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PGR's consequence on yield attributing trait of China aster (*Callistephus chinensis* L. Nees) cv. Ostrich Feather

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Abstract
The present investigation was conducted on China aster (*Callistephus chinensis* L. Nees) cv. Ostrich Feather at the Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) during the year 2013-14. The experiment was laid out in Randomized Block Design with 10 treatments comprising of three levels each of GA_3, NAA and ethrel and a control replicated three times. The observations were recorded for flowering and yield attributing character of China aster cv. Ostrich Feather. The foliar spraying of plant growth regulators GA_3, NAA and ethrel was done 30 days after transplanting. The maximum flower stalk length (25.87 cm), diameter of flower (8.40 cm), flower yield per plant (146.27g) as well as flower yield per hectare (130.02g) were recorded with the foliar application of GA_3 300ppm and minimum values were recorded in control (water spray).

Keywords: GA_3, Naa, ethrel, stalk length

Introduction
Flowers, crowning glory of god creation are an inseparable part of human life. They are part of age old tradition and culture of Indian society symbolizing purity, peace, passion, love and beauty. Due to their aesthetic, economic and social value their demand in the global market is increase tremendously. Among the flowers used for domestic market, China aster (*Callistephus chinensis* Nees.) is to be considered as one of the important annual and commercial flower crops belongs to family Asteraceae. China aster is native to China and spread to European countries and other tropical countries during 1731 AD. The genus Callistephus is derived from two Greek words Kalistos meaning 'most beautiful' and *Stephus*, 'a crown' referring to the flower head. The present day asters have been developed from a single wild species, *Callistephus chinensis*. The stature is medium tall, 18 to 24 inches in height. The first change in the flower type had been the prolongation or development of central florets and the production of quelled flowers. Germans developed double forms during 18th century. The China aster was therefore, in geitonogamous condition (the pollination is accomplished by rain drops). In some varieties, they mature together leading to self-fertilization. The possibility of some amount of cross-pollination was also opined by him.
Flowers are used for the preparation of garlands, in bouquets as fillers, flower arrangements in flower shows and exhibitions. It is popular as a bedding plant and is also used in herbaceous borders in gardens. It is grown as a potted plant and its dwarf cultivars are suitable for edges. Aster is also an important commercial flower crop of Siberia, Russia, Japan, North America, Switzerland and Europe. In India, it is largely grown on commercial scale in Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra (Pune and Nasik) and West Bengal. Increased flower production, quality of flowers and perfection in the forms of plants are important objectives to be reckoned in commercial flower production. Even though the crop has great significance in the market, there are some bottle necks associated in its cultivation. Non-availability of planting material, lack of improved varieties, high market fluctuation is some of the problems which are often faced by the farmers.
Growth and development of plants are under the control of extremely minute quantity of hormone within the plant themselves. Production of improved quality flower depends greatly on the use of plant growth regulators at commercial level.

The growth and flowering of China aster are greatly influenced by judicious application of growth regulators; therefore, it is imperative to find out their optimum doses for quality flower production. Deficiency of plant growth regulators results in poor growth, flowering and yield potential. The present study is therefore, undertaken to investigate the possibilities of improvement in quality and production of China aster with foliar application of different groups of plant growth regulators *viz.* auxin gibberllin and ethrel. Auxin group of growth regulators such as NAA (Naphthalene acetic acid) increases the growth of plant both by cell division and cell elongation, apical dominance, regulation of flowering in a large number of plants. The apical dominance might be under control of auxin produced at the terminal bud and it can regulate the flowering in desired season. Gibberellins are deterpene that promote stem and leaf growth. In some species, GA_3 also induced seed germination and modulate flowering time and development of flowers, fruits and seed (Sum and Gubler, 2004) [10]. Gibberellins increases number of leaves per plant, number of stalk per plant, length of flower stalk and height of plant (Narayan and Syamal, 2002) [6]. The application of ethrel retards plant height, number of nodes and internodal length in China aster. It increased branching, delayed flowering, more number of leaves formed below the terminal flower, increased number of flower per plant in China aster. Ethrel is growth retardant check cell division in apical meristem only resulting in vascular synthesis beneath the apical meristem but the cambial and vascular cell continues to divide over a larger period and this results increase in thickness of stem (Sachs, 1961) [9]. Present investigation has been framed with the objective that to find out the optimum doses of PGR on yield trait of China aster.

Materials and Methods

Experimental Field Description

The field experiment was conducted to study the PGR's consequence on yield attributing trait of China aster (Callistephus chinensis l. Nees) cv. Ostrich Featherat Main Experiment Station, Horticulture, Narendra Deva University of Agriculture & Technology, Narendra Nagar, (Kumarganj), Faizabad (U.P) during winter season of 2013-14, Kumarganj situated at 26.43˚ N latitude and 81.9˚ E longitudes and an altitude of 98 meter above mean sea level.

Climate and meteorological condition

The region enjoys sub humid and subtropical climate receiving a mean annual rainfall of about 1100 mm out of which about 85 per cent is concentrated from mid-June to end of September. The winter months are cold and dry and occasional frost occurs during this period. Westerly hot wind starts from the month of March and continues up to onset of monsoon. Meteorological observation recorded at the meteorological observatory of Narendra Deva University of Agriculture & Technology, Narendra Nagar, Kumarganj, Faizabad, is presented in Fig-3.1.

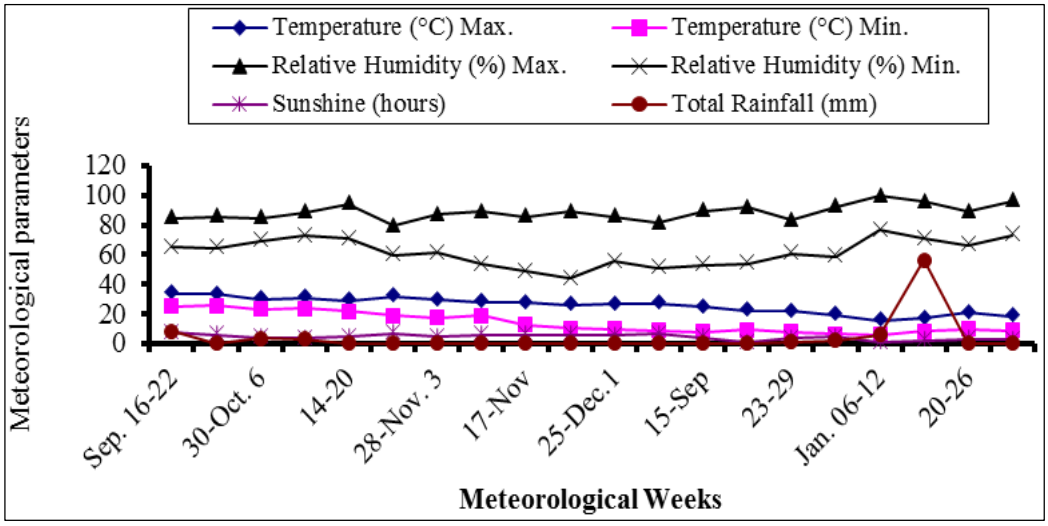

Fig 1: Weekly meteorological data during the crop season in year

Experimental Design

The experiment was laid out in Randomized Block Design (R.B.D.) replicated three times keeping 10 treatments. In the present study China aster cv. Ostrich Feather was taken as experimental material considering total number of plots 30 and 25 plants in each with spacing 30 cm x 30 cm. The treatments consists of three levels each of GA_3 (100,200,300ppm), NAA (50,100,150ppm) and ethrel (100,200,300ppm) and control. The different concentration of plant growth regulators were applied in an aqueous solution as foliar spray one month after transplanting. Control plants were sprayed with distilled water. Statistical analyses of the data obtained in the different treatments of experiments were calculated, as suggested by Panse and Sukhatme (1967). For calculating error of mean and critical differences 't" value was taken at 5 per cent level of significance.

Results and Discussion

Effect of PGR's on growth attributes

Flower stalk length

Gibberellic acid treatments improved stalk length significantly. The maximum flower stalk length (25.87 cm) was measured with application of GA_3 300 ppm followed by GA_3 200 ppm and NAA 50 ppm which was found at par with GA_3 100 ppm while minimum (14.94 cm) length of flower stalk was recorded in control. The increment in stalk length with application of GA_3 might be due to enhanced cell division and cell enlargement, promotion of protein synthesis coupled with higher dry matter and apical dominance in chrysanthemum (Dalal *et al*. 2009) [1]. Gautam *et al*. (2006) [3] also reported maximum length of flower stalk with GA_3 200ppm in chrysanthemum.

Table 1: Effect of plant growth regulators on yield attributing characters of China aster

Treatment	Length of flower stalk (cm)	Diameter of flower (cm)	Yield of flower per plant (g)	Yield of flower per hectare (q)
T_1-Control	14.94	6.87	71.80	63.83
T_2-GA_3 100 ppm	20.94	7.60	105.07	93.27
T_3-GA_3 200 ppm	24.00	8.27	121.00	107.56
T_4-GA_3 300 ppm	25.87	8.40	146.27	130.02
T_5-NAA 50 ppm	23.34	7.34	103.47	91.56
T_6-NAA 100 ppm	19.40	7.66	92.27	82.02
T_7-NAA 150 ppm	19.34	7.27	85.60	76.09
T_8-Ethrel 100 ppm	18.46	6.74	88.40	78.58
T_9-Ethrel 200 ppm	17.34	7.27	103.47	91.98
T_{10}-Ethrel 300 ppm	17.27	7.14	120.20	100.04
SEm±	2.13	0.28	6.25	6.01
CD at 5%	6.32	0.83	18.56	17.85

Effect on diameter of flower

Diameter of flower was found significantly maximum (8.40cm) with application of GA_3 300 ppm followed by GA_3 200 ppm and NAA 100 ppm which was found at par with GA_3 100 ppm while minimum diameter of flower was recorded under Ethrel 100 ppm (6.74 cm). GA_3 at higher concentration increases flower diameter. Patel *et al*. (2010) [8] observed maximum diameter of flower with GA_3 150ppm in chrysanthemum. Similar result was also reported by Dalal *et al*. (2009) [1] studied the effect of gibberellic acid and maleic hydrazide spray at 30th and 60th days after transplanting on growth, flowering and yield of chrysanthemum grown under net house conditions.

Effect of growth regulators on yield attributes

Flower yield per plant

It is evident from the data presented in Table-1 that the maximum flower yield per plant (146.27 g) was recorded with GA_3 300 ppm followed by GA_3 200 ppm whereas, minimum flower yield per plant (71.80g) was recorded in control. Maximum flower yield per plant was recorded with foliar application of GA_3 300ppm followed by GA_3 200ppm. Tyagi and Kumar (2006) [13] evaluated the effect of GA_3 on African marigold (*Tagetes erecta* L.) were maximum flower weight per plant with GA_3 spray at 200ppm. Mohariya *et al.* (2003) [5] studied the effect of GA_3 at 100, 150 ppm on different varieties of chrysanthemum and observed that 150ppm GA_3 hastened flowering and highest number of flower per plant.

Flower yield per hectare

The maximum yield of flower per hectare (130.02q) was recorded with application of GA_3 300 ppm which was found superior over rest of the treatment followed by GA_3 200 ppm, while minimum flower yield per hectare (63.83q/ha) was recorded under control. Similar results were also reported by Patel *et al*. (2010) [8] in chrysanthemum recorded maximum flower yield/ha with GA_3 150ppm. Devadanam *et al.* (2007) [2] reported maximum flower yield per hectare with GA_3 150ppm in tuberose.

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