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Effect of Plant Growth Retardants on Plant Growth and Flower Yield on Pinched Seedling Plants of African Marigold (*Tagetes erecta* L.) cv Pusa Narangi Gainda

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Abstract The present experiment was conducted to determine the effect of different doses of plant growth retardants viz., CCC, Ethephon and MH on growth and flower yield of African marigold (*Tagetes erecta* L.) during the *rabi* season 2014. Ten treatments were included in the trial with randomized block design. The results reveal that CCC, Ethephon and MH treatments had significant response on growth, floral and yield characters. The different concentrations of CCC i.e. 1000 ppm, 1100 ppm and 1200 were produce minimum plant height (49.24 cm), first day to bud appearance (43.35 day) and maximum in number of branches per plant (17.86), number of leaves per plant (679.45), stalk length of flower (8.74 cm), flower diameter (6.77 cm), number of flowers per plant (38.53), weight of flowers (12.39 g) and flower yield per hectare (24.38 t/ha). The treatment T_3 with CCC (1100 ppm) was the best treatment for good vegetative as well as reproductive growth.

Keywords Marigold, CCC, Ethephon, MH, Pinching.

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Introduction

African marigold (*Tagetes erecta* L.) is a widely cultivated as bedding plants, loose flower, perfume, natural colure, pigments, carotinoids, insect and nematodes repellents, nutrient supplement for poultry feed. Marigold plant habit of profuse flowering, short duration to produce marketable flowers, wide spectrum of attractive colures, shape and size and good keeping quality, attracted the attention producers and traders mostly. Marigold occupies anthelmintic, analgesic, anti-inflammatory, aromatic, bronchodilatory, digestive, diuretic, emmenagogue, sedative and stoma tic properties. African Marigolds are tall, erect-growing plants up to three feet in height. The flowers are globe-shaped and lager. Flowers may measure up to 5 inches across. African marigold is very good bedding plants. These flowers are yellow to orange and do not include red colored marigold. In case of pinching, the tip of shoots is removed early, emergence of side branches starts earlier and more numbr of flowers of good quality and uniform size are produced. In recent year, a number of plant growth retardants have been used in the field of agriculture for including more acceptable plant characteristics like compact growth, dwarfness, increase number of healthy branches and more number of quality flowers which are the desired traits in modern floriculture industry [1]. The objective of study was to enhance production of loose marigold flowers by without pinching in field and applying different concentration of growth retardants approaches.

Materials and Methods

A field experiment entitled "Effect of plant growth retardants on plant growth and flower yield on pinched seedling plants of African marigold (*Tagetes erecta* L.) cv Pusa Narangi Gainda" was carried out at Horticultural Experimental Field, Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Deemed-to-be University, during *rabi* season of 2013-2014. Tentreatments were included in the trial viz., T_1 (Control), T_2 CCC (1000 ppm), T_3 CCC (1100 ppm), T_4 CCC (1200 ppm), T_5 Ethephon (200 ppm), T_6 Ethephon (400 ppm), T_7 Ethephon (600 ppm), T_8 MH (200 ppm), T_9 MH (300 ppm) and T_{10} MH (400 ppm) were tested in three replication. Seeds of African marigold cultivar 'Pusa Narangi Gainda' were sown on 15th September, 2013 to raise the nursery bed in size (1.0 × 2.6 m). The seeds are sown by double spacing in nursery. Standard cultural operations like irrigation (depending on soil moisture and climatic condition), weeding (15 days interval), fertigation (1% urea on 10 days interval after irrigation) and pinching tip of seedling (30 days after seed sowing) were followed in nursery. After pinching the seedling are provide a light irrigation. When the pinched seedlings were survived with two leaf stage the seedling was drenching with fungicide and again after 10 days with insecticide. Pinched seedlings of marigold were transplanted 40 × 40 cm plant to plant spacing in the main field when they had 2-3 true leaf stage (55 days) on 9th November, 2013. Experimental plot was ploughed one month before planting of seedling. There after three harrowing were given in order to bring the land to a fine tilth, On 1st November, 2013 the experimental area was laid out in flat beds of size (1.2 × 1.2 m) well decomposed farmyard manure was applied two days prior to the transplanting of the seedling at the rate of the 5 kg/m^2 and mixed well in the soil. Irrigation was given to the plots two days prior to the transplanting of the seedlings. So that seedlings could be transplanted in well moist soil. During the transplanting soil was pressed firmly around the seedlings so that seedlings will not be disturbed by irrigation water immediately after transplanting. The recommended dose of fertilizers with half dose of nitrogen and complete dose of phosphorus and potash were applied at transplanting, while the other half dose of nitrogen was applied 30 days after transplanting. The growth retardants were foliar spray after 15 days after transplanting and again two times on 15 days interval. Gap filling was done when ever required during the first two weeks after transplanting. The plots were kept free throughout the growth period by weeding at regular intervals. First weeding was done after 30 days of planting and later on as when required. Immediately after transplanting a light irrigation was done and later irrigation was done depending upon the moisture requirement of the soil.

Results and Discussion

Influence of different concentration of plant growth retardants viz. Cycoce, I Ethephon and Maliec hydrazide on growth and flower yield characters were recorded as affected by different plant growth retardants are furnished in (Table 1) .The maximum plant height (87.20 cm) was observed in control (T_1) followed by treatment (T_{10}) with MH (400 ppm) (68.13 cm). The plant height was found to be minimum (49.24 cm) in the treatment (T_4) with CCC (1200 ppm). It is evident from above result that the plant height was clearly affected with plant growth retardants. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000, 1100 and 1200 showed lowest plant height, followed by Ethephon and Maliec hydrazide. Inhibition in plant height with increased concentration of Cycocel was recorded eariler [2, 3].

The maximum number of branches per plant (17.86) was observed in the treatment (T_3) with CCC (1100 ppm) followed by treatment (T_4) with CCC (1200 ppm) (16.57). The number of branches per plant was found to be minimum (9.12) in the treatment(T_1) with control. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000, 1100 and 1200 showed maximum number of branches per plant, followed by Ethephon and Maliec hydrazide. These results are in conformity with earlier report [4—7] in marigold experiments.

The maximum number of leaves per plant (679.45) was observed in the treatment (T_3) with CCC (1100 ppm) followed by treatment (T_2) with CCC @ 1000 ppm (671.59). The number of leaves per plant was found to be minimum (440.51) in the treatment (T_1) with control. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000,1100 and 1200 showed maxi-

Table 1. Effect of plant growth retardants on plant growth and flower yield on pinched seedling plants of African marigold (*Tagetes erecta* L.) cv Pusa Narangi Gainda.

		Growth and floral characters on pinched seedling plants of African marigold (Mean)								
	Treatments	Plant height (cm)	Number of branches per plant	Number of leaves per plant	Days required for first flower bud emergence	Stalk length (cm)	Diameter of flower (cm)	Number of flowers/ plant	Weight of flowers (g)	Flower yield t/hectare
T_1	Control	87.20	9.12	440.51	61.33	9.25	4.85	18.33	8.23	12.84
T_2	CCC (1000 ppm)	52.83	14.60	671.59	47.17	8.25	6.43	28.67	11.45	22.67
T_3	CCC (1100 ppm)	51.53	17.86	679.45	43.35	8.54	6.77	38.53	12.39	24.38
T_4	CCC (1200 ppm)	49.24	16.57	666.05	45.27	8.74	6.51	34.33	11.60	22.07
T_5	Ethephon (200 ppm)	58.77	14.11	552.12	55.63	5.38	5.54	21.67	10.80	17.16
T_6	Ethephon (400 ppm)	60.74	13.12	557.25	52.28	5.85	5.26	22.33	11.06	18.21
T_7	Ethephon (600 ppm)	63.03	11.43	563.05	53.45	6.13	5.05	23.27	11.29	19.46
T_8	MH (200 ppm)	65.46	10.32	582.01	51.99	6.87	6.02	24.55	11.38	21.66
T_9	MH (300 ppm)	66.90	10.95	588.11	48.86	7.14	6.15	26.67	11.90	22.99
T_{10}	MH (400 ppm)	68.13	11.43	594.82	49.48	7.48	6.27	25.27	11.54	22.41
	F - test	S	S	S	S	S	S	S	S	S
	SEd (±)	0.214	0.019	1.709	0.746	0.345	0.220	0.272	0.252	0.207
	CD (p = 0.05)	0.042	0.040	3.566	1.556	0.721	0.460	0.569	0.527	0.432

mum number of leaves per plant, followed by Maliec hydrazide and Ethephon. Maximum number of leaves per plant was recorded in earlier similar treatments [8, 9].

The number of days for bud initiation was found to be minimum (43.35) was observed in the treatment (T_3) with CCC (1100 ppm) followed by treatment (T_4) with CCC @ 1200 ppm (45.27). The number of days for bud initiation was found to be maximum (61.12) in the treatment (T_1) with control. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000, 1100 and 1200 showed minimum number of days for bud initiation, followed by Maliec hydrazide and Ethephon. The possible reason highest number of days taken for bud initiation by the treatment (T_1) with control may be due to the promotion of more vegetative growth by no growth retardant and results in the delaying in bud initiation. Findings are in conformity with the earlier findings [10—12].

Stalk length of flower was recorded that the treatment (T_1) has maximum flower stalk length (9.25 cm) followed by treatment (T_4) with CCC @ 1200 ppm (8.74 cm) and (T_3) CCC @ 1100 ppm (8.54 cm).The stalk length of flower was found to be minimum (5.38 cm) in treatment (T_5) with Ethephon (200 ppm). The treatments showed the above result that the average flower stalk length of the flower was clearly affected with growth retardant with Cycocel (CCC) Maliec hydrazide and Ethephon. The treatment (T_5, T_6 and T_7) with Ethephon @ 200, 400 and 600 showed minimum flower stalk length followed by Maliec hydrazide and Cycocel. Similar observations were recorded earlier [13, 14].

The maximum diameter of flower (6.77 cm) was observed in the treatment (T_3) with CCC (1100 ppm) followed by treatment (T_4) with CCC @ 1200 ppm (6.51 cm). The diameter of flower was found to be minimum (4.85 cm) in the treatment (T_1) with control. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000, 1100 and 1200 showed maximum diameter of flower followed by Maliec hydrazide and Ethephon. Sehrawat et al. [15] found that the highest concentration of Cycocel by producing the maximum diameter of flower in marigold.

The maximum number of flowers per plant (38.53) was observed in the treatment (T_3) with CCC (1100 ppm) followed by treatment (T_4) with CCC @ 1200 ppm (34.33). The diameter of flower was found to be minimum (18.33) in the treatment (T_1) with control. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000, 1100 and 1200 showed maximum number of flow-

ers per plant followed by Ethephon and Maliec hydrazide. Similar results were also reported earlier [16] that the highest concentration of Cycocel by producing maximum number of flowers per plant in marigold.

The maximum weight of flower (12.39g) was observed in the treatment (T_3) with CCC (1100 ppm) followed by treatment (T_9) with MH @ 300 ppm (11.90g). The weight of flower was found to be minimum (8.23g) in the treatment (T_1) with control. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000, 1100 and 1200 showed maximum weight of flower followed by Maliec hydrazide and Ethephon. Similar results were also reported earlier [17].

The maximum flower yield (24.38 t/h) was observed in the treatment (T_3) with CCC (1100 ppm) followed by treatment (T_9) with MH @ 300 ppm (22.99 t/h). The flower yield was found to be minimum (12.84 t/h) in the treatment (T_1) with control. The treatment (T_2, T_3 and T_4) with Cycocel (CCC) @ 1000, 1100 and 1200 showed maximum flower yield followed by Maliec hydrazide and Ethephon. Observations were at par with the observations of [18].On the basis of present investigation, it is concluded that treatment (T_3) with CCC (1100 ppm) was found the best treatment in terms of growth and flower yield in African marigold cv Pusa Narangi Gainda in *rabi* season.

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