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Growth, yield and quality of China aster varieties as influenced by pinching

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Abstract
An investigation on "Growth, yield and quality of China aster varieties influenced by pinching" was carried out at College of Agriculture, Nagpur during 2017-18 to study the response of China aster varieties to various pinching treatments in factorial randomised block design with 12 treatment combinations comprising of four varieties of China aster as main factor *viz*., V_1 – Arka Kamini, V_2 –Arka Archana, V_3 - Arka Shashank and V_4 - Arka Adhya and three pinching methods as sub factor *viz*., P_1 – No pinching, P_2 –Single pinching and P_3 –Double pinching replicated thrice. Single pinching was carried out on 30th day and double pinching on 30th and 45th day after transplanting. The results revealed that, significantly maximum plant spread and the earliest commencement of flowering and 50 per cent flowering were recorded with the variety Arka Archana, whereas, stem diameter was noted maximum with Arka Adhya. However, flower yield plant^{-1}, weight of flower and blooming period were recorded highest with the variety Arka Kamini. In respect of pinching methods, plant spread, stem diameter, flower yield plant^{-1} and blooming period were noticed significantly maximum with double pinching, whereas, diameter and weight of flower were noted maximum and days for commencement of flowering and 50 per cent flowering were minimum with no pinching treatment. An interaction effect was found non-significant with respect to all the parameters.

Keywords: aster, pinching, varieties, growth, flower yield, quality

Introduction
China aster (*Callistephus chinensis* Nees.) is a half hardy annual and commercial flower crop belonging to the family Asteraceae. China aster is a free blooming annual grown all over the world for its cut and loose flowers. The species consists of diverse forms, types and wide spectrum of colour ranges. The flowers have long vase life and are used for various purposes. It is used for the preparation of garlands, in bouquets as fillers, flower arrangements, in flower shows and exhibitions. The demand for flowers of China aster is increasing day by day in Vidharbha region of Maharashtra state, but flower yield of this crop is not satisfactory in this region. Successful cultivation of China aster depends upon proper selection of varieties. In recent years, several new cultivars of aster with wide range of colours have entered the market but all the cultivars cannot be grown everywhere successfully. Hence, it is necessary to identify the suitable cultivar for commercial cultivation in the region.
In most of the flower crops, flower yield is mainly dependent on number of flower bearing branches which could be manipulated by arresting vertical growth of plants and encouraging side shoot by means of apical bud pinching. But, studies on influence of pinching in China aster on flower yield and quality particularly under Vidharbha region are meagre. Considering the importance of commercial flower crop of China aster studies on growth, yield and quality of aster varieties as influenced by pinching was conducted to increase the flower yield in Vidharbha region.

Materials and Methods
A field experiment was carried out at Horticulture section, College of Agriculture, Nagpur during the year 2017-18 in Factorial randomised block design to find out the most suitable variety and pinching method for increasing growth and flower yield of China aster with twelve treatment combinations and three replications. The treatments comprised of four varieties of aster *viz*., Arka Kamini, Arka Archana, Arka Shashank and Arka Adhya and three pinching treatments *viz*., No pinching (control), single pinching and double pinching.
The experimental plot was brought to fine tilth by ploughing, clod crushing and harrowing. At the time of land preparation, well-rotted FYM @ 15 t ha^{-1} was mixed uniformly in the soil before last harrowing. The field was then laid out with flat beds of the dimension 1.50 m x 2.40 m. As per the treatment, uniform and healthy seedlings of four varieties of aster were transplanted in the prepared plots at the spacing of 30 cm x30 cm. Treatment wise half the

dose of 100 kg nitrogen was applied in the form of urea before transplanting of seedlings and the remaining half dose of nitrogen was top dressed after 30 days of transplanting. However, the full dose of 50 kg phosphorus and 50 kg potassium ha^{-1} were applied in the form of single super phosphate and muriate of potash, respectively at the time of transplanting. Single pinching was carried out on 30th day and double pinching on 30th and 45th day after transplanting. All the cultural operations *viz*., weeding, irrigation, pest control etc. were carried out as and when required. Various observations on growth, flowering, yield and quality parameters v*iz.*, plant spread, stem diameter, days for commencement of flowering and 50 per cent flowering, flowers yield $plant^{-1}$, flower diameter, weight of flower and blooming period were recorded at proper stages and the data was statistically analysed by the method suggested by Panse and Sukhatme (1995) [4].

Results and Discussion

The data presented in Table 1 revealed that, different varieties of China aster had significant effect on all growth, flowering, yield and quality parameters except diameter of flower. However, the effect of pinching on all the characters studied in China aster was found statistically significant.

Table 1: Growth, yield and quality of China aster varieties as influenced by pinching

Treatments	Plant spread (cm)	Stem diameter (cm)	Days for commencement of flowering (days)	Days for 50 per cent flowering (days)	Flower yield $plant^{-1}$ (g)	Flower diameter (cm)	Weight of flower (g)	Blooming period (days)
Main factor- Varieties								
V_1- Arka Kamini	25.52	1.30	59.06	94.59	110.92	5.51	2.66	38.35
V_2- Arka Archana	31.09	1.22	54.69	90.73	91.07	5.35	2.48	33.57
V_3- Arka Shashank	27.57	1.19	59.37	95.54	78.86	4.92	2.28	36.40
V_4- Arka Adhya	30.03	1.32	56.79	93.21	74.54	5.06	2.35	33.75
F- test	Sig.	Sig.	Sig.	Sig.	Sig.	NS	Sig.	Sig.
SE(m)±	0.69	0.04	0.81	0.80	3.42	0.19	0.08	0.68
CD at 5%	2.03	0.11	2.39	2.35	10.04	-	0.25	2.01
Sub factor- Pinching								
P_1- No pinching	22.86	0.96	48.55	84.21	60.86	6.07	3.28	29.54
P_2- Single pinching	29.27	1.38	57.06	94.12	93.52	5.08	2.35	35.78
P_3- Double pinching	33.52	1.43	66.82	102.23	112.18	4.49	1.70	41.23
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.60	0.03	0.7	0.69	2.96	0.17	0.07	0.59
CD at 5%	1.76	0.09	2.07	2.03	8.70	0.5	0.21	1.73
Interaction (VXP)								
F test	NS	NS	NS	NS	NS	NS	NS	NS
SE(m)±	1.20	0.06	1.41	1.38	5.93	0.34	0.14	1.18
CD at 5%	-	-	-	-	-	-	-	-

Effect of varieties

Significantly maximum plant spread (31.09 cm) and the earliest commencement of flowering (54.69 days) and 50 per cent flowering (90.73 days) were registered with the aster variety Arka Archana and it was found statistically at par with the varieties Arka Adhya (30.03 cm, 56.79 days and 93.21 days, respectively), whereas, stem diameter was found maximum (1.32 cm) with Arka Adhya. However, significantly the highest flower yield $plant^{-1}$ (110.92 g), weight of flower (2.66 g) and blooming period (38.35 days) were noticed with the variety Arka Kamini which was found at par with Arka Archana in respect to weight of flower (2.48 g) and Arka Shashank in respect to vase life of flower (36.40 days). The significant differences in the plant growth, yield and quality of China aster varieties might be attributed due to the differential genetical makeup and varied growth rate among the varieties of China aster. Similar variations in plant growth, yield and quality attributes among the varieties in China aster were also observed by Shailaja and Panchbhai (2014) [5] and Shailaja *et al.* (2014) [6].

Effect of pinching

Significantly the earliest commencement of flowering (48.55 days) and 50 per cent flowering (84.21 days), highest flower diameter (6.07 cm) and weight of flower (3.28 g) were noted with no pinching treatment, whereas, significantly maximum plant spread (33.52 cm), stem diameter (1.43 cm), flower yield $plant^{-1}$ (112.18 g) and blooming period (41.23 days) were recorded with the treatment of double pinching. An increase in the plant spread and stem diameter in pinched plant was mainly due to the removal of apical meristematic tissue which inhibited the apical dominance and diverted plant metabolites from vertical growth to horizontal growth due to which branches $plant^{-1}$ might have increased and as a result plant spread and stem diameter also increased. The flower yield $plant^{-1}$was increased as a result of double pinching which might be due to the reason that extra energy diverted into the production of more reproductive parts instead of vegetative parts. Similar decrease in vertical growth and increase in horizontal growth with increase in flower yield and quality traits due to pinching was reported by Maharnor *et al.* (2011) [2] and Meena *et al.* (2015) [3] in African marigold. The blooming period of aster was enhanced due to pinching treatment. This might be due to the fact that by removing apical position, the plant enters vegetative phase and new shoots took longer time to be physiologically mature and thus, resulted in extended flowering span due to pinching. This result was in line with findings of Jindal *et al.* (2018) [1] in chrysanthemum.

Interaction effect

An interaction effect of China aster varieties and pinching treatments on various growth, flower yield and quality parameters studied was found to be non-significant. Similar non-significant effect of China aster varieties and pinching treatments on various growth, yield and quality parameters was found by Shailaja and Panchbhai (2014) [5] and Shailaja *et al.* (2014) [6].

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