Plant Archives Vol. 26, Supplement 2, 2026 pp. 1823-1829 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.226

INFLUENCE OF VARYING LEVELS OF GIBBERELLIC ACID (GA_3) ON GROWTH AND YIELD OF CHINA ASTER VARIETIES

Ekta Rajput[1]*, N. S. Gupta[1], P. K. Nagre[2], Manisha Deshmukh[1] and S.G. Bharad[3]
[1]Department of Floriculture and Landscape Architecture, PGI, Dr. PDKV Akola, Maharashtra, India
[2]Faculty of Horticulture, Dr. PDKV, Akola, Maharashtra, India
[3]Department of Fruit Science, Dr. PDKV, Akola, Maharashtra, India
*Corresponding author E-mail: rajpute300@ gmail.com
(Date of Receiving : 04-04-2026; Date of Revision : 23-05-2026; Date of Acceptance : 08-06-2026)

ABSTRACT

The present investigation entitled ''Influence of varying levels of gibberellic acid (GA_3) on growth and yield of China aster varieties" was conducted at Department of Floriculture and Landscape Architecture, Dr. PDKV, Akola (Maharashtra, India) in Factorial Randomized Block Design (FRBD) with 24 treatment combinations and three replications. The results revealed significant differences among varieties, GA_3 levels and their interaction effects. Among the varieties, Phule Ganesh White recorded maximum plant height, number of branches per plant and highest flowers yield per plot, whereas Phule Ganesh Pink exhibited maximum plant spread. Foliar application of GA_3 significantly enhanced vegetative growth and yield parameters. GA_3 @ 250 ppm proved most effective, recording the highest plant height, number of branches, plant spread and highest flower yield per plot, it was statistically at par with 300 ppm of GA_3. The interaction effect indicated that Phule Ganesh White with GA_3 @ 250 ppm produced maximum plant height, number of branches per plant and highest flowers yield per plot, while Phule Ganesh Pink with GA_3 @ 250 ppm recorded maximum plant spread. The study concludes that variety Phule Ganesh White with GA_3 @ 250 ppm is suitable for enhancing vegetative growth and yield parameter in China aster.
***Keywords* :** China aster, gibberellic acid (GA_3), varietal response, Phule Ganesh White, Phule Ganesh Purple, Phule Ganesh Pink, Phule Ganesh Violet.

Introduction

China aster (*Callistephus chinensis* (L.) Nees. is one of the most important half-hardy, annual, cool-season crops. It belongs to one of the largest families of flowering plants, Asteraceae and has a diploid chromosome number of 2n = 18. *Callistephus chinensis* is native to China and spread to Europe and other tropical countries around 1731 A.D. A single wild species, *Callistephus chinensis*, is the source of all modern asters. Within the Asteraceae family, the genus *Callistephus* is monotypic and contains only one species. The genus *Callistephus* is derived from two Greek words, *kalistos* and *stephos*, meaning "most beautiful" and "a crown," respectively. Cassini described the China aster as *Callistephus hortensis*. It was first named by Linnaeus as *aster chinensis* and later Nees. changed the name to *Callistephus chinensis* (Munikrishnappa *et al*., 2014). China aster is an important component of the flower basket, particularly in domestic market. It is cultivated for production of cut flowers, loose flowers, pot plants and bedding plants in landscaping.

The increasing demand for China aster in major urban markets of India has encouraged its large-scale cultivation as a commercial annual loose and cut flower crop. In commercial floriculture, enhancement of flower yield in terms of both quality and quantity, along with regulation of plant architecture are key objectives. Excessive plant height often leads to lodging, which adversely affects flower size and yield per plant. Although yield and quality are strongly influenced by environmental conditions and genetic makeup, the exogenous application of plant growth regulators like GA_3 plays a crucial role in modifying vegetative growth parameters such as plant height and branching, as well as yield and flower quality in China aster (Kumar *et al.,* 2015). The use of plant growth regulators has significantly transformed modern agriculture, particularly horticulture in developed nations. Their application has become an integral component of floriculture, representing one of the most important agro-technological advancements for improving floral yield and quality. Plant growth regulators are widely employed to direct plant growth towards desirable traits and optimize commercial flower production (Sharma *et al*., 2001).

Materials and Methods

The Investigations was conducted at Department of Floriculture and Landscaping, Dr. PDKV, Akola, with the objective to study the response of China aster varieties to different concentrations of GA_3 for growth parameters. The experiment was laid out in Factorial Randomized Block Design with three replications and twenty-four treatment combinations including control. Details are as below:

Treatment Combinations

V_1G_1	Phule Ganesh Pink + Control (Water spray)	V_3G_1	Phule Ganesh White + Control (Water spray)
V_1G_2	Phule Ganesh Pink + 100 **PPM GA_3**	V_3G_2	Phule Ganesh White + **100 PPM GA_3**
V_1G_3	Phule Ganesh Pink + 15**0 PPM GA_3**	V_3G_3	Phule Ganesh White + 15**0 PPM GA_3**
V_1G_4	Phule Ganesh Pink + 200 **PPM GA_3**	V_3G_4	Phule Ganesh White + 2**00 PPM GA_3**
V_1G_5	Phule Ganesh Pink + 250 **PPM GA_3**	V_3G_5	Phule Ganesh White + 25**0 PPM GA_3**
V_1G_6	Phule Ganesh Pink + 300 **PPM GA_3**	V_3G_6	Phule Ganesh White + 3**00 PPM GA_3**
V_2G_1	Phule Ganesh **Violet** + Control (Water spray)	V_4G_1	Phule Ganesh Purple + Control (Water spray)
V_2G_2	Phule Ganesh **Violet** + **100 PPM GA_3**	V_4G_2	Phule Ganesh Purple + **100 PPM GA_3**
V_2G_3	Phule Ganesh **Violet** + **150 PPM GA_3**	V_4G_3	Phule Ganesh Purple + **150 PPM GA_3**
V_2G_4	Phule Ganesh **Violet** + **200 PPM GA_3**	V_4G_4	Phule Ganesh Purple + 20**0 PPM GA_3**
V_2G_5	Phule Ganesh **Violet** + 25**0 PPM GA_3**	V_4G_5	Phule Ganesh Purple + 2**50 PPM GA_3**
V_2G_6	Phule Ganesh **Violet** + 3**00 PPM GA_3**	V_4G_6	Phule Ganesh Purple + 30**0 PPM GA_3**

Two foliar sprays of GA_3 were applied in respective treatments at 30 and 45 days after transplanting. The field was prepared to achieve a fine tilth by carrying out repeated ploughing operations and subsequent harrowing. The seedlings were transplanted in main field at Forty-five days with a spacing of 30 cm x 30 cm in flat bed. Fertilizer application, weeding, plant protection *etc.* were carried out as per package and as when required. Five plants were selected randomly from net plot in each treatment and tagged for the purpose of recording observations. The observations were recorded on plant height, number of branches, plant spread and flower yield per plot. The data was statistically analysed using analysis of variance.

Results and Discussion

Plant height

Effect of Varieties

The data on plant height recorded at 60 and 90 days after transplanting and is presented in Table 1. Significant differences among varieties were observed at all growth stages. Among the evaluated varieties, Phule Ganesh White recorded the maximum plant height at 60 and 90 DAT (64.62 and 84.65 cm respectively). It was significantly superior over all other varieties. The minimum plant height was recorded in Phule Ganesh Violet (48.00 and 60.81 cm at respective stages). The observed variation in plant height among varieties may be attributed to inherent genetic differences and differential adaptability to environmental conditions. Similar varietal differences in plant height of China aster were reported by Rai and Chaudhary (2016), Naikwad *et al.* (2019), Sahu *et al.* (2023), Shete *et al.* (2023) and Bhargav *et al*. (2019).

Effect of GA_3

The data shows a significant effect of GA_3 on plant height of China aster at all stages of growth. The treatment GA_3 @ 250 ppm recorded the highest plant height (63.12 and 76.84 cm respectively) at 60 and 90 DAT. Which was statistically at par with GA_3 @ 300 ppm (61.72 and 75.51 cm respectively). The control recorded the lowest plant height (46.54 and 64.03 cm respectively). The increase in plant height due to GA_3 application may be attributed to enhanced cell division and cell elongation, increased cell wall plasticity, stimulation of protein synthesis. These physiological processes promote internodal elongation, resulting in increased plant height. Similar findings were reported by Sharma and Joshi (2015), Bhandari *et al.* (2022) in China aster, Delvadia *et al.* (2009) in gaillardia and by Khangjarakpam *et al.* (2019) and Mujadidi *et al.* (2019) in marigold.

Interaction effect

The interaction of variety and GA_3 concentration significantly influenced plant height at 60 and 90 DAT. The treatment combination Phule Ganesh White with GA_3 @ 250 ppm recorded the maximum plant height (74.21 and 93.30 cm respectively) at 60 and 90 DAT. It was at par with Phule Ganesh White with GA_3 @ 300 ppm (71.17 cm) at 60 DAT and at 90 DAT it was statistically superior over the other varieties. It was followed by treatment combination Phule Ganesh White with GA_3 @ 200 ppm (67.92 and 87.04 cm) at 60 and 90 DAT. While the minimum plant height (41.79 and 54.43 cm respectively) was observed under control. The variety Phule Ganesh Violet exhibited its highest plant height at GA_3 @ 300 ppm (53.33 and 66.27 cm respectively) at 60 and 90 DAT. The superior performance of Phule Ganesh White at 250 and 300 ppm GA_3 showed higher physiological efficiency and greater responsiveness to exogenous GA_3, possibly due to enhanced receptor sensitivity and better assimilate mobilization. Conversely, the comparatively lower response of Phule Ganesh Violet indicates genotypic limitations in GA_3 responsiveness.

Number of branches per plant

Effect of varieties

Significant differences in number of branches per plant were observed at 75 and 90 DAT (Table 2). Variety Phule Ganesh White (V_3) recorded maximum number of branches per plant (19.23,24.72 respectively), which was significantly superior than rest of all the varieties and it was followed by variety Phule Ganesh Purple (16.60,21.32 respectively) at 75 and 90 DAT. Whereas, significantly minimum number of branches per plant were recorded with the Phule Ganesh Violet (11.03,15.12 respectively) at 75 and 90 DAT. The variation in branching may be attributed to genetic differences governing plant architecture. Similar findings were reported by Tirakannanavar *et al.* (2015), Naikwad *et al.* (2019), Munikrishnappa *et al.* (2013) , Zosiamliana *et al.* (2012), Sahu *et al.* (2023), Rai and Chaudhary (2016) and Kolur *et al.* (2022).

Effect of GA_3

GA_3 @ 250 ppm recorded the highest number of branches per plant 17.65 at 75 DAT and 22.61 at 90 DAT and was significantly superior to all other treatments. This was followed by treatment GA_3 @ 300 ppm, which recorded 16.43, 21.82 branches per plant respectively at 75 and 90 DAT. Whereas, the lowest number of branches per plant (11.90,16.82) at 75 DAT and 90 DAT under the control treatment .This is might be due to, GA_3 influence of translocation and transcription mechanism of protein biosynthesis, also stimulation of cell division and cell elongation, while increasing plasticity of cell wall and formation of energy rich phosphates resulting in an increased plant height with a greater number of productive branches, The study confirms the results of Bhandari *et al*. (2022) in China aster, Delvadia *et al.* (2009) in Gaillardia, Khangjarakpam *et al*. (2019), Mujadidi *et al.* (2019), Kumar *et al.* (2012) in Marigold.

Interaction effect

The treatment combination Phule Ganesh White with GA_3 @ 250 ppm showed maximum number of branches per plant (22.79, 28.64 respectively) at 75 and 90 DAT, which was significantly higher than all the other treatment combinations. It was followed by the treatment Phule Ganesh White with 300 ppm of GA_3 which recorded 20.81,27.35 branches respectively. The treatment combination Phule Ganesh Violet with GA_3 @ 250 ppm recorded the least number of branches per plant (8.56,13.01 respectively) at 75 and 90 DAT. Although Phule Ganesh Violet showed overall lower branching compared to other varieties, it exhibited its maximum response at GA_3 @ 300 ppm **(**12.76, 16.99 respectively) at 75 DAT and 90 DAT. Phule Ganesh Violet showed improved response at 300 ppm GA_3, indicating a requirement for higher hormonal concentration. The significant interaction confirms that GA_3 response is genotype-specific, with Phule Ganesh White showing maximum responsiveness at 250 ppm.

Plant spread at 50 % flowering

Effect of varieties

Significant variation in plant spread was observed among varieties (Table 3). Phule Ganesh Pink recorded the maximum plant spread (33.86 cm) at 50% flowering stage and it was followed by Phule Ganesh Violet (29.84 cm) and Phule Ganesh White (26.46 cm). The minimum plant spread was recorded in Phule Ganesh Purple (25.21 cm). The differences may be attributed to inherent genetic potential and adaptability. Similar findings were reported by Zosiamliana *et al.* (2012), Shete *et al.* (2023), Bhagve *et al.* (2020), Rinu *et al.* (2024), Bhargav *et al.* (2019), Rai and Chaudhary (2016) and Guddaraddi and Mishra (2021).

Effect of GA_3

GA_3 @ 250 ppm recorded the maximum plant spread (32.83 cm) and it was at par with GA_3 @ 300 ppm (32.28 cm). The control treatment recorded the minimum (22.30 cm) plant spread. The increase in plant spread might be due to enhanced cell division, elongation and improved translocation of photosynthates. The marginal reduction observed at 300 ppm indicate that higher concentrations may not proportionately enhance growth due to supra-optimal hormonal effects. These results are in conformity with the findings of Palekar *et al.* (2018), Bhandari *et al.* (2022), Kumar *et al.* (2012), Sunna *et al.* (2021), Kuri *et al*. (2018) in China aster, Khangjarakpam *et al.* (2019), Mujadidi *et al.* (2019) in Marigold. Delvadia *et al.* (2009) in Gaillardia.

Interaction effect

The treatment combination of Phule Ganesh Pink with GA_3 @ 250 ppm produced the maximum (39.60 cm) plant spread at 50% flowering, followed by variety Phule Ganesh Pink with GA_3 @ 300 (37.03 cm), while the minimum plant spread (19.89 cm) was recorded in Phule Ganesh Purple under control conditions. Phule Ganesh Violet showed better response (34.31 cm) at 300 ppm of GA_3. The superior performance of Phule Ganesh Pink at 250 ppm GA_3 indicates its higher sensitivity and better utilization of exogenously applied gibberellins, leading to maximum canopy expansion.

Flower yield per plot

Effect of varieties

The data reveals significant differences among China aster varieties with respect to flower yield per plot (kg) presented in Table 4. Among the four varieties, V_3- Phule Ganesh White recorded the highest flower yield 5.07 kg per plot. Which was significantly superior than all other varieties? It was followed by variety V_4- Phule Ganesh Purple produce 4.20 kg flower yield per plot. Variety V_2 i.e. Phule Ganesh Violet (2.59 kg) recorded the minimum yield per plot.

The increases in flower yield per plot is might be due to the production of greater number of flowers per plant and improvement in weight and diameter of flower per plant. So, increases the yield of flowers per plot. These findings are in close conformity with earlier reports in China aster by Bhagve *et al.* (2020), Zosiamliana *et al.* (2012).

Effect of GA_3

The data reveals a significant effect of GA_3 treatments on flower yield per plot. The highest flower yield per plot was recorded with G_5 - 250 ppm of GA_3 which recorded 5.15 kg per plot. This treatment shows statistically superior than other. It was followed by treatment G_6 - 300 ppm which recorded flower yield of 4.77 kg per plot. The G_1 - control treatment recorded the lowest flower yield per plot (1.85 kg).

The increase in flower yield observed with GA_3 application, may be attributed to its ability to stimulate cell elongation, enhance nutrient absorption, expand leaf area and facilitate efficient translocation of photosynthates towards developing floral buds. These physiological improvements collectively contributed to a higher number of flowers per plot. Similar findings have been reported by Kumar *et al.* (2015) in China aster, Delvadia *et al.* (2009) in Gaillardia, Kumar *et al.* (2020) and Mujadidi *et al.* (2019) in marigold.

Interaction effect

The data reveals a significant interaction effect between varieties and GA_3 treatments on flower yield per plot. The highest flower yield per plot 6.83 kg was obtained from Phule Ganesh White (V_3) in combination with GA_3 at 250 ppm (G_5). Which was statistically superior than other? It was followed by treatment combination Phule Ganesh White (V_3) in combination with GA_3 at 300 ppm (G_6) producing 6.28 kg flower per plot. The lowest flower yield (1.27 kg) was observed in the control treatment in variety Phule Ganesh Violet (V_2G_1). Phule Ganesh Violet (V_2) attained its maximum yield per plot at 300 ppm $GA_3(G_6)$, recording 3.67 kg per plot, which was significantly higher than its performance at lower GA_3 concentrations.

The significant interaction between varieties and GA_3 levels resulted in enhanced flower yield per plot. The increase in flower yield due to GA_3 application may be attributed to its stimulatory effect on vegetative growth characters such as plant height, leaf area, and number of branches per plant, which ultimately improved the source–sink relationship. The improved translocation and utilization of photosynthates might have contributed to higher flower production per plot. Similar findings regarding increased flower yield with GA_3 application in China aster were also reported by Sharma and Joshi (2015).

Table 1 : Effect of China aster varieties and different concentrations of GA_3 on plant height (cm) of China aster

Plant Height (cm)		
Treat.	**60 DAT**	**90 DAT**
Factor A-Varieties		
V_1	53.43	66.84
V_2	48.00	60.81
V_3	64.62	84.65
V_4	58.98	73.32
'F' test	**Sig.**	**Sig.**
SE (m) ±	**0.55**	**0.68**
CD at 5%	**1.57**	**2.04**
Factor B -Concentration of GA_3		
G_1	46.54	64.03
G_2	52.16	67.99
G_3	55.19	70.66

G_4	58.83	73.42
G_5	63.12	76.84
G_6	61.72	75.51
'F' test	**Sig.**	**Sig.**
SE (m) ±	**0.68**	**0.79**
CD at 5%	**1.92**	**2.36**
Interaction effect		
V_1G_1	44.35	59.97
V_1G_2	49.72	63.66
V_1G_3	52.43	66.24
V_1G_4	56.08	68.85
V_1G_5	60.22	72.15
V_1G_6	57.79	70.16
V_2G_1	41.79	54.43
V_2G_2	45.10	57.63
V_2G_3	47.19	59.96
V_2G_4	49.41	62.35
V_2G_5	51.21	64.24
V_2G_6	53.33	66.27
V_3G_1	51.52	76.03
V_3G_2	59.72	80.92
V_3G_3	63.23	83.92
V_3G_4	67.92	87.04
V_3G_5	74.21	93.30
V_3G_6	71.17	88.50
V_4G_1	48.50	65.69
V_4G_2	54.09	69.74
V_4G_3	57.92	72.51
V_4G_4	61.96	75.44
V_4G_5	66.82	79.47
V_4G_6	64.58	77.11
SE (m) ±	**1.35**	**1.39**
CD 5%	**3.85**	**4.10**

Table 2 : Effect of varieties and different concentrations of GA_3 on number of branches per plant of China aster

Factor A-Varieties		
	75th DAT	**90th DAT**
V_1	13.08	18.80
V_2	11.03	15.12
V_3	19.23	24.72
V_4	16.60	21.32
'F' test	**Sig.**	**Sig.**
SE (m) ±	**0.23**	**0.23**
CD at 5%	**0.64**	**0.65**
Factor B - Concentrations of GA_3		
G_1	11.90	16.82
G_2	13.81	18.57
G_3	14.65	19.52
G_4	15.46	20.67
G_5	17.65	22.61
G_6	16.43	21.82
'F' test	**Sig.**	**Sig.**
SE (m) ±	**0.28**	**0.28**
CD at 5%	**0.79**	**0.80**
Interaction effect		
V_1G_1	10.91	16.30
V_1G_2	12.02	17.58
V_1G_3	12.72	18.48
V_1G_4	13.69	19.35
V_1G_5	14.78	21.08
V_1G_6	14.34	20.03
V_2G_1	8.56	13.01
V_2G_2	9.99	14.20
V_2G_3	10.73	14.53
V_2G_4	11.70	15.66
V_2G_5	12.43	16.31
V_2G_6	12.76	16.99
V_3G_1	14.81	20.12
V_3G_2	18.05	22.72
V_3G_3	19.15	24.03
V_3G_4	19.78	25.46
V_3G_5	22.79	28.64
V_3G_6	20.81	27.35
V_4G_1	13.33	17.83
V_4G_2	15.18	19.78
V_4G_3	15.98	21.02
V_4G_4	16.64	22.23
V_4G_5	20.62	24.42
V_4G_6	17.82	22.66
SE (m) ±	**0.55**	**0.56**
CD at 5%	**1.57**	**1.60**

Table 3 : Effect of varieties and different concentrations of GA_3 on plant spread at 50 % flowering of China aster

Plant Spread at 50 % flowering (cm)					
	Varieties				
Treat.	**V_1**	**V_2**	**V_3**	**V_4**	**Mean**
G_1	25.36	23.39	20.57	19.89	**22.30**
G_2	30.93	27.69	24.42	23.31	**26.59**
G_3	33.86	29.70	26.05	24.73	**28.59**
G_4	36.38	31.42	27.82	26.20	**30.46**
G_5	39.60	32.50	30.35	28.88	**32.83**
G_6	37.03	34.31	29.55	28.23	**32.28**
Mean	**33.86**	**29.84**	**26.46**	**25.21**	
	(V)	**(G)**		**(V X G)**	
'F' test	**Sig.**	**Sig.**		**Sig.**	
S.E (m)±	**0.29**	**0.35**		**0.70**	
CD at 5 %	**0.82**	**1.00**		**1.99**	

Table 4 : Effect of varieties and different concentrations of GA_3 on flowers yield per plot.

flowers yield per plot kg)					
	Varieties				
Treat.	**V_1**	**V_2**	**V_3**	**V_4**	**Mean**
G_1	1.63	1.27	2.42	2.11	**1.85**
G_2	2.76	2.07	4.52	3.79	**3.28**
G_3	3.28	2.41	4.82	4.09	**3.65**

G_4	3.69	2.79	5.57	4.52	**4.14**
G_5	4.83	3.31	6.83	5.65	**5.15**
G_6	4.09	3.67	6.28	5.06	**4.77**
Mean	**3.38**	**2.59**	**5.07**	**4.20**	
	(V)	**(G)**		**(V X G)**	
'F' test	**Sig.**	**Sig.**		**Sig.**	
S.E (m)±	**0.07**	**0.09**		**0.08**	
CD at 5 %	**0.21**	**0.26**		**0.53**	

Conclusion

From the findings of present investigation, maximum growth of China aster plant *viz*, plant height, number of branches per plant and maximum yield per plot of China aster was observed in variety Phule Ganesh White, whereas Phule Ganesh Pink exhibited maximum plant spread. Foliar application of GA_3 significantly enhanced vegetative growth parameters and yield parameter, GA_3 @ 250 ppm showed most effective, recording the highest plant height, number of branches, plant spread and highest flowers yield per plot. The interaction effect indicated that Phule Ganesh White with GA_3 @ 250 ppm produced maximum plant height, number of branches per plant and highest flower yield per plot, while Phule Ganesh Pink with GA_3 @ 250 ppm recorded maximum plant spread. Thus, the treatment combination *Phule Ganesh White with 250 ppm* GA_3 was found to be most suitable for enhancing the vegetative parameters as well as yield of China aster.

References

Bhagve, S., Raut, V. U., Chopde, N., & Satar, V. P. (2020). Evaluation of China aster varieties under Vidarbha conditions. *International Journal of Chemical Studies*, **8**(3), 337–339.

Bhandari, R., Bohra, M., Singh, K. C., & Bisht, A. S. (2022). Effect of different plant growth regulators on seed germination and growth performance of China aster (*Callistephus chinensis* (L.) Nees) var. Kamini. *International Journal of Current Microbiology and Applied Sciences*, **11**(2), 297–305.

Bhargav, V., Kumar, R., Rao, T. M., Sane, A., Venugopalan, R., & Kumari, P. (2019). Evaluation of China aster (*Callistephus chinensis* (L.) Nees.) genotypes for vegetative, flowering, yield and postharvest life. *Indian Journal of Plant Genetic Resources*, **32**(1), 80–84.

Delvadia, D. V., Ahlawat, T. R., & Meena, B. J. (2009). Effect of different GA_3 concentration and frequency on growth, flowering and yield in gaillardia (*Gaillardia pulchella*) cv. Lorenziana. *Journal of Horticultural Science*, **4**(1), 81–84.

Guddaraddi, A., & Mishra, A. (2021). Varietal evaluation and genetic variability of chrysanthemum (*Dendranthema grandiflora*). *Journal of Pharmacognosy and Phytochemistry Innovation*, **10**(12), 563–566.

Khangjarakpam, G., Leishangthem, J. B., Maitra, S., & Mandal, S. (2019). Influence of foliar application of gibberellic acid on growth, development, yield and biochemical constituents of African marigold cv. Pusa Narangi Gainda. *Journal of Pharmacognosy and Phytochemistry*, **8**(4), 1581–1585.

Kolur, S. M., Hejjegar, I., & Patil, S. S. (2022). Evaluation of China aster (*Callistephus chinensis*) genotypes for cut flower production. *International Journal of Biological Forum*, **14**(3), 975–978.

Kumar, A., Kumar, J., Singh, B. M., Rajbeer, J. P., & Ram, N. (2012). Studies on the effect of plant growth regulators on growth, flowering and yield of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *Annals of Horticulture*, **5**(1), 47–52.

Kumar, K. P., Padmalatha, T., Pratap, M., & Reddy, S. N. (2015). Effect of plant bio-regulators on growth, flowering and seed yield in China aster (*Callistephus chinensis* L. Nees) cv. Kamini. *Indian Journal of Agricultural Research*, **49**(4), 348–352.

Kuri, S., Bahadur, V., Prasad, V. M., Bander, A. N., & Niranjan, R. (2018). Effect of plant growth regulators on vegetative, floral and yield characters of China aster (*Callistephus chinensis* (L.) Nees) cv. Phule Ganesh Purple. *International Journal of Chemical Studies*, **6**(4), 3165–3169.

Mujadidi, A., Kumar, M., Malik, S., Prakash, S., Singh, B., Singh, M. K., & Chaudhary, V. (2019). Effect of time and concentrations of gibberellic acid on growth and flowering of African marigold (*Tagetes erecta* L.) cv. Pusa. *Progressive Agriculture*, **19**(2), 293–297.

Munikrishnappa, P. M., Patil, A. A., Patil, V. S., Patil, B. N., Channappagoudar, B. B., & Alloli, T. B. (2013). Studies on the growth and yield parameters of different genotypes of China aster (*Callistephus chinensis* Nees). *Karnataka Journal of Agricultural Sciences*, **26**(1), 107–110.

Munikrishnappa, P. M., & Chandrashekar, S. Y. (2014). Effect of growth regulators on growth and flowering of China aster (*Callistephus chinensis* (L.) Nees). *Agricultural Research Communication Centre*, **35**(1), 57–63.

Naikwad, D., Kandpal, K., Hugar, A., Patil, M. G., & Kulkarni, V. (2019). Performance of different varieties of China aster for north eastern dry zone of Karnataka. *Journal of Pharmacognosy and Phytochemistry*, **8**(4), 1486–1494.

Palekar, A. R., Raut, V. U., Watane, A. A., & Thakre, S. A. (2018). Growth, flowering and quality of China aster flowers influenced by various plant growth regulators. *International Journal of Chemical Studies*, **6**(5), 1182–1184.

Rai, T. S., & Chaudhary, S. V. S. (2016). Evaluation of China aster (*Callistephus chinensis* Nees.) cultivars under mid hill conditions of Himachal Pradesh. *The Bioscan*, **11**(4), 2367–2370.

Rinu, U., Deshmukh, B., Sahu, T. L., Netam, N., & Patel, S. (2024). Evaluation of flowering parameters of different China aster (*Callistephus chinensis* L.) varieties under Rajnandgaon district of Chhattisgarh. *International Journal of Advanced Biochemistry Research*, **8**(9, Special Issue), 1170–1174.

Sahu, D., Gupta, P., & Kumar, V. (2023). Standardization of sowing dates of different varieties of China aster under Raipur region of Chhattisgarh plains. *Journal of Pharmaceutical Innovation*, **12**(6), 431–436.

Sharma, C. P., Maurya, A. N., Srivastava, O. P., & Mishra, A. (2001). Role of GA_3, maleic hydrazide and ethrel in modifying vegetative and floral characters of *Chrysanthemum morifolium*. *Orissa Journal of Horticulture*, **29**(2), 35–38.

Sharma, M. K., & Joshi, K. I. (2015). Effect of foliar spray of GA_3 and NAA on growth, flowering and yield of China aster (*Callistephus chinensis* Nees.) cultivars. *International Journal of Agricultural Sciences Research*, **5**(4), 105–110.

Shete, M. B., Gaikwad, S. D., Lohate, S. R., & Bhagat, A. A. (2023). Evaluation of China aster varieties under Pune conditions. *Journal of Pharmaceutical Innovation*, **12**(5), 3266–3268.

Sunna, D., Tirkey, T., & Kumar, A. (2021). Effect of varieties and plant growth regulators on vegetative growth of China aster (*Callistephus chinensis* (L.) Nees) under Chhattisgarh conditions. *Journal of Pharmaceutical Innovation*, **10**(3), 441–445.

Tirakannanavar, S., Katagi, A., Jagadeesha, R. C., & Halesh, G. K. (2015). Studies on genotypic evaluation and correlation studies in China aster (*Callistephus chinensis* (L.) Nees). *Indian Research Journal of Genetics and Biotechnology*, **7**(2), 179–186.

Zosiamliana, J. H., Reddy, G. S. N., & Rymbai, H. (2012). Growth, flowering and yield characters of China aster (*Callistephus chinensis* Nees). *Journal of Natural Products and Plant Resources*, **2**(2), 302–305.