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Effect of plant growth regulators on flower yield and quality of China aster (*Callistephus chinensis* (L) Nees.)

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Abstract
A field investigation entitled "Response of plant growth regulators on flower yield and quality of China aster (*Callistephus chinensis* (L) Nees)" was carried out during the year 2020-21 at Department of Floriculture and Landscape Architecture, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola with the objectives to study the effect of different growth regulators on growth, flowering, yield and flower quality of China aster cv. Phule Ganesh White and to find out the suitable concentration of growth regulators for higher and quality production of China aster. The experiment was laid out in Randomized Block Design with ten (10) growth regulator treatments which were replicated thrice. The treatment comprised three levels each of GA_3 (50,100 and 150 ppm), Salicylic acid (50,100 and 150 ppm) and Triacontanol (1500, 2000 and 2500 ppm) along with control (Water spray).
The result of the present investigation indicated that, the growth regulator treatments significantly influenced yield and quality of China aster. Maximum flower yield per plant (318.42 g), per plot (8.91 Kg) and per hectare (3.53 t) and maximum diameter of fully opened flower (6.53 cm), stalk length (31.45 cm), stalk diameter (0.295 cm) and weight of flower (6.23 g) were recorded with GA_3 @ 150 ppm spray. While maximum shelf life (8.54 days) and vase life (10.13 days) of flower were recorded with Triacontanol @ 1500 ppm spray.

Keywords: China aster, GA_3, salicylic acid, triacontanol

Introduction
China aster (*Callistephus chinensis* L. Nees.) is an important annual crop belonging to family Asteraceae. The main stay of Indian floriculture is growing of traditional flowers in open field conditions. The area under sector is expanding at a rate of 7% while the trade in the sector is growing at a steady pace of 10% per annum. Only 1.5% of area is under the cut flower crops grown primarily under the polyhouses to cater to the export markets. In Maharashtra, total area under floriculture was 11.36 thousand hectares during the year 2018-2019 with the production of 57.61 and 0.11 thousand MT of loose and cut flowers, respectively (Anon, 2018) [2]. China aster as a cut flowers last for long and are used in vases and floral decoration and loose flowers are used in garland. Aster also make very showy bedding plants when grown in large masses and are valuable for filling up the gap in mixed herbaceous border, the dwarf type are put in front and the taller behind. Some strains are used as pot plants. Dwarf cultivars are also suitable for edging and window boxes. Plant growth regulators play an important role in flower production, which in small amount promotes or inhibits modifies growth and development. Gibberellins are diterpene that promote growth and elongation of cell. A significant increase in plant height, plant spread, and number of branches and longer intermodal length of the plant were obtained in China aster (Vijaykumar *et al.*, 2017) [13]. Salicylic acid (SA) is a phenolic compound of hormonal nature produced by plants and plays an important role in responses to several abiotic stresses and to pathogen attack (Noreen *et al.*, 2009) [9]. Triacontanol (TRIA) is a natural plant growth regulator found in epicuticular waxes. It is used to enhance the crop production in millions of hectares, particularly in Asia. Quite a number of researchers have reported the TRIA-mediated improvement in growth, yield, photosynthesis, protein synthesis, uptake of water and nutrients, enzymes activities and contents of free amino acids in various crops.

Materials and Methods
The present investigation entitled "Response of plant growth regulators on flower yield and quality of China aster (*Callistephus chinensis* (L) Nees.)" was carried out at Department of

Floriculture and Landscape Architecture, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during October, 2020 to March 2021. A field experiment was laid out with ten treatments *viz.* GA_3 @ 50 ppm (T_1), GA_3 @ 100 ppm (T_2), GA_3 @ 150 ppm (T_3), Salicylic acid @ 50 ppm (T_4), Salicylic acid @ 100 ppm (T_5), Salicylic acid @ 150 ppm (T_6), Triacontanol @ 1500 ppm (T_7), Triacontanol @ 2000 ppm (T_8), Triacontanol @ 2500 ppm (T_9) and Water spray (T_{10}). The treatments were replicated thrice in a Randomized Block Design. The experiment was conducted in 96.6 m^2 area in which total 30 beds were plotted each having the gross plot size 1.2 m × 2.10 m. The materials of the experiment were collected from Department of Floriculture and Landscape Architecture, Faculty of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. In this present investigation the growth regulators of the respective concentration were sprayed twice at 20 and 30 days after transplanting with the help of hand sprayer. The whole plants were sprayed completely by taking precaution to avoid the mixing of spray from one treatment to another.

Results and Discussion

A) Effect of plant growth regulators on yield parameters

Flower yield per plant, per plot and per hectare

The data in respect of flower yield per plant (g)**,** flower yield per plot (kg), flower yield per ha (t) in China aster as influenced by different treatments of plant growth regulators is presented in Table 1 which exhibited significant differences among the different treatments exhibited significant differences among the different treatments in China aster.

Maximum flower yield per plant (318.42 g), per plot (8.91 Kg) and per hectare (3.53 t) were recorded with the treatment T_3 (GA_3 @ 150 ppm). This was followed by the treatment T_2 (307.58 g, 8.61 Kg and 3.41 t respectively). The treatments T_3 and T_2 were at par with each other. However, significantly minimum flower yield per plant (246.11 g), per plot (6.89 g) and per hectare (2.73 t) were recorded with the treatment T_{10}. An increase in flower yield per plant, per plot and per hectare in China aster with the application of gibberellic acid at concentration of 150 ppm might be due to the production of large number of laterals at early stage of growth which had sufficient time to accumulate carbohydrate for proper flower bud differentiation due to enhanced reproductive efficiency and photosynthesis restrictive plant type. The findings are in line with the results obtained by Aklade *et al*. (2009) [1] in chrysanthemum, Munikrishnappa and Chandrashekar (2014) [8], Vijayakumar *et al.* (2017) [13], Imandi and Subba Reddy (2017) [14] in Marigold, Sindhuja *et al.* (2018) [15] and Kuri *et al.* (2018) [7] in China aster.

B) Effect of plant growth regulators on quality parameters

The data in respect of quality parameters presented in China aster as influenced by different treatments of plant growth regulators is presented in Table 1 which exhibited the significant differences among the different treatments. The treatment T_3 (GA_3 @ 150 ppm) recorded significantly maximum diameter of fully opened flower (6.53 cm), stalk length of flower (31.45 cm), stalk diameter of flower (0.295 cm) and weight of the flower (6.23 g) which was significantly superior than rest of all the treatments. While, maximum shelf life of loose flowers (8.54 days) and Maximum vase life of cut flower (10.13 days) were recorded with the treatment T_7 (Triacontanol @ 1500 ppm). However, significantly minimum diameter of fully opened flower (4.10 cm), stalk length of flower (21.34 cm), stalk diameter (0.200 cm) and weight of the flower (4.29 g), shelf life of loose flowers (5.83 days) and vase life of cut flower (6.18 days) were recorded with the treatment T_{10} (Water spray).

The maximum flower diameter in China aster was observed with the plants treated with gibberellic acid. This might be due to the active cell elongation in the flower caused increase in length of petals and pedicels or might be owing to division of photosynthates towards flower as a consequence of which there is intensification of sink in China aster and increase in the length of flower stalk might be due to an increase in the length of the branch. This increase in stalk length might be due to the translocation of photosynthesis to the flower as a consequence of intensification of the sink and also due increased cell division and elongation. This might be due to the maximum stalk length and stems were straight and thicker having high accumulation of carbohydrates. The findings are in line with the results obtained by Aklade *et al.* (2009) [1] in chrysanthemum and Vijayakumar *et al.* (2017) [13] in China aster.

However, increase in stalk length might be due to the utilization of food material for development of stalk and produced maximum stalk diameter. Similar results were obtained by Elsadek (2018) [3] in Dahilla and the highest weight of a flower in the treatment of GA_3 @ 150 ppm might be attributed to the fact that gibberellic acid promoted the efficacy of plants in terms of photosynthetic activity; uptake of nutrients and their translocation as well as better partitioning of assimilates intoreproductive parts. The results obtained during this investigation are closely in agreement with the findings of Aklade *et al.* (2009) [1] in chrysanthemum and Munikrishnappa and Chandrashekar (2014) [8] in China aster.

The maximum extension of shelf life which might be due to the overall modified effect on the vegetative and reproductive growth of the plant and for vase life, one of the greatest problems in post harvest flower physiology is the blockage of the vascular system. This blockage might be due to air or bacterial growth. Another cause of vascular blockage is the plants reactions to the actual cut. Even in the flower stem that is removed from the mother plant, certain enzymes are mobilized to the wounded area where chemicals are released in order to try to seal the wound. The reason for such result might be due to the availability of optimum quantity of Triacontanol @ 1500 ppm under this treatment resulting in significantly increased days for shelf life and vase life of flower. This is in accordance with the findings of Kuri *et al.* (2018) [7] in China aster**.**

Table 1: Effect of plant growth regulators on flower yield and quality of China aster

Parameters	Yield Parameters			Quality Parameters					
Treatment	Flower yield per plant (g)	Flower yield per plot (Kg)	Flower yield per ha (t)	Diameter of fully opened flower (cm)	Flower stalk length (cm)	Flower stalk diameter (cm)	Weight of flower (g)	Shelf life of loose flower (days)	Vase life of cut flower (days)
T_1-GA_3 @ 50 ppm	297.12	8.31	3.30	5.80	28.21	0.228	5.98	6.44	7.65
T_2-GA_3 @ 100 ppm	307.58	8.61	3.41	6.48	30.01	0.287	6.09	7.66	9.59
T_3-GA_3 @ 150 ppm	318.42	8.91	3.53	6.53	31.45	0.295	6.23	8.36	10.03
T_4-Salicylic acid @ 50 ppm	264.06	7.39	2.93	4.69	23.07	0.210	4.88	6.54	8.22
T_5-Salicylic acid @ 100 ppm	279.08	7.81	3.09	5.32	24.72	0.240	5.76	7.51	9.33
T_6-Salicylic acid @ 150 ppm	273.91	7.66	3.04	5.11	24.78	0.260	5.66	7.19	8.83
T_7-Triacontanol @ 1500 ppm	301.66	8.44	3.35	6.26	25.83	0.220	6.02	8.54	10.13
T_8-Triacontanol @ 2000 ppm	291.30	8.14	3.23	5.77	27.64	0.230	5.63	8.28	10.01
T_9-Triacontanol @ 2500 ppm	286.49	8.02	3.18	5.64	30.79	0.279	5.58	7.89	9.84
T_{10}-Water spray	246.11	6.89	2.73	4.10	21.34	0.200	4.29	5.83	6.18
'F' test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
S.E(m) ±	4.30	0.12	0.048	0.08	0.40	0.0036	0.08	0.11	0.13
CD at 5%	12.79	0.36	0.14	0.25	1.20	0.010	0.25	0.34	0.39

Conclusion

From the findings of present investigation, maximum flower yield per plant, yield per plot and yield per ha, diameter of fully opened flower, stalk length, stalk diameter, weight of flower were recorded with GA_3 @ 150 ppm spray. Maximum shelf and vase life of flower were recorded with Triacontanol @ 1500 ppm spray. Thus, inference can be drawn from the present investigation that, the treatment of T_3 (GA_3 @ 150 ppm) and T_7 (Triacontanol @ 1500 ppm spray) found to be suitable for enhancing flower yield and quality of China aster.

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