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Effect of chemical and bioregulators on growth, flowering and yield attributes of African marigold (*Tagetes erecta* L.)

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ABSTRACT

A field experiment was conducted to evaluate the effect of chemical regulators and bioregulators on growth, flowering and yield attributes of African marigold. The experiment was laid out in Randomized Block Design with three replication and 9 treatments. The treatment comprising of GA_3 at 50, 100 and 150 ppm, NAA at 50, 100 and 150 ppm, Vermiwash 3% and Panchagavya 3%. Among the 9 treatments of chemical regulators and bioregulators, the GA_3 100 ppm was the best for improving growth parameters *viz.*,plant height (135.6 cm), plant spread (55.3 cm) and number of branches plant^{-1} (18.3). Flowering parameters *viz.*, days taken to bud initiation (37.2), days to 50 % flowering (58.4) and flower diameter (6.9 cm). Yield parameters *viz.*, number of flowers plant^{-1} (59.9), single flower weight (6.94 g), weight of flowers plant^{-1} (351.1 g) and estimated flower yield ha^{-1} (29249.8 kg) of African marigold.

Key words: *Chemical Regulators, Bioregulators, Growth, Flowering and Yield*

Introduction

Marigold (*Tagetes erecta* L.) belongs to the family Asteraceae, this family includes 1,600 genera and 23,000 species (Hussain *et al.*, 2012). It is an important commercial loose flower crops in the global floriculture industry. It is very fashionable flowering plant due to easy to grow and wider adaptability in tropical and subtropical regions. Flowers are selling in the market as loose flower or for making garlands. High- quality of perfumes can also be made from its essential oils. It contains mucilage, saponins, flavanoid, xanthophylls, phenolics, essential oils and carotenoids. It is used for its antispasmodic and anti- inflammatory effects. It is used as a cure of skin diseases, gastric diseases, eye diseases and also for some burns (Osman *et al*., 2008; Ataei *et al*., 2013).

African marigold is a widely cultivated as loose flower, perfume, pigments, bedding plants, carotenoids, natural colours, insect and nutrient supplement, nematodes repellents for poultry feed. Marigold plant tendency of generous flowering, squat period to produce marketable flowers, wide range of gorgeous colours, good keeping quality, attracted the attention producers and traders mostly. Marigold occupies anthelmintic, analgesic, anti-inflam-

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matory, aromatic, digestive, diuretic, sedative and stomatic properties.

In recent year, a number of plant growth regulators have been used in the field of farming for including more adequate plant characteristics like increased height of the plants, increased plant spread, increased number of healthy branches and a greater number of quality flowers (Tyagi and Kumar, 2006; Rajagopalan, 1994 and Sanjay Kumar and Dixit 2007) which are the desired traits in modern floriculture industry. Plant growth regulators play a key role in overcoming the factors restraining the yield and quality for obtaining maximum benefit from flower production. It is realized that the exogenous application of plant growth regulators stimulates flowering (Sunitha, 2006). Growth regulators find their widespread use in ornamental crops for modifying their developmental process. Plant growth regulators play a significant role in flower invention, which in small amount promotes or inhibits or quantitatively modifies growth and development.

Gibberellins are the most widely used and proven growth substances in horticulture. Gibberellic acid proved to be very effective in manipulating growth and flowering in marigold (Kumar *et al*., 2014). Naphthalene Acetic Acid is reported to be a root promoter improves plant growth (Ullah *et al*, 2013). Bioregulators attributed to the enhanced vegetative growth simultaneously increase in flower and quality parameters. Panchagavya is a single organic input, which can act as growth promoter and immunity booster. It has significant role in providing resistance to pest and diseases and in increasing the yield and shelf life.

Materials and Methods

A field experiment was conducted at the Department of Horticulture, Adhiparasakthi Agricultural and Horticultural college to investigate the effect of chemical regulators and bioregulators on growth, flowering and yield attributes of African marigold (*Tagetes erecta* L.). Seed of African marigold were sown in nursery bed in lines and covered with paddy straw. After one month the healthy seedling are transplanted in the main field at spacing of 40 × 30 cm consisting of 25 plants per plot were transplanted in the evening. Irrigation was given after transplanting. Seven and ten days after transplanting, the gap filling was done twice with fresh seedling, in order to maintain 100 % plant population in each plot. Recommended dose of organic manure 10 kg per plot, NPK at 30:20:10 g per meter^2 and other inputs were applied at appropriate time. There were 9 treatments i.e., GA_3 at 50, 100 and 150 ppm, NAA at 50, 100 and 150 ppm, vermiwash 3% and panchagavya 3%. The plant growth regulators and bioregulators were applied to the African marigold plant as foliar spray after 40 days of transplanting, whereas control plants sprayed with distilled water. The plants were sprayed one time in their life span. Data were observed for days to plant height, plant spread (cm), number of branches plant^{-1}, days taken to bud initiation, days to 50 % flowering, flower diameter (cm), number of flowers plant^{-1}, single flower weight (g), weight of flowers plant^{-1} (g) and estimated flower yield ha^{-1} (kg) of African marigold. The data were subjected to analysis of variance (ANOVA), and the mean values were compared using Duncan's multiple range test at P=0.05 level.

Results and Discussion

The plant height was significantly prejudiced by chemical regulators and bioregulators spray. The maximum plant height (135.6 cm) was recorded with $GA_3$100 ppm spray. Control recorded lower plant height (85.13 cm). Plant spread maximum in GA_3 100 ppm (55.3 cm). Significantly higher number of branches was observed in (18.3 cm) compared to untreated plants (9.3 cm) at harvest (Tables 1). The increase in plant height, plant spread and number of branches per plant with application of GA_3 seems to be due to enhanced cell division and cell enlargement, promotion of protein synthesis coupled with higher dry matter accumulation in the plant. Stimulation of branching may be endorsed to the breakage of apical dominance (Sunitha *et al.*, 2007). Similar results were reported by Lal and Mishra (1986) in aster and marigold, Verma *et al.* (2004) in African marigold, Shivaprasad Shetty (1995) and Doddagoudar (2002) in China aster.

Among the chemical regulators and bioregulators spray, GA_3 100 ppm spray recorded days taken to bud initiation (37.2 days) and early days to 50 per cent flowering (58.4 days) (Tables 1). The number of flowers per plants was significantly influenced by growth regulators. The treatments significantly increased the number of flowers (59.9 /plant) compared to untreated plants (32.1/ plant). GA_3 reduces juvenile period and with the extinction of juvenile phase, the shoot apical meristem as a replacement

Table 1. Effect of chemical and bioregulators on growth, flowering and yield attributes of African marigold

Treatments		Vegetative parameters			Flowering and yield parameters						
		Plant height (cm)	Plant spread (cm)	No. of branches plant^{-1}	Days taken to bud initiation	Days to 50% flowering	Flower diameter (cm)	No. of flowers plant^{-1}	Single flower weight (g)	Weight of flowers plant^{-1} (g)	Estimated flower yield ha^{-1} (kg)
T_1	GA_3 50 ppm	109.8	51.5	15.1	47.9	64.8	6.6	56.1	6.83	339.3	28249.8
T_2	GA_3 100 ppm	135.6	55.3	18.3	37.2	58.4	6.9	59.9	6.94	351.1	29249.8
T_3	GA_3 150 ppm	123.4	53.8	15.5	39.3	65.5	6.7	52.4	6.53	323.8	26916.5
T_4	NAA 50 ppm	96.4	48.4	12.6	47.3	66.3	5.4	47.3	6.03	283.9	25381.3
T_5	NAA 100 ppm	101.3	46.3	11.5	49.8	65.9	5.3	49.3	6.12	306.5	25499.9
T_6	NAA 150 ppm	92.4	45.6	11.1	42.3	68.3	5.2	48.8	5.71	291.1	24249.6
T_7	Vermiwash 3%	100.9	49.1	12.8	47.3	69.4	5.2	43.2	5.55	274.1	22833.2
T_8	Panchagavya 3%	103.6	50.6	14.5	49.5	68.5	5.6	36.5	4.91	242.5	20166.5
T_9	Control	85.13	33.5	9.3	52.4	73.8	4.8	32.1	4.91	205.8	18083.2
	SEd	0.81	1.07	0.75	0.76	1.03	0.31	0.31	0.32	0.71	1.33
	CD @ 5%	1.54	2.31	1.61	1.63	2.18	0.68	0.61	0.70	1.62	2.91

for producing leaves and branches start producing buds. Similar finding was also reported by Dahiya and Rana (2001) in chrysanthemum. Early flowering in GA_3 spray may be due to increase in the endogenous gibberellin levels in the plants, as gibberellins are well known for inducing early flowering in several crop plants. Similar findings were reported by Singh *et al.* (1991) in African marigold. GA_3 at 100 ppm increased flower diameter (Tables 1). The explanation for enhancement of flower size might be due to increase in length of petals and pedicles and it was caused by depiction photosynthates to the flower as a consequence of strengthening of sink (Zieslin *et al.*, 1974). The results are in conformity with the studies of Reddy and Sulladmath (1983) in China aster and Abdul Khader (1994) in Chrysanthemum. Maximum number of flowers per plant was recorded with application of GA $_3$100 ppm (59.9). The enhancement in number of flowers per plant might be due to the production of large number of laterals at early stage of growth which had sufficient time to accumulate carbohydrate for proper flower bud differentiation due to enhanced reproductive efficiency and photosynthesis restrictive plant type. The results were in close conformity with Sunitha *et al*. (2007).

Weight of single flower was reported significantly maximum (6.94 g) with application of GA 100 ppm (Table 1). The maximum flower yield per plant (351.1g) recorded with foliar application of GA_3 100 ppm. Devadanam *et al*. (2007) observed maximum flower yield per hectare with GA_3 treatment in African marigold. The increase in yield and yield parameters with GA_3 spraying was due to better crop growth, a greater number of branches thus increased the number of flowers per plant and ultimately increased the seed yield. This can be attributed to translocation of source to sink. Similar results were reported by Shivaprasad Shetty (1995) and Doddagoudar (2002) in China aster. GA_3 application which brought metabolic change that affected both quality and quantity of the desired product. It also stimulates synthesis of hydrolylic enzymes which are secreted and acted on starchy endosperm in turn affecting physiology of seed germination and establishment of seedlings, vigour index and field emergence.

Conclusion

Experiment on effect of chemical regulators and bioregulators on growth, flowering and yield attributes of African Marigold revealed that, different vegetative characters like plant height, plant spread and numbers of branches per plant was maximum on the plant treated with GA_3 @ 100 ppm. Similarly different flowering and yield attributing characters like early flower bud initiation, days to 50 % flowering, flower diameter (cm), number of flowers per plant, single flower weight, weight of flowers per plant and estimated flower yield ha^{-1} (kg) was found to be maximum to GA_3 treated plant at a concentration of 100 ppm as compared to other treatments.

Conflict of Interest

The authors declair no conflict of interest.

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