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Influence of plant growth regulators on yield and Economics of China aster var. Arka Archana

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Abstract
A field experiment on "Influence of plant growth regulators on yield and economics of China aster var. Arka Archana" was undertaken at Floriculture Research Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during the *Rabi* season of 2020-2021. The experiment comprised ten treatments *viz.*, GA_3 100 ppm, GA_3 150 ppm, GA_3 200 ppm, Salicylic acid 50 ppm, Salicylic acid 100 ppm, Salicylic acid 150 ppm, NAA 100 ppm, NAA 150 ppm and NAA 200 ppm along with no (water) spray. The experiment was laid out in randomized block design (RBD) with three replications in China aster var. 'Arka Archana'. Plant growth regulators were applied as foliar spray at 30 and 45 days after transplanting. The findings show that numerous treatments had different impacts on yield and economics. Among different concentrations of plant growth regulators, 200 ppm GA_3 was found numerically highest in the number of flowers per plant, yield of flowers per plot and hectare at 45 and 60 DAT. Moreover, the benefit cost ratio (BCR) was also recorded as maximum with the application of GA_3 @ 200 ppm.

Keywords: plant growth regulator, Salicylic acid, GA_3, NAA, Arka Archana, BCR

Introduction
China aster is the most popular, annual commercial flower crop. The plants are best suited for landscape gardening as bedding, herbaceous borders, edging, window boxes, formal beds and pots. Flowers are used commercially as cut flowers for interior decoration and in vases whereas loose flowers are used for garland making, worship and decorations. The genus *Callistephus* includes the only ornamental cultivated species, chinensis and belongs to the family Asteraceae. The generic name *Callistephus* is derived from two Greek words '*Kalistos*' meaning most beautiful and '*stephus*' meaning flower resembling a crown. The plants are half hardy, annual, growing erect with hairy branches, leaves are ovate, deeply and irregularly toothed, flowers solitary, and attractive with different colours.

The growth and yield of the plant are mainly influenced by two principal factors *viz.*, genetic and management factors. In recent years, scientists have paid due attention to the idea of regulating plant growth by means of growth regulators as the third most important factor in improving growth, yield and flower quality in various ways. Plant growth regulators play a vital role in altering the morphology and physiology of plants by acting as chemical messengers for intercellular communication. Growth regulators have different effects depending on the plant genus, species, variety, and concentration utilized (Jemini Patel *et al.* 2023) [1]. These substances modify the plant system, which ultimately affects plant growth and development. Synthetic growth regulating chemicals have become very popular in enhancing the growth and development of flower crops. Economics plays a vital role for flower growers. The selection of crops and economics is a fundamental part of the successful production of flower crops. Keeping these points in view, the present study was undertaken to ascertain the most suitable concentration of GA3, salicylic acid and NAA for better yield and economics of China aster var. Arka Archana.

Materials and Methods
Experimental Site
The present investigation entitled "Influence of plant growth regulators on growth, flowering and yield of China aster var.

Arka Archana" was carried out at Floriculture Research Farm, ASPEE College of Horticulture & Forestry, Navsari Agricultural University, Navsari during the *Rabi* season of 2020-21.

Treatments and Applications Details

The experiment was laid out in a Randomized Block Design (RBD) with three replications and ten treatments of GA_3 (100 ppm, 150 ppm, 200 ppm, respectively), Salicylic acid (50 ppm, 100 ppm, 150 ppm, respectively) and NAA (100 ppm, 150 ppm and 200 ppm, respectively) along with control (no spray). The treatments were applied as a foliar spray at 45 and 60 days after transplanting. Solutions of GA_3, Salicylic acid and NAA at different concentrations were prepared by dissolving a calculated quantity of chemicals in a small quantity of absolute alcohol. Different yield and economic parameters were observed and recorded. The gathered data for all the characters were subjected to the statistical analysis by adopting the 'Analysis of Variance' technique as described by Panse and Sukhatme (1985) [6] for Randomized Block Design.

Calculation of Cost for Cultivation

Calculations of cost of cultivation include fixed cost, Variable cost, Total cost, Gross realization, Net realization and Benefit Cost Ratio. The cost of cultivation is calculated by the formula.

Fixed cost: It is obtained by sum of the cost of planting materials, hired labour, fertilizer cost, weeding, mulching, pesticides, irrigation, depreciation and interest of working capital.

Variable cost: It is obtained by treatment cost according to chemicals.

Total cost: It is sum total of Fixed cost and Variable cost.

Gross Realization: Total yield of flower multiplied by the price of 1 kg flower. (Here, the price of 1 kg flower is Rs. 40.)

Net Realization: Gross Realization - Total cost

BCR = (Net Realization) / (Total cost)

Results and Discussion

The results regarding different yield attributes of China aster var. Arka Archana as influenced by different plant growth regulators was recorded during the experimentation presented in Table 1. Maximum number of flowers per plant (46.87) was recorded through the application of GA_3 200 ppm (T_3). There was a particular effect on weight of flowers per plot, T_3 - GA_3 200 ppm (2324.79 g) which was statistically at par with T_2 GA_3 150 ppm (2128.00 g) and T_4 - Salicylic acid 50 ppm (2071.67 g). Moreover, maximum flower production per hectare (9686.61 kg) was also recorded in T_3 - GA_3 200 ppm. The increase in yield attributes might be due to the fact that gibberellic acid stimulated vegetative growth and induced changes in vegetative morphology. It could be ascribed to accelerate the number of laterals per plant and increase flower production. It also be due to greater dry matter accumulation which is suggested that better photosynthetic activity, other metabolic activities and uptake of nutrients from the soil. Therefore, the growth promoting substances might have a positive influence on the yield of flowers. The present results are in conformity with the findings of Ragini Maurya and Singh (2018) [7] in China aster, Vijaykumar *et al*. (2017) [8] in China aster cv. Local, Kumar *et al*. (2015) [2] in China aster cv. Kamini, Mamilla Sindhuja and Prasad (2018) [5] in China aster cv. Shashank, Kumar *et al*. (2018) in China aster cv. Ostrich Feather and Kumar *et al*. (2010) in African marigold cv. Pusa Narangi Gainda.

Economics is the main deliberation which helps to taking a decision regarding the adoption of a new technology. The net income in rupees per hectare was worked out from weight of flowers by considering their average price and the inputs used during the period of experimentation. From the above study, it is apparent (Table 2) that the highest net returns (Rs. 2,46,558) was recorded under the treatment T_3 - GA_3 200 ppm and followed by T_2 - GA_3 150 ppm *i.e.* Rs. 2,15,558 and minimum return of Rs. 1,10,158 was obtained under T_{10} - Control. With respect to BCR, the GA_3 200 ppm (T_3) gave the highest BCR (1.75) and it was followed by T_4 - Salicylic acid *i.e.*1.58. The result indicates that the GA_3 200 ppm (T_3) is economically most beneficial for flower production of China aster var. Arka Archana. These findings are in line with Mamilla Sindhuja and Prasad (2018) [5] in China aster cv. Shashank.

Table 1: Effect of plant growth regulators on number of flowers per plant, yield of flowers per plot and per hectare in China aster

Treatments	No. of flowers/plant	Yield of flowers	
		Per plot (g)	Per ha (kg)
T_1: GA_3 100 ppm	40.67	1981.12	8254.67
T_2: GA_3 150 ppm	42.80	2128.00	8866.67
T_3: GA_3 200 ppm	46.87	2324.79	9686.61
T_4: Salicylic acid 50 ppm	41.63	2071.67	8631.94
T_5: Salicylic acid 100 ppm	40.40	1732.33	7218.06
T_6: Salicylic acid 150 ppm	39.27	1608.99	6704.14
T_7: NAA 100 ppm	36.07	1515.37	6314.03
T_8: NAA 150 ppm	38.13	1534.72	6394.67
T_9: NAA 200 ppm	38.87	1567.96	6533.15
T_{10}: Control	34.67	1463.26	6096.92
S.Em.±	1.74	86.49	360.36
C.D. @ 5%	5.16	256.96	1070.67
C.V. %	7.53	8.36	8.36

Table 2: Economics of flower production per hectare in China aster (Rs./ha)

Treatments	Yield of flowers per ha (kg)	Income (Rs.) of flowers	Fixed cost (Rs.)	Variable cost (Rs.)	Total cost (Rs.)	Gross realization (Rs./ha)	Net realization (Rs./ha)	BCR
T_1	8255.00	330200.00	125856.00	3600.00	129456.00	137322.00	192878.00	1.40
T_2	8867.00	354680.00	125856.00	5400.00	131256.00	139122.00	215558.00	1.55
T_3	9687.00	387480.00	125856.00	7200.00	133056.00	140922.00	246558.00	1.75
T_4	8632.00	345280.00	125856.00	72.50	125928.50	133794.00	211486.00	1.58
T_5	7218.00	288720.00	125856.00	145.00	126001.00	133867.00	154853.00	1.16
T_6	6704.00	268160.00	125856.00	217.50	126073.50	133939.00	134211.00	1.00
T_7	6314.00	252560.00	125856.00	576.00	126432.00	134298.00	118262.00	0.88
T_8	6395.00	255800.00	125856.00	864.00	126720.00	134586.00	121214.00	0.90
T_9	6533.00	261320.00	125856.00	1152.00	127008.00	136874.00	126446.00	0.94
T_{10}	6097.00	243880.00	125856.00	0	125856.00	133722.00	110158.00	0.82

Selling Price: 40 Rs./kg

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