Original Research Article

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

Abstract

The present investigation entitled "Effect of foliar spray of micronutrients on growth, yield and quality of China aster" was carried out at Departmental Research Field of Department of Horticulture, SHUATS, Prayagraj from October, 2022 to March, 2023. Four micronutrients $ZnSO_4$, $FeSO_4$, $CuSO_4$, $MgSO_4$ and its interaction effect at 0.2% and 0.4% with foliar spraying method in addition to control included eleven treatments. The experiment was conducted in Randomized Block Design (RBD) with three replications. The experimental results revealed that the treatment T_{11} ($ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4%) found best in terms of Growth, yield and quality parameters of China aster, followed by treatment T_{10} ($ZnSO_4$ @0.2% + $FeSO_4$ @0.2% + $CuSO_4$ @0.2% + $MgSO_4$ @0.2%). Whereas treatment T_5 ($FeSO_4$ @0.4%) found best in days to first flower bud initiation, days from flower bud initiation to anthesis and days to 50% flowering. In terms of economics of different treatments, maximum Gross return, Net return and Benefit cost ratio was found in T_{11}, followed by T_{10} whereas minimum was recorded in treatment (T_1) Control.

Keywords: China aster, $ZnSO_4$, $FeSO_4$, $CuSO_4$ and $MgSO_4$

1. Introduction

The Indian flower industry is one of the largest in terms of production and consumption, among which China aster (*Callistephus chinensis* L.) is considered as one of the most demanding annual flowering plants grown throughout the year in many parts of the world. It belongs to the family Asteraceae. The crop is diploid with chromosome number of 2n = 18. The genus

Callistephus is derived from two Greek word *Kalistos* meaning “most beautiful” and *Stephus* “a crown” referring to the flower head. China aster is commercially cultivated in India, France, Germany, Netherlands, U.K., Siberia, Russia, North America, Japan, Europe, and Switzerland. In India, it is widely grown in Karnataka, Tamil Nadu, West Bengal, and Maharashtra. The hardy and free blooming annual is grown for its loose flowers as well as cut flowers. It is also used as a dry flower. It is one of the most important traditional flowers in India and has maximum use for its traditional purpose. It is used for performing religious, ceremonial functions, preparation of garlands, bouquets as well as filler materials, flower arrangements in flower shows and exhibition as cut flowers. It is also grown as a potted plant and its dwarf cultivars are suitable for edges. Though the flowers are less fragrant, they are very popular because of their attractive colours and size.

The importance of micronutrients in Indian agriculture is truly well recognised and their use had significantly contributed to the increased productivity of several crops. The nutrient element which are required comparatively in small quantities are called as micro or minor nutrients or trace elements. Micronutrients are essentially as important as macronutrients to ensure better growth, yield, and quality in plants. Various research workers have reported that the proper concentration of micronutrients help to increase the yield of good quality flowers in China aster.

2. Materials and Methods

The experiment was conducted in Randomized Block Design with 11 treatments, each replicated three times at the Departmental Research Field of Department of Horticulture, Sam Higginbottom University of Agricultural, Technology and Sciences, Prayagraj during October 2022 to March 2023. Total number of treatments were viz. (T_1) Control, (T_2) $ZnSO_4$ @0.2%, (T_3) $ZnSO_4$ @0.4%, (T_4) $FeSO_4$ @0.2%, (T_5) $FeSO_4$ @0.4%, (T_6) $CuSO_4$ @0.2%, (T_7) $CuSO_4$ @0.4% (T_8) $MgSO_4$ @0.2% (T_9) $MgSO_4$ @0.4%, (T_{10}) $ZnSO_4$ @0.2% + $FeSO_4$ @0.2% + $CuSO_4$ @0.2% + $MgSO_4$ @0.2% (27.33), (T_{11}) $ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4%. The planting materials for the experiment comprising China aster genotypes were obtained from IIHR, Bengaluru (Arka Archana).

The experimental field was thoroughly ploughed and brought into fine tilth. All the weeds, stubbles, stones were removed and well decomposed FYM @10 t ha^{-1} was mixed uniformly in the soil. Fertilizers were applied at the rate of 180: 60: 60 kg NPKha^{-1}. Planting was done at 30x30cm spacing in between the plants. The irrigation and weeding were done as and when required. The stock solution of Zinc sulphate, Ferrous sulphate, Copper sulphate and Magnesium sulphate were prepared by taking the required quantity (0.2% and 0.4%) and dissolving them with water as per the treatment concentration. Foliar application with the help of hand sprayer was done thrice at 30,60 and 90 DAT. The observations were recorded and the data were statistically analysed adopting 'Analysis of variance' as described by Panse and Sukhatme (1985).

3. Results and Discussions

The result of the experiment has been presented under the following heading:

A. Growth Parameters: The maximum vegetative growth in China aster in respect of plant height, plant spread, number of leaves per plant and number of branches per plant were recorded with the treatment (T_{11}) $ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% whereas, minimum was recorded in treatment (T_1) Control. Increase in growth parameters due to combination of micronutrients indicates the synergistic effect of all the micronutrient viz. $ZnSO_4$, $FeSO_4$, $CuSO_4$ and $MgSO_4$ 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.

B. Flowering Parameters: The treatment (T_5) $FeSO_4$ @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 are in conformity with results of Kumar et al. (2010) in marigold and Likith E. K. (2018) in China aster. Whereas, the treatment (T_{11}) $ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @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.

C. 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 (T_{11}) $ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% whereas, minimum was recorded in treatment (T_1) Control. The increase in flower yield might be due to the increased vegetative characters, like 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.

D. Quality Parameters: The maximum quality attributes in China aster in respect of weight of flower, diameter of flower and shelf life were recorded with the treatment (T_{11}) $ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% whereas, minimum was recorded in treatment (T_1) Control. Improvement in flower quality might be attributed to the fact that, application of combined dose of micronutrients might have promoted the synthesis of plant hormone 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.

D. 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 (T_{11}) $ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @0.4% whereas, minimum was recorded in treatment (T_1) Control.

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.

Treatment Symbol	Treatment Combinations	Plant height (cm)			Plant spread (cm)			Number of leaves per plant			Number of branches per plant	
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	60 DAT	90 DAT
T_1	Control	6.56	13.50	29.22	6.67	13.19	29.06	6.67	29.11	62.11	1.67	7.78
T_2	ZnSO4@0.2%	7.50	15.11	32.00	7.89	15.75	31.00	7.67	30.11	65.67	2.33	10.00
T_3	ZnSO4@0.4%	7.50	15.63	29.00	7.89	15.94	30.67	7.78	30.11	71.89	3.22	8.11
T_4	FeSO4@0.2%	6.61	14.94	34.44	9.19	15.89	31.22	8.33	32.89	65.11	2.78	10.33
T_5	FeSO4@0.4%	7.02	15.24	31.11	8.42	14.68	29.61	8.22	29.44	69.67	3.11	8.78
T_6	CuSO4@0.2%	6.63	14.50	32.00	7.44	16.56	31.17	7.89	30.33	78.00	1.89	9.89
T_7	CuSO4@0.4%	7.00	16.41	32.67	8.81	15.26	31.39	8.33	28.33	72.00	2.89	8.67
T_8	MgSO4@0.2%	7.17	15.11	34.78	9.22	15.36	30.44	7.78	29.33	74.11	2.56	9.33
T_9	MgSO4@0.4%	6.78	15.50	36.00	9.25	16.11	30.67	7.89	30.44	78.89	1.89	8.67
T_{10}	ZnSO4@0.2% + FeSO4@0.2% + CuSO4@0.2% + MgSO4@0.2%	7.52	17.98	36.33	9.44	16.89	32.33	9.56	31.89	82.44	3.44	10.56
T_{11}	ZnSO4@0.4% + FeSO4@0.4% + CuSO4@0.4% + MgSO4@0.4%	8.11	18.83	38.44	10.00	17.54	33.50	10.00	35.89	91.00	4.56	10.89
	F-test	S	S	S	S	S	S	S	S	S	S	S
	S. Em.	0.27	0.98	1.45	0.59	0.75	0.77	0.27	1.23	3.86	0.35	0.67
	CD at 5%	0.80	2.89	4.28	1.74	2.20	2.28	0.81	3.64	11.42	1.03	1.98

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	ZnSO4@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	ZnSO4@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	FeSO4@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	FeSO4@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	CuSO4@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	CuSO4@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	MgSO4@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	MgSO4@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}	ZnSO4@0.2% + FeSO4@0.2% + CuSO4@0.2% + MgSO4@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}	ZnSO4@0.4% + FeSO4@0.4% + CuSO4@0.4% + MgSO4@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	

4. Conclusion

Based on the present investigation it is concluded that the treatment T_{11} $ZnSO_4$ @0.4% + $FeSO_4$ @0.4% + $CuSO_4$ @0.4% + $MgSO_4$ @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 T_5 ($FeSO_4$ @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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