replications was utilized. Data were collected on plant height, number of branches per plant, plant spread, days to first bud appearance, days to 50 per cent flowering, flower weight per plant and number of flowers per plant and per hectare. Significant varietal differences were observed across all assessed parameters. Phule Ganesh Pink consistently demonstrated superior performance in plant height (64.10 cm), number of branches per plant (18.70) and plant spread (29.30 cm²) and also yielded the highest flower weight per plant (165.90 g). Arka Archana was noted for producing the highest number of branches (19.50) and the earliest to flower, with first bud appearance at 63.20 days and 50 per cent flowering at 73.40 days. Arka Archana and Phule Ganesh Pink also produced the highest number of flowers per plant (53.90 and 51.70 respectively) and per hectare (337,265.60 and 322,937.50 respectively). Arka Shashank generally exhibited the lowest performance across most growth and yield parameters, while Arka Kamini displayed intermediate characteristics. The findings suggest that Phule Ganesh Pink and Arka Archana are particularly promising varieties for cultivation on rice bunds, offering potential for enhanced productivity and diversified income for small and marginal farmers in the region.

Keywords: China aster; varietal performance; rice bunds; growth characters; flowering characters; yield attributes

INTRODUCTION

Chhattisgarh covers a rice cultivation area of 3.76 million hectares representing 8.10 per cent of India's total. This area contributes 7.90 million tonnes to the national rice production, accounting for 6.06 per cent of the country's total, with a yield of 2,101 kg per hectare in the year 2021-22 (Anon 2023). However, rice productivity remains low here, largely because most of the farmers are marginal and smallholders, meaning they work with very small and fragmented land parcels. These small holdings are further divided by bunds (earthen embankments or field boundaries), which take up a significant portion of the valuable rice production area. While bunds are crucial for retaining water on sloped land, providing field access and marking property lines, they can also become sources of weed spread if not managed well. On the flip side, when

bunds are properly maintained, they can actually generate extra income if cash crops are grown on them. Wide bunds in rice fields are a significant concern; when viewed cumulatively, the substantial area they occupy essentially becomes wasteland. While these bunds are crucial for retaining moisture on sloped ground and clearly marking field boundaries, they can also become a source of weed spread if not properly managed (Rao et al 2017).

A promising solution involves selecting a suitable and profitable flower crop and variety that can thrive on these bunds. China aster *{Callistephus chinensis}* (L) Ness stands out as an excellent choice. It's a half-hardy annual and a commercially important flower crop, cultivated globally and highly valued in India. Among annual flowers, China aster ranks third in popularity, next only to chrysanthemum and marigold

(Zosiamliana et al 2012). This is a new flower crop for Chhattisgarh state and the climatic conditions of Chhattisgarh are well-suited for its cultivation. It belongs to the family Asteraceae and is native to China (Navalinskien et al 2005). The original plant has single flowers with two or four rows of blue, violet or white ray florets. Its stature is medium tall, typically eighteen to twenty four inches in height. The evolution of China aster shows a history of remarkable variations. The flowers of China aster are used for various purposes, including flower arrangements, interior decoration, garland making and worshipping. It's also grown in gardens as herbaceous borders and in formal beds. However, these flowers are most significantly used commercially as cut flowers for higher profit.

In Chhattisgarh, floriculture is gaining traction, The area under floriculture in the state was 13,003 ha with the production of 172,857 MT approximately in the year 2023-24 (<https://agriportal.cg.nic.in/horticulture/HortiEn/Default.aspx>). China aster stands out as a promising new option. It's an attractive, semi-hardy crop that's easy to grow in open fields. Its versatility means the flowers can be sold as both cut flowers and loose flowers, offering a valuable source of extra income for marginal and small farmers. This can help offset the low productivity often seen in rice and other winter (rabi) crops. Moreover, growing China aster can enhance the visual appeal of fields and boost natural biodiversity.

MATERIAL and METHODS

This study was conducted during the winter seasons of 2018-19 and 2019-20 at Krishi Vigyan Kendra, Rajnandgaon, Chhattisgarh situated on the bank of the Shivnath river, at 21°06' N latitude and 81°02' E longitude, with an altitude of 307 m amsl. The region experiences a tropical climate with a dry spell throughout the year. The experiment utilized four China aster varieties: Arka Archana, Arka Shashank, Arka Kamini and Phule Ganesh Pink. The experiment was laid out in a randomized block design with four replications. This field was a rice bund area, which was thoroughly prepared using a mattock and spade. Manual labour was employed for ploughing, followed by the removal of crop residues and grasses. The experimental plots were laid out according to the design plan, using a measuring tape, rope and bamboo pegs. Ridges and furrows were prepared with a 45 cm row-to-row distance and 30 micron poly-mulching was applied along with drip lines. The recommended

fertilizer dose of 30:15:10 g per m² NPK was applied. Half nitrogen and the full doses of phosphorus and potassium were applied during field preparation. The remaining half nitrogen was administered through drip irrigation at ten-day intervals, starting thirty days after transplanting. Observations were recorded for plant height, number of branches per plant, plant spread, number of days for first bud emergence, number of days for 50 per cent flowering, weight of flowers per plant and number of flowers per plant and per hectare.

RESULTS and DISCUSSION

The analysis of variance revealed that all the genotypes differed significantly for the growth, flowering and yield attributes.

Growth parameters

Data on the growth parameters of tested China aster varieties are given in Table 1.

Plant height: Phule Ganesh Pink consistently exhibited maximum plant height across both years and in the pooled data (64.10 cm). Arka Shashank was the second tallest (50.00 cm), while Arka Archana showed the shortest plant height (39.50 cm).

Total number of branches per plant: Arka Archana and Phule Ganesh Pink consistently produced the highest number of branches (19.50 and 18.70 respectively). Arka Shashank had the minimum branches (13.10). Significant differences in branching were observed among the varieties.

Plant spread: Phule Ganesh Pink also demonstrated the largest plant spread (29.30 cm²), followed by Arka Kamini (27.00 cm²). Arka Shashank (19.30 cm²) showed the least plant spread.

Phule Ganesh Pink appeared to be a robust variety, showing superior performance in terms of plant height and plant spread. Arka Archana and Phule Ganesh Pink excelled in producing a higher number of branches.

Flowering parameters

The data on different flowering parameters of China aster at 90 DAS are presented in Table 2.

Days to first bud appearance: Arka Archana consistently showed the earliest first bud appearance, with pooled data indicating 63.20 days. Arka Kamini

Table 1. Growth performance of China aster varieties (90 DAT)

Variety	Plant height (cm)			Number of branches/plant			Plant spread (cm ²)		
	I Year	II Year	Pooled	I Year	II Year	Pooled	I Year	II Year	Pooled
Arka Archana	38.80	40.20	39.50	18.20	20.80	19.50	24.0	24.80	24.40
Arka Shashank	49.10	50.90	50.00	11.90	14.40	13.10	18.10	20.40	19.30
Arka Kamini	41.90	44.40	43.10	13.60	17.00	15.30	26.00	27.90	27.00
Phule Ganesh Pink	63.60	64.60	64.10	17.70	19.80	18.70	28.40	30.10	29.30
SEm [±]	1.03	0.95	0.83	0.53	0.77	0.61	0.68	0.5	0.5
CD _{0.05}	3.31	3.04	2.67	1.69	2.46	1.96	2.16	1.61	1.59

Table 2. Performance of China aster varieties for flowering parameters (90 DAT)

Variety	Days to first bud appearance			Days to 50% flowering			Flower weight/plant (g)		
	I Year	II Year	Pooled	I Year	II Year	Pooled	I Year	II Year	Pooled
Arka Archana	63.80	62.60	63.20	74.00	72.70	73.40	98.00	116.70	107.30
Arka Shashank	72.50	70.90	71.70	80.50	78.80	79.60	36.00	36.70	36.30
Arka Kamini	79.40	77.40	78.40	87.80	85.80	86.80	61.00	65.50	63.30
Phule Ganesh Pink	73.80	69.50	71.65	83.70	79.80	81.80	164.10	167.60	165.90
SEm [±]	0.6	0.56	0.49	1.36	1.29	0.78	3.02	2.66	2.06
CD _{0.05}	1.93	1.79	1.58	4.35	3.88	2.56	9.69	8.35	6.68

was the latest to develop buds, with a pooled average of 78.40 days. Phule Ganesh Pink (71.65 days) and Arka Shashank (71.70 days) had similar timings for bud appearance.

Days to 50 per cent flowering: Similar to bud appearance, Arka Archana reached 50 per cent flowering earliest, with a pooled mean of 73.40 days. Arka Kamini was again the latest to reach 50 per cent flowering, taking 86.80 days (pooled). Phule Ganesh Pink and Arka Shashank exhibited intermediate flowering times.

Flower weight per plant: Phule Ganesh Pink demonstrated exceptionally high flower weight per plant, with a pooled average of 165.90 g. This was significantly higher than all other varieties. Arka Archana showed the second highest flower weight (107.30 g pooled), followed by Arka Kamini (63.30 g pooled). Arka Shashank had the lowest flower weight per plant, with a pooled average of just 36.30 g.

The data clearly indicates significant varietal differences in flowering parameters of China aster. Arka Archana proved to be an early-flowering variety, showing the quickest first bud appearance and 50 per

cent flowering. However, Phule Ganesh Pink stood out for its remarkable flower yield, producing significantly heavier flowers per plant, despite having an intermediate flowering time. Arka Shashank consistently exhibited the lowest performance in terms of flower weight and was among the later flowering varieties. Arka Kamini was generally the latest to flower but produced a moderate flower weight.

Yield parameters

The yield parameters for selected China aster varieties at 90-120 DAS are detailed in Table 3.

Number of flowers per plant: Arka Archana (53.90) and Phule Ganesh Pink (51.70) produced the highest number of flowers per plant and were at par. Arka Kamini showed a moderate number of flowers at 34.00, while Arka Shashank had the lowest number of flowers per plant, with a pooled average of 23.60.

Number of flowers per hectare: Mirroring the per-plant performance, Arka Archana and Phule Ganesh Pink also led in the number of flowers produced per hectare. Arka Archana had a pooled average of 337,265.60 flowers per ha and Phule Ganesh Pink yielded a pooled average of 322,937.50 flowers per

Table 3. Performance of China aster varieties for yield attributes (90-120 DAT)

Variety	Number of flowers					
	per plant			per ha bund area		
	I Year	II Year	Pooled	I Year	II Year	Pooled
Arka Archana	49.28	58.68	53.90	308,000.00	366,531.30	337,265.60
Arka Shashank	22.20	25.00	23.60	138,750.00	156,109.40	147,429.70
Arka Kamini	32.89	35.21	34.00	205,562.50	220,140.60	212,851.60
Phule Ganesh Pink	51.10	52.23	51.70	319,500.00	326,375.00	322,937.50
SEm \pm	1.07	1.18	0.74	6,659.70	7,383.80	4,529.63
CD _{0.05}	3.49	3.77	2.31	21,305.55	23,622.00	14,491.08

Per ha bund area = 7% of per ha land area

ha. Arka Kamini produced 212,851.60 flowers per ha and Arka Shashank had the lowest yield at 147,429.70 flowers per ha.

Thus Arka Archana and Phule Ganesh Pink were superior in terms of both the number of flowers produced per plant and per hectare, making them high yielding varieties. In contrast, Arka Shashank consistently demonstrated the lowest yield.

Bhagve et al (2020) found that the China aster variety Arka Poornima achieved the greatest plant height. Phule Ganesh showed significantly higher leaf area, branches per plant, flower yield per plant, flower weight, flower length with pedicel and blooming period. The variety Phule Ganesh Pink was notable for having the maximum number of petals per flower, while Arka Archana was the earliest to initiate its first flower bud.

Zosiamliana et al (2013) observed maximum plant height, number of primary and secondary branches, plant spread and number of leaves at all stages of plant growth in Phule Ganesh Violet. Phule Ganesh Pink recorded minimum number of days for first flower bud initiation (57.20), first flowering (66.73), 50 per cent flowering (85.67) and flowering duration (60.96). Phule Ganesh White produced maximum flower diameter (7.37 cm), stalk length (34.78 cm) and vase life both as cut (9.13 days) and loose (4.73 days) flower and gave maximum number of flowers per plant (36.73) and yield both per plant (208.81 g) and per hectare (23.20 tonnes/ha).

Shete et al (2023) revealed that Phule Ganesh White excelled in maximum plant height, stalk length, number of flowers per plant, shelf life, prolonged

flowering duration and a higher 100-flower weight. Phule Ganesh Violet was superior in terms of plant spread, days to flowering and flower diameter.

Chavan et al (2010) found that the variety Phule Ganesh White was superior in all growth parameters, which produced significantly highest plant height (44.63 cm) and maximum primary branching (15.55), but maximum plant spread (35.66 cm²) was recorded in variety Phule Ganesh Pink. Highest fresh and dry weight of plant was recorded in Phule Ganesh Purple. Variety Phule Ganesh White also recorded maximum number of days to open first flower (80.58), highest number of flowers per plant (30.54) and highest yield of flowers (151.39 kg/ha).

Santhosh et al (2020) recorded greatest plant height (68.86 cm), number of primary branches (14.25), number of leaves (56.48), stem girth (11.09 cm) and plant spread (50.08 cm) in Phule Ganesh Pink. Leaf area was highest in Phule Ganesh White (34.31 cm²) and number of flowers per plant in variety Arka Shashank (20.20), while Arka Archana (18.47), Local Pink (18.47), Phule Ganesh Pink (17.73), Phule Ganesh White (16.93) and Arka Kamini (16.27) were on par. Flower stalk length was highest in variety Phule Ganesh Pink (21.39 cm), Phule Ganesh Purple (20.61 cm), Phule Ganesh Violet (19.73 cm), AAC-1 (18.27 cm) and Phule Ganesh White (17.73 cm). Flower yield was highest in variety Phule Ganesh Pink (55.99 g). Duration of flowering was the longest in Local Pink (62.40 DAP) and Phule Ganesh Pink (60.60 DAP).

Among the nine cultivars tested by Savitha et al (2016), maximum number of flowers per plant was recorded in cultivar Phule Ganesh Violet (57.27), while

these were least in cultivar Budiguppa Local (43.93). The flower yield and seed yield per plant was recorded highest in cultivar Phule Ganesh White (308.68 and 8.70 g respectively), whereas, least flower yield and seed yield per plant was noticed by cultivar Budiguppa Local (98.45 and 2.29 g respectively). Fresh weight, dry weight and diameter of flower were maximum in cv Phule Ganesh White (5.70 g, 0.81 g and 6.80 cm respectively) and were found to be superior over other cultivars.

CONCLUSION

This study showed significant variations in the growth, flowering and yield characteristics among the four China aster varieties (Arka Archana, Arka Shashank, Arka Kamini and Phule Ganesh Pink) when cultivated on rice bunds in Chhattisgarh.

Phule Ganesh Pink consistently proved to be a robust variety, exhibiting superior plant height and expansive plant spread. Crucially, it was found to produce the heaviest flowers per plant, indicating its high potential for commercial yield. Concurrently, Arka Archana was identified as an early flowering variety, showing the quickest bud appearance and achieving 50 per cent flowering in the shortest time.

These two varieties also led in the total number of flowers produced per plant and per hectare. In contrast, Arka Shashank consistently registered the lowest performance across most of the assessed growth and yield parameters, suggesting it may be less suitable for this specific cultivation context. Arka Kamini displayed moderate performance across the observed traits.

Overall, the findings highlight that Phule Ganesh Pink and Arka Archana were distinctly superior in terms of yield contributing traits, making them highly recommended varieties for cultivation on rice bunds.

The successful growth of these varieties on previously underutilized bund areas offers a viable and sustainable pathway to increase overall farm productivity, diversify income sources for marginal and small farmers and enhance the agricultural landscape in Chhattisgarh. This research provides valuable insights for promoting floriculture as a profitable alternative crop in rice-dominated regions.

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