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RESPONSE OF PLANT GROWTH REGULATORS ON THE GROWTH, FLOWERING AND YIELD ATTRIBUTES OF AFRICAN MARIGOLD *(TAGETES ERECTA. L)*

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ABSTRACT

Tagetes is a genus of annual, perennial or herbaceous plant in the family Asteraceae. Most of the species have pinnate green leaves. Blooms are naturally occurring in golden, orangeyellow, and white colour, often with maroon highlights. Floral heads are 4 to 6 cm in diameter, generally with both ray florets and disc florets. The present study was conducted at the post graduate research laboratory at Department of Horticulture, Faculty of Agriculture, Annamalai University to find out the "Effect of plant growth regulators on flowering and yield of African marigold (*Tagetes erecta* Linn)". The experiment was laid out in Randomized Block Design with three replications. There were ten treatments, viz., GA3 100 ppm, GA3 200 ppm and GA3 300 ppm, NAA 100 ppm, NAA 200 ppm, NAA 300 ppm, Ethrel 50 ppm, Ethrel 100 ppm, and Ethrel 150 ppm and control. Among the growth regulators tried, GA3 200 ppm as foliar application on 30 and 60 days after transplanting registered the highest values for plant characters like plant height (47.1 cm), number of branches (35.1), days taken to first flower bud appearance (39.3 days), days taken to flower opening (37.6 days), longevity of flower (11.17 days), stalk length (12.1 cm), diameter of flower (7.8 cm), number of flowers per plant (40.3), weight of the single flower (9.1 g), yield of flowers per plant (337 g) and flower yield per plot (11.1 kg). From the present study, it is recommended that spraying of GA3 200 ppm on 30 and 60 days after transplanting improved yield and quality of African marigold flowers.

Keywords: African marigold, GA3, NAA, Ethrel.

INTRODUCTION

African marigold (*Tagetes erecta* Linn.) is one of the commercially exploited ornamental crops, grown for loose flower, for pigment Xanthophyll, aromatic oil and poultry feed. It occupies special status due to its hardiness, easy culture, wider adaptability to different soil and climatic conditions of flower growers. Flowers are in golden, orange, yellow, and white color, often with maroon highlights. Floral heads are 4 to 6 cm in diameter, generally with both ray florets and disc florets. It is suitable for potted plant, bedding, edging, garland making and religious offering. Apart from its significance in ornamental horticulture, it has been valued for aromatic oil called as "*Tagetes* oil" which is used for preparation of higher-grade perfume and also as an insect repellent. Recently, dried flower petals of marigold are used as poultry feed in order to improve the colour of egg yolk as well as broilers skins. So, it is gaining industrial importance due to its huge potential in value addition, to fulfil the demand of farmers and industrialist, it is necessary to increase its production through improved production technologies.

Plant growth regulators have gained wide acceptance for optimizing the yield of plants by modifying growth, development and stress behaviour (Atam Prakash *et al*., 2001). Not all plant cells respond to hormones, but those cells that are programmed to respond at specific points in their growth cycle. Plants need these hormones at very specific times during plant growth and at specific locations. Synthetic plant growth regulators, such as auxins, cytokinins and various growth retardants when applied exogenously to the plant, influence various aspects of the plant development and bio synthesis of important components like growth and flowering (Atam Prakash *et al*., 2001). Plant growth regulators are found beneficial in enhancing the plant growth and flower production in marigold (Girwani *et al.,* 1990). Hence, the present investigation was conducted to evaluate the effect of growth regulators on growth, flowering and yield of African marigold plants.

MATERIALS AND METHODS

The present study was conducted at the post graduate research laboratory at Department of Horticulture, Faculty of Agriculture, Annamalai University. There was ten treatment imposed in Randomized Block Design which is replicated thrice. The nine treatments were T1: GA_3 100 ppm; T2: GA_3 200 ppm; T3: GA_3 300 ppm; T4: NAA 100 ppm; T5: NAA 200 ppm; T6: NAA 300 ppm; T7: Ethrel 100 ppm; T8: Ethrel 200 ppm; T9: Ethrel300 ppm; T1: GA_3 100 ppm. The marigold hybrid used for the study was Supreme Yellow. These plants have wider adaptability and flowers are compact and bright yellow in colour. The

Sl. No.	Treatments	Plant height (cm)	Number of branches	Days taken for flower bud appearance (days)	Days taken for first flower opening (days)	Length of flower stalk (cm)
T_1	GA_3 100 ppm	43.5	28.7	42.6	43.6	9.8
T_2	GA_3 200 ppm	47.1	35.1	36.6	37.6	12.1
T_3	GA_3 300 ppm	41.5	30.2	39.3	41.3	8.8
T_4	NAA 100 ppm	38.5	27.5	39.0	42.6	8.5
T_5	NAA 200 ppm	44.3	32.3	38.3	41.0	11.0
T_6	NAA 300 ppm	38.3	28.3	41.3	44.0	7.7
T_7	Ethrel 50 ppm	34.7	26.7	43.0	46.0	8.6
T_8	Ethrel 100 ppm	32.4	24.4	43.0	46.0	9.1
T_9	Ethrel 150 ppm	31.7	23.7	39.6	44.0	8.1
T_{10}	Control	36.6	23.6	46.6	49.5	7.1
S. Ed		0.49	0.32	0.32	0.25	0.36
CD (P= 0.05)		0.94	0.64	0.64	0.54	0.76

Table 1. Effect of PGR on growth and flowering attributes of African marigold

Sl. No.	Treatments	Flower longevity (days)	Fresh Weight of flower (g)	Diameter of flower (cm)	Number of flowers per plant	Flower yield per plant (g)	Flower yield per plot (kg)
T_1	GA_3 100 ppm	9.92	8.4	6.5	37.0	264.0	9.1
T_2	GA_3 200 ppm	11.17	9.1	7.8	40.3	337.0	11.1
T_3	GA_3 300 ppm	8.35	7.0	6.2	34.0	241.6	8.4
T_4	NAA 100 ppm	7.88	6.6	5.9	33.6	212.2	7.8
T_5	NAA 200 ppm	10.59	8.8	6.6	38.2	329.6	10.6
T_6	NAA 300 ppm	8.65	6.8	6.0	33.3	224.5	8.0
T_7	Ethrel 50 ppm	6.03	6.2	5.2	28.3	196.4	7.2
T_8	Ethrel 100 ppm	7.07	6.8	6.0	29.6	224.0	8.1
T_9	Ethrel 150 ppm	8.12	7.0	6.2	31.6	241.0	8.4
T_{10}	Control	5.03	5.4	4.8	25.0	160.3	6.4
S. Ed		0.45	0.26	0.24	1.35	2.27	0.26
CD (P= 0.05)		0.91	0.55	0.52	2.84	4.77	0.56

Table 2. Effect of PGR on the yield attributes of African marigold

soil was brought to fine tilth by incorporating FYM and recommended dose of fertilizers. Ridges and furrows were prepared at a spacing of 60 x 45 cm. Seedlings of 22 days old plants grown in nursery were transplanted to the main field. Plant Growth regulators were sprayed twice by using knapsack sprayer at 30th and 60 th days after transplanting to the main field. Observations were taken from five randomly selected plants from each replication from all the treatments at 15 days interval from the date of transplanting. Yield parameters were recorded once in a week at the time of harvesting.

RESULTS AND DISCUSSION

Plant height was significantly increased by successive increase in concentration of GA_3. The result reveals that the higher concentration of GA_3 is most effective in multiplication of cells as well as elongation of young tissues whereas the lower concentration was less desirable. The promotive effect of gibbrellins on growth may be by increasing the auxin level of tissue or enhancing the conversion of tryptophan to IAA, which cause cell division and cell elongation (Kuraishi and Muir, 1964). The number of main branches per plant increased with successive increase in GA_3 concentration. The maximum number of branches per plant was observed with treatment treated with 200 ppm GA_3. Hyper elongation of inter nodal length caused extension in plant height while increase in nodal count on main axis consequently increased number of dormant buds from where primary branches originates proportionately. The increase in the concentrations of GA_3, the diameter increases due to a reflection of the stimulation of cambium and its immediate cell progeny (Ko Jae Young *et al*., 1996). Days taken to first flower bud initiation, earliest bud initiation and flowering was observed with the application of GA_3 200 ppm. Plants treated with GA_3 @ 200 ppm found to form first bud after transplanting than the plants sprayed with normal water. Gibberellins reduces juvenile period and the termination of juvenile phase, the shoot apical meristem instead of producing leaves and branches start producing buds

(Dahiya and Rana, 2001).

In the present study, application of GA_3 200 ppm was found to promote the flowering characters in marigold like days taken to first flower appearance, longevity of flower, stalk length, diameter of flower and number of flowers per plant. The changes in floral parameters by the application of GA_3 can be explained in the light of the fact that GA_3 was quite effective in reducing juvenile period of plant because of its higher capacity of cell division and cell elongation which cause early maturity in plants (Lockhart, 1960). These parameters might also have increased due to increase in overall vegetative growth of the plant facilitating more photosynthetic area and metabolic activities resulting in more transport and utilization of the photosynthetic product resulting in higher flower yield. These results were also in consonances with the report of (Singh *et al.,* 1991) in African marigold and (Leena *et al.,* 1992) in gladiolus. Every increase in the concentrations of GA_3 enhanced early flowering and long duration of flowering but effect was vice-versa with Ethrel spraying.

Among all the treatments of GA_3 200 ppm was found most effective. (Singh *et al*., 1991) observed the similar result with the application of GA_3 African marigold cv. Sunset Gaint.Significantly maximum flower stalk length and maximum flower diameter were recorded with foliar spray of $GA_3$200 ppm. The increase in stalk length and flower diameter might be due to enhanced cell division and cell enlargement, promotion of protein synthesis coupled with higher dry matter of apical dominance (Dalai *et al*., 2009 and Tyagi and Kumar, 2006). The diameter of flower increased with successive increase in concentration of GA_3. The maximum and minimum diameter was recorded with 200 ppm GA_3 and 25 ppm GA_3 respectively and reverse was the case with Ethrel, it was maximum with 100 ppm Ethrel and minimum with 400 ppm Ethrel. Similar results have also been reported by (Dehale *et al*., 1993) in chrysanthemum.

The number of flowers per plant enhanced progressively with the increasing level of GA_3 and maximum number of flowers per plant was noted with the application of 200 ppm GA_3. Similar findings also obtained by Singh *et al.,* (1991) in African marigold, Tripathi *et al.,* (2003) in French marigold and Talukdar and Paswan (1994), Deotale *et al.,* (1994) and Dutta *et al.,* (1993) in chrysanthemum.Maximum number of flowers yield per plant was recorded with application of GA_3 at 200 ppm sprayed plants. These results are in accordance with the findings of Verma and Arha, (2004),Sunita *et al., (*2008), Amith kumar *et al., (*2012), Mithilesh kumar *et al., (*2014) and Suvalaxmi *et al.,* (2016) in African marigold and Devadanam *et al.,* (2007) in tuberose. Maximum yield of flower per plot was recorded at GA_3 200 ppm followed by NAA 200 ppm. Lower concentration of Ethrel (100 ppm and 200 ppm) increased flower yield per plant but higher concentration (300 ppm and 400 ppm), decreased flower yield per plant compared to control. Tripathi *et al*., 2003 suggested by the spraying of GA_3 (100, 200 and 400 ppm) on French marigold increased the flower yield and quality. Thus from the present study, it can be concluded that the foliar application of GA_3 200 ppm on 30 and 60 days after transplanting improved all the growth characters and yield characters in the hybrid supreme yellow of African marigold. This was followed by the foliar application of NAA 200 ppm.

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