

Investigating the Effect of foliar spray of micronutrients on growth, yield and quality of China aster

ABSTRACT

A field experiment was carried out to investigate the efficacy of foliar spray of micronutrients on growth, flowering parameter, yield, and quality of China aster during October 2022 to March 2023 at Floriculture Research Field, Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences, Prayagraj (U.P.). The experiment was designed with eleven treatment combinations, including ZnSO₄, FeSO₄, CuSO₄, and MgSO₄, along with their interaction effects at concentrations of 0.2% and 0.4% using the foliar spraying method, alongside a control group. The experimental results revealed that the treatment T₁₁ (ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4%) found best in terms of growth, yield and quality parameters of China aster, followed by treatment T₁₀ (ZnSO₄ @0.2% + FeSO₄ @0.2% + CuSO₄ @0.2% + MgSO₄ @0.2%). Whereas treatment T₅ (FeSO₄ @0.4%) found the best results in terms of days to first flower bud initiation, days from flower bud initiation to anthesis, and days to 50% flowering. In terms of the economics of the different treatments, the maximum gross return, net return, and benefit-cost ratio were found in T₁₁, followed by T₁₀, while the minimum was recorded in treatment T₁ (Control).

Keywords: China aster, ZnSO₄, FeSO₄, CuSO₄ and MgSO₄

1. INTRODUCTION

The flower industry in India holds a prominent position in terms of both production and consumption. Among the various flowering plants cultivated worldwide, China aster (*Callistephus chinensis* L.) stands out as a highly desired annual plant that is grown throughout the year. Belonging to the Asteraceae family, China aster is a diploid crop with a chromosome number of $2n = 18$. The genus *Callistephus* derives its name from two Greek words, *Kalistos* meaning "most beautiful" and *Stephus* meaning "a crown," referring to the flower head.

It is commercial cultivated across different countries, including India, France, Germany, Netherlands, the United Kingdom, Siberia, Russia, North America, Japan, Europe, and Switzerland. In India specifically, it thrives in regions such as Karnataka, Tamil Nadu, West Bengal, and Maharashtra. Recent reports reveal that during 2021-2022, flower production in India covered approximately 276 thousand hectares, resulting in a total output of around 2,936 thousand metric tons.

China aster is a robust and prolific annual plant cultivated for its loose flowers, cut flowers, and even as a dried flower. In India, it holds great significance as a traditional flower, finding extensive use in religious ceremonies, garland and bouquet preparations, as well as in flower shows and exhibitions. Its versatility extends to being grown as a potted plant, and its compact varieties are ideal for borders.

While China aster is treasured for its beauty and cultural importance, micronutrients enhance its resilience and play vital roles in plant physiology—activating enzymes, aiding photosynthesis, and facilitating nutrient uptake. Tayade et al. (2018) found that foliar application of 0.4% zinc and 0.4% iron increased the number of spikes in gladiolus. Similarly, Joseph et al. (2019) recorded that micronutrient treatments improved the growth, flower production, and quality of China aster.

2. MATERIALS AND METHODS

The experiment was conducted in a Randomized Block Design with 11 treatments, each replicated three times at the Floriculture Research Field, Department of Horticulture, Sam Higginbottom University of Agricultural, Technology and Sciences, Prayagraj, from October 2022 to March 2023. Total number of treatments were viz. (T1) Control, (T2) ZnSO₄ @0.2%, (T3) ZnSO₄ @0.4%, (T4) FeSO₄ @0.2%, (T5) FeSO₄ @0.4%, (T6) CuSO₄ @0.2%, (T7) CuSO₄ @0.4% (T8) MgSO₄ @0.2% (T9) MgSO₄ @0.4%, (T10) ZnSO₄ @0.2% + FeSO₄ @0.2% + CuSO₄ @0.2% + MgSO₄ @0.2% (27.33), (T11) ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4%. The planting materials for the experiment, which consisted of China aster genotypes, were obtained from IIHR, Bengaluru (Arka Archana).

Prior to planting, meticulous preparation was undertaken in the experimental field. This involved thorough ploughing to ensure a fine tilth and the removal of weeds, stubbles, and stones. To enhance soil fertility, well-decomposed Farm Yard Manure (FYM) was uniformly mixed at a rate of 10 t ha⁻¹. The application of balanced NPK fertilizers at a ratio of 180:60:60 kg ha⁻¹ further optimized nutrient levels. Planting was carried out with a spacing of 30x30cm between plants, followed by regular irrigation and timely weeding. For the micronutrient treatments, stock solutions of Zinc sulphate, Ferrous sulphate, Copper sulphate, and Magnesium sulphate were prepared and applied through foliar spraying at

specific intervals. The entire process adhered to the principles of 'Analysis of variance' as described by Panse and Sukhatme (1985).

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The maximum vegetative growth in China aster, with respect to plant height, plant spread, number of leaves per plant, and number of branches per plant, was recorded with the treatment (T₁₁) ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4%, whereas the minimum growth was recorded in treatment (T₁) Control. Increase in growth parameters due to combination of micronutrients indicates the synergistic effect of all the micronutrient viz. ZnSO₄, FeSO₄, CuSO₄ and MgSO₄ which plays a major role in stimulating the physiological activities. Zinc plays a vital role in synthesis of tryptophan and thus auxins which stimulates the growth causing internode elongation. While iron, copper and magnesium are involved in the biosynthesis of chlorophyll, catalytic function, enzymatic activities and other metabolic processes which helps in enhancing growth of the plants. Similar results were observed in Kashyap and Tikey (2021) in gladiolus and Verma *et al.* (2017) in China aster.

3.2 Flowering Parameters: The treatment (T₅) FeSO₄ @0.4% took significantly minimum period for first flower bud initiation (58.00 days), days from flower bud initiation to anthesis (8.89 days) and days to 50 percent flowering (82.22 days). Among the different treatments studied, Ferrous sulphate was the earliest in respect to first flower bud initiation, days from flower bud initiation to anthesis and days to 50 percent flowering in China aster. This might be due to reduction of juvenile period, the shoot apical meristem instead of producing leaves and branches starts producing buds. Similarly, these findings align with the results of Kumar *et al.* (2010) in marigold and Likith E. K. (2018) in China aster. Whereas, the treatment (T₁₁) ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4% recorded maximum flower duration (42.33 days). This might be due to an increased production of flowering shoots. These results are in close agreement with the findings of Kakade *et al.* (2009) in China aster, Chopde *et al.* (2015) in gladiolus.

3.3 Yield Parameters: The maximum yield in China aster in respect of number of flowers per plant, flower yield per plant and flower yield per hectare were recorded with the treatment (T₁₁) ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4% whereas, minimum was recorded in treatment (T₁) Control. The increase in flower yield might be due to the enhanced vegetative traits, such as plant height, plant spread, number of branches which helps in production of more photosynthesis resulting in greater accumulation of

carbohydrates which in turn directly or indirectly lead to the production of more number of flowers per plant. Similar results were also obtained by Poornima et al. (2018) in rose.

3.4 Quality Parameters: The maximum quality attributes in China aster in respect of the weight of the flower, the diameter of the flower, and shelf life were recorded with the treatment (T₁₁) ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4% whereas, minimum was recorded in treatment (T₁) Control. Improvement in flower quality might be attributed to the fact that the application of the combined dose of micronutrients might have promoted the synthesis of plant hormones and increased the quality of flowers. These findings are in line with the observations of earlier works viz. Fahad et al. (2014) and Naik et al. (2015) in gladiolus.

3.5 Economics of cultivation: In terms of Economics, maximum Gross Return (Rs. 594600), Net Return (Rs. 447764) and Benefit cost Ratio (1:4.04) from China aster flowers were recorded with the treatment (T₁₁) ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4% whereas, minimum was recorded in treatment (T₁) Control.

4. CONCLUSION

Based on the present investigation it is concluded that the treatment T₁₁ ZnSO₄ @0.4% + FeSO₄ @0.4% + CuSO₄ @0.4% + MgSO₄ @0.4% was found best in terms of plant height, plant spread, number of leaves per plant, flowering duration, weight of flower, diameter of flower, shelf life and benefit-cost ratio, whereas T₅ (FeSO₄ @0.4%) found best in days to first flower bud initiation, days from flower bud initiation to anthesis and days to 50% flowering.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

Table 1: Effect of micronutrients on plant height (cm), plant spread (cm), number of leaves per plant and number of branches per plant of China aster.

Table 2: Effect of micronutrients on days to first flower bud initiation, days from flower bud initiation to anthesis, days to 50% flowering, flowering duration, number of flowers per plant, flower yield per plant, flower yield per hectare, weight of flower, diameter of flower, shelf life and benefit cost ratio of China aster.

Treatment Symbol	Treatment Combinations	Days to first flower bud	Days from flower bud initiation to anthesis	Days to 50% flowering	Flowering duration	Number of flowers per plant	Flower yield per plant	Flower yield per hectare	Weight of flower	Diameter of flower	Shelf life	Benefit cost ratio
T ₁	Control	68.44	12.67	91.22	25.33	21.44	74.88	7.49	3.99	5.07	1.22	2.46
T ₂	ZnSO ₄ @0.2%	64.78	10.22	86.89	30.67	26.78	108.05	10.80	4.04	6.03	1.67	3.33
T ₃	ZnSO ₄ @0.4%	66.56	10.44	88.33	29.33	26.78	133.27	13.32	5.03	6.72	2.00	3.87
T ₄	FeSO ₄ @0.2%	59.78	9.67	83.89	41.78	23.11	94.92	9.45	4.17	7.09	2.22	2.83
T ₅	FeSO ₄ @0.4%	58.00	8.89	82.22	42.33	22.67	103.04	10.30	4.60	5.84	1.67	2.83
T ₆	CuSO ₄ @0.2%	62.56	10.89	84.67	35.56	24.33	111.59	11.15	4.60	6.36	1.89	3.33
T ₇	CuSO ₄ @0.4%	63.78	11.33	86.78	32.22	24.78	114.45	11.34	4.88	6.00	1.44	3.11
T ₈	MgSO ₄ @0.2%	64.67	10.78	85.89	27.78	23.00	117.38	11.73	5.21	6.89	2.44	3.7
T ₉	MgSO ₄ @0.4%	66.11	12.11	84.89	36.56	24.11	118.86	11.88	4.88	6.34	1.89	3.6
T ₁₀	ZnSO ₄ @0.2% + FeSO ₄ @0.2% + CuSO ₄ @0.2% + MgSO ₄ @0.2%	62.56	9.78	84.78	35.00	27.33	154.79	15.47	5.86	7.16	2.78	3.9
T ₁₁	ZnSO ₄ @0.4% + FeSO ₄ @0.4% + CuSO ₄ @0.4% + MgSO ₄ @0.4%	62.33	10.11	85.11	41.11	32.33	198.19	19.82	6.14	7.50	3.44	4.04
	F-test	S	S	S	S	1.37	9.45	0.94	0.34	0.12	0.30	
	S. Em.	1.93	0.70	0.88	1.14	4.05	27.87	2.79	1.02	0.37	0.88	
	CD at 5%	5.71	2.08	2.61	3.37	3.64	11.42	1.74	2.2	2.28	1.03	

REFERENCES

1. Ashita Joseph, VM Prasad, Vijay Bahadur, Samir E Topno and Deepanshu. Effect of micronutrients on growth, flower quality and yield of China aster (*Callistephus chinensis* L) under Allahabad agro climatic condition. *The Pharma Innovation Journal* 2019; 8(7): 609- 613.
2. Nishant Kashyap and Dr. T Tikey. Effect of micronutrients on plant growth, flowering and corm production of *Gladiolus* cv. summer sunshine. *The Pharma Innovation Journal* 2022; 11(9): 2503-2506
3. Chopde Neha, Neha Nehare, SR Maske, Sushma Lokhande, PN Bhute. Effect of foliar application of zinc and iron on growth, yield and quality of gladiolus. *Plant Archives* 2015; 15 (1), 417-419.
4. Verma, V.K., J.P. Verma and R.K. Meena. Response to foliar spray of micronutrients (Zn, Fe &Cu) in respect to growth and flower productivity of china aster (*Callistephus chinensis* L.) cv. Princes. *Plant Archives* 2017; 17(2): 1643-1646.
5. Fahad, S., Ahmad, K. M., Anjum, M. A. and Hussaiin, S. The effect of micronutrient (B, Zn and Fe) foliar application on the growth, flowering and corm production of gladiolus (*Gladiolus grandiflorus*) in calcareous soils. *J. Agr. Sci. Tech.* 2014; 16:1671-1682
6. Kakade, D. K., S.G. Rajput and K.I. Joshi. Effect of foliar application of 'Fe' and 'Zn' on growth, flowering and yield of China aster (*Callistephus chinensis* L. Nees). *The Asian Journal of Horticulture*, (June to November, 2009) Vol. 4 No. 1: 138-140.
7. Kumar, P., J. Kumar, V. K. Umrao and Rajbeer. Effect of nitrogen and iron on growth and flowering parameters in African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *Ann. Hort.* 2009; 3(1): 118-119.
8. Naik, D.V., Dhaduk, B. K., Kapadia, D.B. and Jambhale, S.S. Studies on the effect of different micronutrients in gladiolus cv. American Beauty, Ecology, environment and conservation paper 2015; 21(1): 425-428.
9. S Poornima, PM Munikrishnappa, S Anil Kumar, GK Seetharamu, Rajiv Kumar. Effect of foliar application of micronutrients on growth and flowering of floribunda Rose under open condition. *Int, J. Curr. Microbiol. App. Sci* 2018; 7 (10), 1873-1878.
10. Tayade, M. J., S. Badge, S. Bayaskar and C. Wasnik. Growth & yield of tuberose as influenced by micronutrients. *J. Soil and crops* 2018; 28(1): 142-145.
11. Panse, V. G. and Sukhatme, B. V. (1985). *Statistical Method for Agricultural Workers*, IInd Ed., Indian Council of Agricultural Research, New Delhi.
12. Second Advance Estimates of Area and Production of Horticultural crops released (2021-2022). Available: <https://pib.gov.in/PressReleasePage.aspx?PRID=1841480>