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Effect of bio-regulators on vegetative growth of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda

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Abstract
The present investigation entitled "Effect of bio-regulators on vegetative growth of African Marigold (*Tagetes erecta* L.)" was carried out at Horticultural Research Centre (HRC) of Sardar Vallabhbhai Patel University of Agriculture and Technology Modipuram, Meerut, Uttar Pradesh during the year 2016-2017. The layout of experimental field was laid down in Randomized Block Design in which ten treatments along with 3 replications. The height of plant was recorded significantly maximum with application of GA_3 300 ppm (76.05 cm) which was at par with GA_3 200 ppm (75.24 cm), while minimum plant height was recorded with MH 400 ppm (56.07 cm). The application of Ethrel 400 ppm showed maximum number of branches (43.35) however, minimum numbers of branches were recorded in control (25.33). Maximum spread of the plant was recorded with GA_3 300 ppm (51.55 cm) however, minimum spread of plant was recorded in Ethrel 400 ppm (34.64 cm). It is recommended to farmers for commercial cultivation of African marigold (*Tagets erecta* L.) cv. Pusa Narangi Gainda.

Keywords: African marigold (*Tagets erecta* L.), vegetative growth, GA_3, MH and ethrel

Introduction
African Marigold (*Tagetes erecta* L.) is a native of Central and South America especially Mexico, and belongs to family Asteraceae is one of the most commonly grown loose flower and use extensively on religious and social functions in different forms. African Marigold flowers has attractive range of colours for a considerably prolonged period and the flowers can be kept remarkably well when cut. Sometimes, the whole plant can be used for decorations. They can be planted in beds for mass display, in mixed borders and can also be grown in pots. The generic name Tagetes is derived from, "Tages", the name of Estrucsch God, known for his beauty. French was the first to apply the name Tagetes, which was later adopted by others. Marigold were domesticated and used as an ornamental plant during pre-Columbian period before they were introduced in Europe and South Asia including India. Marigold is one of the oldest cultivated ornamental plants, being very popular in tropical and sub-tropical countries as a garden plant for beautification. Marigold is grown as landscape plants due to its variable height and various colours of flowers. It is highly suitable as a bedding plant, in herbaceous border and is also ideal for newly planted shrubbery to provide colour and fill spaces. French Marigold is ideal for rockeries, edging, hanging baskets and window boxes the use of plant growth substances has been found to be of great significance in the commercial cultivation of many ornamental crops. In our country, their use is very limited but in many Western countries they are creating many excitements in the field of agriculture. Gibberellic acid and cycocel are very important plant growth regulators and are widely used in agriculture and horticulture. GA_3 regulates the growth and involve in both cell division and cell enlargements (Haber and Leopold, 1960) [5]. The GA_3 has manifold effects, it affects the seed dormancy, seed germination, stem growth, root growth, flowering etc. (Rappaport and Singh, 1960) [12] Sachs *et al*. (1960) [13] reported that application of CCC retarded stem elongation by preventing cell division in the sub-apical meristem, usually without similarly affecting the apical meristem. Cycocel treatments have been found effective in the direction of earliness in flowering and fruiting. The application of Ethrel retards plant height, number of nodes and internodal length in marigold. It increased branching, delayed flowering, more number of leaves formed below the terminal flower, increased number of flower per plant. Ethrel is growth retardant check cell division in apical meristem only resulting in vascular synthesis below the apical meristem but the cambial and vascular cell continue to divide over a larger period and this result increase in thickness of stem (Sachs, 1961) [13].

Marigold responds to application of Maleic hydrazide in, axillary bud controller, growth retardant, increase number of branches, increase in weight and number of flower, more number of leaves and increase number of seed per flower in marigold. Pawar *et al.* (2011) [11]. Number of studies on the effects of foliar application of plant growth regulators has been carried out in India on different flower crops. If we can determine the optimum concentration of various growth regulating chemicals to cause beneficial effect on growth and flowering behavior of marigold. The commercial flower production will be greatly benefited. The present study was aimed at investigating the effect of bio-regulators on vegetative growth of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda.

Materials and Methods

The present investigation entitled "Effect of bio-regulators on vegetative growth of african marigold (*Tagets erecta* L.) cv. Pusa Narangi Gainda." Was undertaken during November - March in 2016-17 at Horticultural Research Centre (HRC), Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology Meerut, (UP). The layout of experimental field was laid down in Randomized Block Design in which ten treatments along with 3 replications. The treatments are T_1 (Control), T_2 (GA_3 100 ppm), T_3 (GA_3 200 ppm), T4 (GA_3 300 ppm), T_5 (MH 200 ppm.), T_6 (MH 300 ppm.), T_7 (MH 400 ppm), T_8 (Ethrel 200 ppm), T_9 (Ethrel 300 ppm), T_{10} (Ethrel 400 ppm). Seeds of Pusa Narangi Gainda were procured from GBPUAT, Pantnagar, (UK). The seeds of marigold were sown in well prepare raised nursery beds, mixture of 10 kg FYM and leaf mould per meter square was thoroughly mixed at the time of soil preparation. Seeds were sown in line and a thin layer of mixture of sand, soil and FYM was applied over the seed mulching was also employed to avoid the disturbance during watering and to conserve moisture. The sowing was done on 21 Oct 2017. The healthy seedlings were transplanted 25-30 days after seed sowing in the evening at a spacing 45×45 cm consisting of 20 plants per plot. After transplanting light irrigation was applied in the field. After establishment of seedlings uniform cultural operations were performed regularly in each plot to maintain the plants in proper health. The control measure for insect pest and disease were also taken from time to time. The observations on height of plant (cm), number of branches and spread of plant (cm). The data obtained were subjected to statistical analysis as outlined by Gomez and Gomez (1984) [4]. The weed count data were analyzed after subjecting the original data to ($\sqrt{x}$ + 0.5) transformation. The treatment means were compared by using the transformed values.

Results and Discussion

Vegetative growth characters

Height of plant: The plant height was recorded at 30, 60 and 90 days after transplanting in marigold cv. 'Pusa Narangi Gainda'. The result presented in Table-1 indicated that variation in height of the plant influenced significantly by the foliar application of bio-regulators. It is clear from the Table-1 that at initial stage i.e.30 days after transplanting there is no significant difference in height plant and at this stage the spraying bio-regulator was done. The height at 60 DAT maximum height of marigold plants were recorded with the application of GA_3 300 ppm (62.25cm.) which was found at par with GA_3 200 ppm (60.05), GA_3 100 ppm (55.43) and Ethrel 200 ppm (56.03). The minimum height was noted in Ethrel 400 ppm (41.22). The height of plant at 90 DAT was significantly maximum with application of GA_3 300 ppm (76.05 cm) which was found at par with GA_3 200 ppm (75.24 cm), Ethrel 200 ppm (71.49 cm) and GA_3 100 ppm (69.27 cm) while minimum plant height was obtained with MH 400 ppm (56.07 cm). The promotive effect of Gibberellins on growth may be due to increasing auxin level of tissues or enhance the conversion of Tryptophane to IAA which causes the cell-division and cell elongation. Mohariya *et al.* (2003) [9] studied the effect of GA_3 at 100-150 ppm on different varieties of chrysanthemum and observed that 150 ppm GA_3 increased plant height. Similar results to were also reported by Kumar *et al*. (2003) [6] in tuberose using GA_3 200 ppm in African marigold using GA_3 200 ppm Pal *et al.* (1986) [10] in calendula using Ethrel 100 ppm.

Number of branches: The data presented in showed that at initial stage ie.30 days after transplanting no significant difference was recorded for number of branches in marigold plant. At this stage the spraying of Bio-regulators was done. At 60 DAT, the number of branches in the marigold varied significantly with different treatments. Significantly maximum numbers of branches (11.83) were recorded in GA_3 100 ppm which was at par with Ethrel 300 ppm (11.47), however minimum branches were recorded in T_6 i.e. MH 300 ppm (6.64). The data on number of branches was presented in Table-1 indicate that the number of branches on 90 days after transplanting varied from 25.33-43.35 in marigold cv. 'Pusa Narangi Gainda'. The application of Ethrel 400 ppm showed maximum number of branches (43.35) which was found at par with Ethrel 300 ppm (37.39) and MH 400 ppm (36.03). Minimum number branches were recorded in control (25.33). The results are conformity with Sunitha *et al*. (2007) [15] reported the effect of foliar application of Ethrel (750 and 1000 ppm) on African marigold (*Tagetes erecta* L.) cv. Orange Double recorded increased number of main branches, Kumar *et al.* (2010) [7] reported regulation of growth and flowering in African marigold with Ethrel (100, 200, 300 and 400 ppm) treatment and reported increased number of main branches. Pawar *et al*. (2011) [11] reported increased branches in African marigold with MH 500 ppm. Singh (2004) [14] also reported that MH (200 and 400 ppm) increased number of branches per plant in African marigold.

Spread of plant: It is clear from the data presented in Table-1 that foliar application of bio-regulators affected significantly the spread of plant in marigold cv. 'Pusa Narangi Gainda'. Spread of the plant ranged from 34.64-51.55 cm at 90 DAT. Maximum spread of the plant was recorded with GA_3 300 ppm (51.55 cm) which was statistically at par with GA_3 200 ppm (49.39 cm), MH 200 ppm (46.97 cm), Ethrel 200 ppm (46.75 cm). Minimum spread of plant was recorded in Ethrel 400 ppm (34.64 cm). GA_3 resulted hyper elongation of internodal length caused extension in plant height while increase in total count of main axis consequently increased number of dormant buds from where primary branches originated which results optimum spread of plant Gautam *et al*. (2006) [3]. These findings are in close conformity with result of Mehar *et al.* (1990) [8] in chrysanthemum with GA_3 150 ppm**,** Dutta *et al*. (1998) [2] in chrysanthemum with GA_3 150 ppm.

Ta ble 1

Treatments	Plant Height (cm)			Number of Branches			Spread of plant (cm)
	30 Dat	60 Dat	90 Dat	30 Dat	60 Dat	90 Dat	90 Dat
T_1 Control	25.17	51.06	66.66	6.63	7.21	25.33	39.72
T_2 GA_3 100 ppm	24.69	55.43	69.27	6.73	11.83	32.9	46.38
T_3 GA_3 200 ppm	26.51	60.05	75.24	6.01	7.26	34.98	49.39
T_4 GA_3 300 ppm	26.18	62.25	76.05	6.71	9.88	35.08	51.55
T_5 MH 200 ppm	24.73	44.68	60.72	6.77	7.17	35.97	46.97
T_6 MH 300 ppm	24.99	42.85	57.45	6.98	6.64	35.35	37.46
T_7 MH 400 ppm	25.25	41.22	56.07	6.42	8.43	36.03	38.12
T_8 Ethrel 200 ppm	26.52	56.03	71.49	6.5	7.39	28.99	46.75
T_9 Ethrel 300 ppm	26.25	47.03	61.68	7.63	11.47	37.39	41.4
T_{10} Ethrel 400 ppm	26.04	42.15	56.09	5.87	8.05	43.35	34.64
SE(m)±	1.02	1.84	2.35	0.23	0.32	1.27	1.55
CD at 5%	2.95	5.32	6.8	0.68	0.91	3.68	4.48

Conclusion

On the basis of result obtained from the present investigation it can be concluded that foliar application of GA_3 300 ppm one month after transplanting was found most effective with respect to vegetative growth character, flowering behavior, and maximum flower yield and of African marigold (*Tagetes erecta* L.) and can be recommended to farmers for commercial cultivation of African marigold (*Tagets erecta* L.) cv. Pusa Narangi Gainda.

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