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Effect of Growth Regulators and Pinching on Vegetative, Flowering and Flower Yield Parameters in African Marigold cv Culcatta Orange

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ABSTRACT

Investigation on "Effect of pinching and plant growth regulators on growth, flowering, yield and quality of African marigold (Tagetes erecta L.) cv. Calcutta Orange" was carried out during October, 2015 to February, 2016. The field experiments were carried out to find the effect of two levels of pinching i.e., no pinching and pinching and different plant growth regulators viz., GA_3 at 200 ppm, NAA at 60 ppm, CCC at 1000 ppm and TIBA at 1000 ppm. The vegetative, flowering and flower yield parameters maximum and significant results with pinched plants compared to unpinched plants. However, stem girth initially showed non-significant results, but later at 60 and 90 DAT showed significant results. Among the growth regulators, GA_3 spray recorded significantly higher plant height, stem girth, plant spread, flowering and flower yield followed by NAA at all stages of crop growth period. The treatment, CCC spray produced significantly more number of primary and secondary branches followed by GA_3. The interactions between pinching and growth regulators among the treatments did not exhibit significant results for all growth, flower yield and its components and flower quality parameters. Among the growth regulators, benefit cost ratio was found to be maximum in GA_3 followed by NAA and CCC and minimum benefit cost ratio was found in TIBA. Among pinching, pinching had highest benefit cost ratio compared to unpinched plants, among the interactions, benefit cost ratio was found to be maximum and positive in G_1P_1, G_2P_1 and minimum for control G_4P_0. The experiment can be concluded that pinching of apical bud and foliar spray of GA_3 at 200 ppm independently gave higher yield, better quality flowers with maximum benefit in African marigold cv. Calcutta Orange.

Key words: *GA_3-Gibberellic acid, NAA- Alpha - Naphthalene acetic acid, CCC-Cycocel or 2-chloro ethyl trimethyl ammonium chloride and TIBA-2, 3, 5 triiodobenzoic acid.*

INTRODUCTION

African marigold (*Tagetes erecta* L.) is a widely cultivated as bedding plants, loose flower, perfume, natural colure, pigments, carotenoids, insect and nematodes repellents, nutrient supplement for poultry feed.

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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, emme- nagogue, sedative and stoma tic properties. In case of pinching, the terminal portion of shoots is removed early, emergence of side branches starts earlier and more number of flowers of good quality and uniform size are produced. In recent year, a number of plant growth regulators have been used in the field of agriculture for including more acceptable plant characteristics like compact growth, dwarf- ness, increase number of healthy branches and more number of quality flowers[2] which are the desired traits in modern floriculture industry. Effect of pinching, both manual and chemically; using growth regulators was ascertained for improving the production of compact African marigold cv Calcutta orange Although a lot of information is available to maximum flowering and yield in commercially important plants yet comparative studies involving the use of growth regulators and pinching scarce. Therefore, an experiment was carried out to compare the effects of growth regulators and manual pinching on African marigold cv Calcutta orange. The objective of study was to enhance production of best quality loose marigold flowers by applying different pinching and growth regulator approaches.

MATERIAL AND METHODS

The present experiment was conducted at the in the experimental field of Department of Floriculture and Landscape Architecture, University of Horticultural Sciences, Bagalkot, during the year 2015-16. The field experiments were carried out to find the effect of two levels of pinching *i.e*., no pinching and pinching and different plant growth regulators *viz*., GA_3 at 200 ppm, NAA at 60 ppm, CCC at 1000 ppm and TIBA at 1000 ppm. The marigold cultivar Calcutta Orange seedlings used for the experiment were collected from C.S. Biradar nursery, Ghataprabha.

One month old, healthy, uniform seedlings were used for transplanting. Seedlings were planted at a spacing of 60 x 45 cm and light irrigation was given soon after transplanting. The operation of transplanting was carried out in the afternoon followed by a light irrigation to allow for proper establishment of seedlings. Well decomposed FYM @ 20 tonnes per hectare was applied at the time of land preparation. The recommended dose of fertilizer 225:60:60 kg NPK/ha[1].

RESULTS AND DISCUSSION

The parameters such as, number of primary and secondary branches per plant, leaf area, plant spread, flower bud initiation, flower initiation, days to 50 per cent flowering, duration of flowering, flower yield per plant, per plot and per hectare, weight of flower, flower diameter, shelf life of flower, total chlorophyll and xanthophyll content in leaves and flowers respectively showed maximum and significant results with pinched plants compared to unpinched plants. However, stem girth initially showed non-significant results, but later at 60 and 90 DAT showed significant results.

Among the growth regulators, GA_3 spray recorded significantly higher plant height, stem girth, plant spread followed by NAA at all stages of crop growth period as shown in the table 1. The treatment, CCC spray produced significantly more number of primary and secondary branches followed by GA_3. The plants sprayed with GA_3 took less days to flower initiation and 50 per cent flowering followed by NAA. While, delay in the plants to reach 50 per cent flowering was with TIBA spray as shown in the table 2. The same growth regulator, GA_3 took significantly maximum duration of flowering followed by NAA compared to control. GA_3 spray recorded significantly greater flower yield per plant, per plot and per hectare followed by NAA compared to control as shown in the table 3

and figure 1.. Similarly, the flower quality parameters like flower diameter, individual weight of the flower and shelf life were better in the plants sprayed with GA_3 whereas, the control plants had poor flower quality. The interactions between pinching and growth regulators among the treatments did not exhibit significant results for all growth, flower yield and its components and flower quality parameters.

Pinching of apical bud and foliar spray of GA_3 at 200 ppm (30 and 40 days after transplanting respectively) jointly or separately gave higher vegetative growth, flower yield coupled with better quality flowers followed by NAA at 60 ppm compared to TIBA at 1000 ppm and control. Increase in concentration of TIBA significantly reduced the plant height over pinching with water spray (G_0P_1). The plant growth retardants interact with gibberellins or indole acetic acid oxidase and lower diffusible auxins and thereby suppress the growth[3].

Pinching of apical bud and foliar spray of CCC at 1000 ppm (30 and 40 days after transplanting respectively) jointly or separately produced maximum number of primary and secondary branches followed by pinching and foliar spray of GA_3 at 200 ppm compared to control (G_0P_0).

The interactions between pinching and growth regulators did not exhibit significant results for all growth, flower yield and its components and flower quality parameters. This may be because of these treatments acted independently rather than synergistically. Similar results were also reported by Singh *et al*[4] and Tomar *et al*[5] in African marigold.

Practical application of the results

I. Pinching at 30 days after transplanting can be done for obtaining higher flower yield in African marigold cv. Calcutta Orange.

II. Spraying of GA_3 (200 ppm) or NAA (60 ppm) at 40 days after transplanting was found to be beneficial for obtaining higher flower yield and quality in African marigold cv. Calcutta Orange.

Table 1: Effect of plant growth regulators and pinching on plant height, no of branches, leaf area and stem girth of marigold cv. Calcutta Orange

Treatments	45 DAT	90 DAT	45 DAT	90 DAT	45 DAT	90 DAT	45 DAT	90 DAT
Growth regulator	**Plant height**		**No of branches**		**Leaf area**		**Stem girth**	
G_0	31.10	59.79	18.74	46.16	31.23	64.92	0.74	1.19
G_1	34.85	64.54	22.07	53.14	40.32	74.99	0.89	1.40
G_2	33.22	62.00	21.33	51.86	38.31	72.37	0.76	1.32
G_3	32.66	59.31	23.14	55.37	37.40	71.53	0.83	1.34
G_4	31.88	58.46	20.22	43.96	30.15	63.65	0.75	1.22
SE.m±	1.21	1.14	1.28	1.35	1.33	1.94	0.02	0.02
CD at 5 %	3.62	3.39	3.805	4.02	3.95	5.75	0.07	0.08
Pinching								
P_0	33.97	62.91	18.94	47.32	33.48	67.12	0.77	1.25
P_1	31.51	58.73	23.39	52.87	37.48	71.86	0.81	1.33
SE.m±	0.77	0.72	0.81	0.86	0.84	1.22	0.01	0.01
CD at 5 %	2.29	2.14	2.404	2.54	2.49	3.63	0.04	0.05
Interaction								
G_0P_0	34.21	64.22	16.69	42.78	30.20	64.01	0.71	1.10
G_0P_1	28.00	55.37	22.66	49.55	32.26	65.83	0.78	1.29
G_1P_0	36.21	67.87	19.74	50.20	38.58	71.44	0.88	1.38
G_1P_1	33.49	61.21	24.41	56.08	42.06	78.54	0.90	1.43
G_2P_0	33.71	63.23	19.22	49.33	35.24	70.80	0.75	1.30
G_2P_1	32.73	60.78	23.44	54.39	41.38	73.94	0.78	1.34
G_3P_0	32.9	60.00	20.69	53.35	34.23	69.32	0.81	1.32
G_3P_1	32.43	58.63	25.59	57.40	40.57	73.74	0.85	1.36
G_4P_0	32.83	59.25	18.38	40.97	29.15	60.05	0.74	1.18
G_4P_1	30.94	57.67	20.86	46.94	31.15	67.25	0.77	1.26
SE.m ±	1.72	1.61	1.82	1.92	1.88	2.74	0.03	0.04
CD at 5 %	5.12	4.80	5.382	5.69	5.59	8.13	0.11	0.12

DAT- Days after transplanting
P_0 – No Pinching P_1 – Pinching
G_0– Water spray
G_1 – GA_3 at 200 ppm
G_2 – NAA at 60 ppm
G_3 – CCC at 1000 ppm G_4 – TIBA at 1000 ppm

Table 2: Effect of plant growth regulator and pinching on flowering parameters of marigold cv. Calcutta Orange

Treatments	Flower bud initiation in days	Flower initiation in days	Days to 50% flowering	Duration of flowering
Growth regulators				
G_0	42.93	60.89	71.50	86.01
G_1	41.73	58.08	68.57	92.74**
G_2	42.97	60.15	69.62	90.94*
G_3	47.79	66.22	75.66	90.35
G_4	49.24	69.52	79.32	87.78
SE.m±	2.00	1.98	2.35	1.47
CD at 5 %	5.92	5.87	6.98	4.36
Pinching				
P_0	41.83	59.41	69.78	89.07
P_1	48.03	66.53	76.09	90.12
SE.m±	1.26	1.25	1.49	0.93
CD at 5 %	3.74	3.71	4.41	NS
Interaction				
G_0P_0	36.17	52.35	63.75	85.96
G_0P_1	49.70	69.43	79.25	86.06
G_1P_0	38.26	54.10	65.90	92.22
G_1P_1	45.20	62.07	71.25	93.26
G_2P_0	39.79	56.70	66.75	90.63
G_2P_1	46.15	63.61	72.50	91.6
G_3P_0	47.20	65.65	74.00	89.58
G_3P_1	48.39	66.79	77.33	91.13
G_4P_0	47.75	68.29	78.50	87.00
G_4P_1	50.73	70.75	80.15	88.56
SE.m±	2.82	2.80	3.32	2.08
CD at 5 %	8.38	8.31	9.87	6.16

DAT- Days after transplanting P_0 – No Pinching P_1 – Pinching
G_0– Water spray
G_1 – GA_3 at 200 ppm
G_2 – NAA at 60 ppm
G_3 – CCC at 1000 ppm G_4 – TIBA at 1000 ppm

Table 3: Effect of plant growth regulator and pinching on flower yield parameters of marigold cv. Calcutta Orange

Treatments	Flower yield per plant (in g)	Weight of flower (in g)	Flower diameter (in cm)	Shelf life of flower
Growth regulators				
G_0	175.33	4.70	5.35	5.03
G_1	415.00	8.30	6.75	7.10
G_2	359.83	7.35	6.40	6.54
G_3	250.00	6.90	6.30	6.03
G_4	195.50	5.48	5.80	5.76
SE.m±	21.00	0.27	0.16	0.40
CD at 5 %	62.40	0.80	0.50	1.19
Pinching				
P_0	250.00	6.25	5.96	5.89
P_1	308.26	6.84	6.28	6.28
SE.m±	13.28	0.17	0.10	0.25
CD at 5 %	39.47	0.51	0.31	0.75
Interaction				
G_0P_0	145.00	4.43	5.10	4.86
G_0P_1	205.66	4.98	5.60	5.20
G_1P_0	385.00	8.15	6.70	6.94
G_1P_1	445.00	8.45	6.80	7.27
G_2P_0	330.00	6.96	6.20	6.48
G_2P_1	389.66	7.75	6.60	6.60
G_3P_0	220.00	6.60	6.10	5.80
G_3P_1	280.00	7.20	6.50	6.26
G_4P_0	170.00	5.15	5.70	5.41
G_4P_1	221.00	5.82	5.90	6.11
SE.m±	29.70	0.38	0.23	0.57
CD at 5 %	88.26	1.14	0.70	1.69

DAT- Days after transplanting NS – Nonsignificant
P_0 – No Pinching P_1 – Pinching
G_0– Water spray G_1 – GA_3 at 200 ppm
G_2 – NAA at 60 ppm
G_3 – CCC at 1000 ppm G_4 – TIBA at 1000 ppm

Plate 1: African marigold cv. Calcutta Orange as influenced by pinching and plant growth regulators GA_3 at 200 pm (top: G_1P_1) and TIBA at 1000 ppm (bottom: G_4P_1) treatments

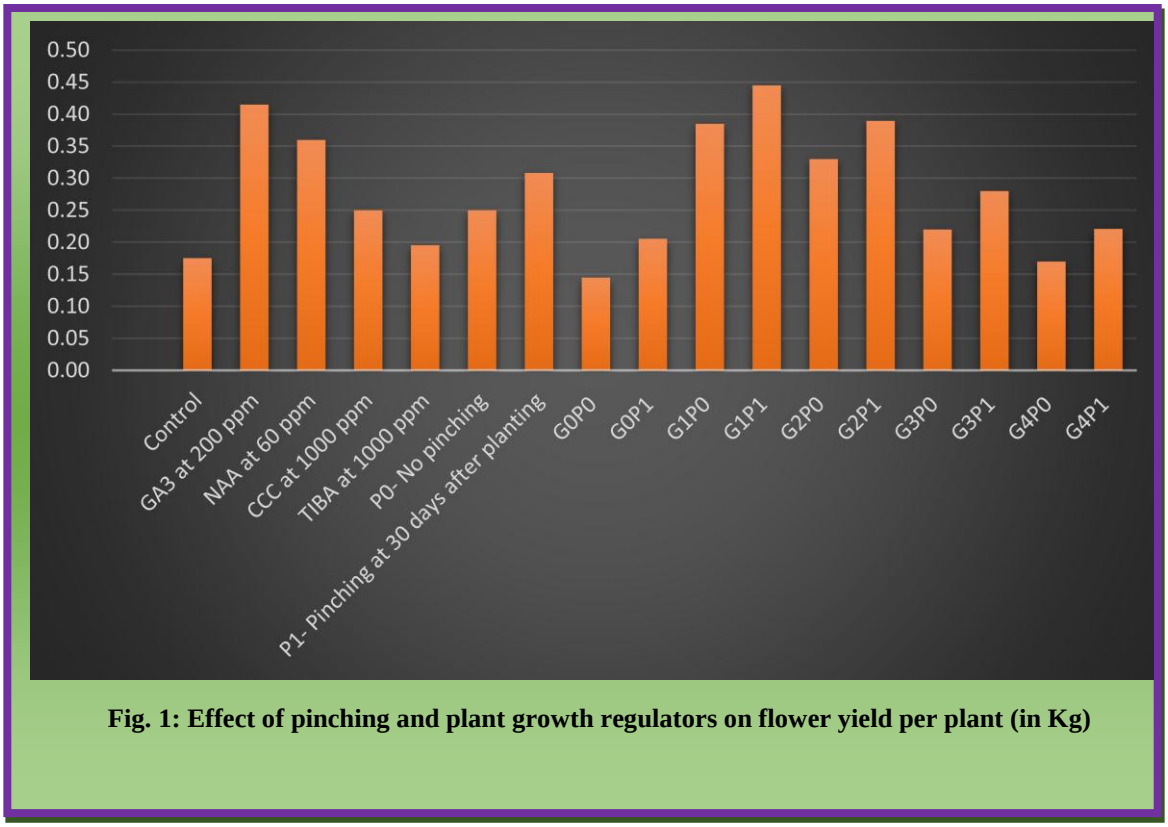

Fig. 1: Effect of pinching and plant growth regulators on flower yield per plant (in Kg)

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