Original Research Article

Effect of plant growth regulators and pinching on growth and yield of marigold (*Tagetes erecta* L.) under prayagraj agro climatic conditions

ABSTRACT

The experiment was conducted to determine the response of plant growth regulators and pinching on growth and flower yield of African marigold (*Tagetes erecta* L.) in the Department of Horticulture, Sam Higginbottom University of Agriculture Technology and Science, Prayagraj, (UP) during the rabi season 2021, 9 treatments were included in the trial viz; T_0 Control, T_1 GA_3 100 PPM + Pinching, T_2 GA_3 200 PPM + Pinching, T_3 Triacontanol 20 ppm + Pinching, T_4 Triacontanol 30 ppm + Pinching, T_5 Lihocin 2000 ppm + Pinching, T_6 Lihocin 4000 ppm + Pinching, T_7 NAA 10 ppm + pinching, T_8 NAA 20 ppm + pinching were tested in three replication. The experiment of design was randomized block design. The results revealed that GA_3 treatments and pinching had significant response on plant height, number of branches per plant, number of leaves per plant, plant spread per plant, days from bud initiation to harvest, days required for flower appearance from transplanting, number of flowers per plant, flower diameter, fresh weight of flower, dry weight of flower, flower yield per plant, flower yield per plot, and flower yield per hectare. The maximum plant height (76.17cm), Number of branches per plant (53.21), Plant spread (90.22cm), Number of leaves per plant (409.07), Flower yield per plant (402.13 g/plant), Flower yield per plot (1.57kg), and Flower yield per hectare (15.67) were produced by the treatment T_2 GA_3 200 PPM + Pinching. It was the best treatment for good vegetative as well as yield Production.

Key words: - Marigold, Plant growth regulators, Pinching, growth and yield

1. INTRODUCTION

Marigold (*Tagetes spp.*) is one of the most popular and commercial loose flower crop cultivated in India. Marigold belongs to family Asteraceae. The two most popularly cultivated species of marigold are African marigold (*Tagetes erecta* L.) and French marigold (*Tagetes patula* L.) which have their origin in Mexico and South Africa, respectively. Marigold gains its popularity due to its hardiness, easy culture, wide adaptability to different soil and climatic conditions and easy transportation which attracts the attention of flower growers. It is suitable for potted plant, bedding,

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The plant growth regulators (PGR, also known as plant bioregulators) are compounds used to alter the growth of a plant or a plant part. The use of plant growth regulators to increase the productivity of horticulture crops is not a new one. Several plant growth regulators are used in different kinds of horticulture crops to increase the quality and quantity of produce. Gibberellic acid (GA_3) is an important PGR used for the regulating growth and yield in various horticultural crops (**Taiz and Zieger, 2002**). GA_3 regulate the plant growth through both cell division and cell enlargement. Use of GA_3 is a very crucial for increasing vegetative growth and simultaneously the yield of flower crops. The plant growth regulator triacontanol (TRIA) has a great role in enhancing growth, yield, photosynthesis, nitrogen fixation, enzymatic activities and level of free amino acids, reducing sugars and soluble proteins. TRIA application increases plant growth, the number of inflorescences and the quality of flower. NAA is another important PGR, which stimulate cell division, cell enlargement and cell elongation in apical region of plant. It increases osmotic pressure and permeability of cytoplasm to water and nutrients and decrease in cell wall pressure increase in cell wall permeability (**Pandey and Sinha, 1986**).

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Pinching and growth regulators spray can play an important role in the improvement of flowering and yield of marigold. In most of the flower crops, the flowering and yield is mainly dependent on number of flower bearing branches which can be manipulated by checking vertical growth of plants and encouraging side shoots by means of apical bud pinching. But, studies on influence of pinching of apical bud in African marigold and its effect on flowering and yield are meagre. Growth regulators are used to overcome the factors limiting the growth and yield to harness maximum benefit from flower production.

2. MATERIALS AND METHODS

The experiment was carried out at the department of research field, department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj(2021-22) which is situated in the agro climatic zone (sub-tropical belt) of Uttar Pradesh. Prayagraj is located in the south-east part of Uttar Pradesh India. Prayagraj falls under agro-climate zone IV which is named as “middle Gangetic plains” the site of experiment is located at 98 meters from sea level at 25.57º N latitude 81.51º E longitude has a typical subtropical climate with extremes of summer and winter. The maximum temperature of the location reaches up to 46ºc - 48ºc and seldom falls down as low as 4ºc-5ºcC ~~during winter the average rainfall in this area is around~~ during winter season especially in the month of December and January the average rainfall in this area is around 1027 mm annually with maximum concentration during July to September with few showers and drizzles in winter also.

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The experiment was laid out in Randomized Block Design (RBD) with three replications and nine treatments: T_0 Control, T_1 GA_3 100 PPM + Pinching, T_2 GA_3 200 PPM + Pinching, T_3 Triacontanol 20 ppm + Pinching, T_4 Triacontanol 30 ppm + Pinching, T_5 Lihocin 2000 ppm + Pinching, T_6 Lihocin 4000 ppm + Pinching, T_7 NAA 10 ppm + pinching, T_8 NAA 20 ppm + pinching in net plot area of 1m × 1m whereas Marigold seeds were sown in portrays filled with sterilised cocopeat and well decomposed fine compost in october, 2021, after 30,60,90 DAT the readings were recorded. The results and data were subjected to statistical analysis separately by using analysis of variance technique (ANOVA). The difference among treatments means was compared by using least significant difference test at 5% probability levels.

RESULT AND DISCUSSION

Growth Parameters

The growth parameters in were measured in terms of plant height (cm), Plant spread, Number of branches, Number of leaves are shown in table 1. At 90 DAT, maximum plant height (76.17 cm) was recorded with application of (GA_3 @ 200 ppm + Pinching), followed by (GA_3 @ 100 ppm + Pinching) with (75.14 cm) and lowest plant height (53.07 cm) was recorded in (Lihocin 4000 ppm + Pinching). The significant increase in the height with GA_3, which may be attributed to the action of gibberellins that promotes vegetative growth by way of cell division and cell elongation and this may have resulted in the increase of plant height. GA_3 helps in increasing the photosynthesis activity in plants. This might have increased osmotic uptake of water and nutrients, by maintaining constant swelling force against the softening of cell walls. These results are nearby with the findings of **Sunitha (2007),**

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Naidu (2011), Dobaria (2012), Yadav (2013), Palei (2016), Markam (2017), Kumar (2017).

Maximum plant spread (E-W) at 90 DAT was recorded with application of (GA_3 @ 200 ppm + Pinching) (90.22 cm) followed by (GA_3 @ 100 ppm + Pinching) with (89.13 cm) and lowest (38.49 cm) was recorded in (Lihocin 4000 ppm + Pinching). Maximum plant spread (N-S) was recorded with application of (GA_3 @ 200 ppm + Pinching) (90.12 cm) followed by (GA_3 @ 100 ppm + Pinching) with (89.07 cm) and lowest (38.47 cm) was recorded in (Lihocin 4000 ppm + Pinching). Among the various concentrations of GA_3 the maximum average plant spread was observed at 200 ppm. It reveals that 200 ppm was the optimum dose for maximum average plant spread. GA_3 at optimum dose (200 ppm) might have enhanced the metabolic activities of the plant and influences the uptake of water and nutrients. Therefore, the plant spread has recorded increased magnitude. Similar results were recorded by **Pandya (2000), Naidu (2011) and Dobaria (2012).**

The maximum number of branches per plant was observed in (GA_3 @ 200 ppm + Pinching) (53.21) followed by (GA_3 @ 100 ppm + Pinching) with (52.98) and lowest (39.91) was recorded in (Lihocin 4000 ppm + Pinching). The variation of number of branches per plant might be due to the use of different compositions of different plant growth regulators and pinching. However, the different growth regulators used in experiment showed notable differences. GA_3 significantly showed highest average number of branches with 200 ppm spray. Followed by maximum average branches was observed by GA_3 100 ppm. The results are in close conformity with the findings of **Pandya (2000), Patidar (2003), Dobaria (2012), Yadav (2013), Palei *et al.*, (2016)** in marigold**.**

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The maximum number of leaves at 90 DAT was recorded with application (GA_3 @ 200 ppm + Pinching) (409.07) followed by (GA_3 @ 100 ppm + Pinching) with (407.13) and lowest (274.53) was recorded in (Lihocin 4000 ppm + Pinching). The leaves are the prime important functional units for photosynthesis, which greatly influence the growth and flower yield of crop. The variation in number of leaves per plant in different treatments may be due to effect of various concentrations of different plant growth regulators. As mentioned earlier in the result that different growth regulators have significantly affected the number of branches per plant, there with all the leaves per plant were also significantly increased in GA_3, the results were close to observation of **Patidar (2003), Sunitha (2007), Naidu (2011), Dobaria (2012), Sherpa (2013), Palei *et al.*, (2016), Kumar (2017)** in marigold**.**

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Table 1. Effect of plant growth regulators and pinching on growth attributes of Marigold.

Treatments	Plant height (cm)	Plant spread (cm)		Number of branches	Number of leaves
		(E-W)	(N-S)		
Control	59.95	70.44	70.28	44.40	370.80
GA_3 100 ppm + Pinching	75.14	89.13	89.07	52.98	407.13
GA_3 200 ppm + Pinching	76.17	90.22	90.12	53.21	409.07
TRIA 20 ppm + Pinching	71.89	85.21	85.17	52.13	328.47

TRIA 30 ppm + Pinching	72.02	88.59	88.52	52.83	330.07
Lihocin 2000 ppm + Pinching	55.06	41.88	41.84	40.03	277.93
Lihocin 4000 ppm + Pinching	53.07	38.49	38.47	39.91	274.53
NAA 10 ppm +Pinching	66.16	78.38	78.32	44.66	391.13
NAA 20 ppm +Pinching	67.54	81.00	80.87	44.79	393.27
F- test	S	S	S	S	S
SEm (±)	0.73	2.34	2.30	0.24	6.06
CD (5%)	2.18	7.02	6.89	0.72	18.17

Yield parameters

The observation regarding yield attributes *viz.*, Number of flower per plant, Flower yield per plant (g/plant), Flower yield per plot (kg/plot), Flower yield per hectare (t/ha)are shown in table 2. The maximum average number of flowers per plant were recorded with application GA_3 @ 200 ppm + Pinching (41.12) followed by GA_3 @ 100 ppm + Pinching (40.80) and lowest was recorded in Lihocin 4000 ppm + Pinching (22.20). The higher number of flowers is mainly due to production of more number of branches with good number of developed flowers on the branches. The flower yield per plant might be dependent on individual flower weight and number of flowers per plant leading to variation in flower yield among the different PGR treatments and pinching. Similar results in flower yield were observed by **Patidar (2003), Sunitha (2007), Naidu (2011), Kumar *et al.*, (2012), Dobaria (2012), Yadav (2013), Kumar (2017) with GA_3 treatment. Markam, (2017).**

Maximum average yield per plant was recorded at 90 DAT with application of GA_3 @ 200 ppm + Pinching (402.13 g/plant) followed by GA_3 @ 100 ppm + Pinching (397.07 g/plant) and minimum flower yield per plant was recorded in Lihocin @ 4000 ppm + Pinching (316.50 g/plant). The increase in yield might be due to direct growth regulating action of GA_3. The presence of GA_3 might have increased the growth promoting enzymes thereby manufacturing more nucleic acid, etc. in the plants. The findings were in accordance with the results of **Patel Naidu (2011), Kumar *et al.*,**

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(2012), Dobaria (2012), Palei *et al.*, (2016), Wadgave (2016), Markam, (2017) and Kumar (2017).

Maximum average yield per plot was recorded at 90 DAT with application of GA_3 @ 200 ppm + Pinching (1.57 kg/plot) followed by GA_3 @ 100 ppm + Pinching (1.44 kg/plot) and minimum yield per plot was noted in Lihocin @ 4000 ppm (0.96 kg/plot). These results might be due to variation in production of flower yield as different growth regulators accelerate or decrease the metabolic process within the plants. Data recorded on flower yield per plot might have differed due to the effect of PGR to yield flowers. There was visible increase in yield of flowers in the plots treated with GA_3. Similar results were obtained by **Naidu (2011), Kumar *et al.*, (2012), Dobaria (2012), Palei *et al.*, (2016), Wadgave (2016), Markam, (2017) and Kumar (2017).**

Maximum average yield per hectare was recorded at 90 DAT with application of GA_3 @ 200 ppm + Pinching (15.67 t/ha) followed by GA_3 @ 100 ppm (14.37 t/ha) and minimum yield per hectare was recorded in Lihocin @ 4000 ppm (9.60 t/ha). The increase in flower yield per ha might be due to increased flower weight and number of flowers per plant in respective treatment by the variety. Similar variation in flower yield after treatment of various plant growth regulators with different concentrations was also reported in past. The increase in flower yield per hectare with the treatment of GA_3 was also supported with the results of **Naidu (2011), Kumar *et al.*, (2012), Dobaria (2012), Palei *et al.*, (2016), Wadgave (2016), Markam, (2017), Kumar (2017)** in marigold plant.

Table 2. Effect of plant growth regulators and pinching on yield attributes of Marigold.

Treatments	Number of flower per plant	Flower yield per plant (g/plant)	Flower yield per plot (kg/plot)	Flower yield per hectare (t/ha)
Control	23.72	325.73	0.98	9.80
GA_3 100 ppm + Pinching	31.26	395.07	1.44	14.37
GA_3 200 ppm + Pinching	31.76	402.13	1.57	15.67
TRIA 20 ppm + Pinching	29.71	369.00	1.08	10.80

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TRIA 30 ppm + Pinching	30.09	375.11	1.09	10.90
Lihocin 2000 ppm + Pinching	22.86	318.67	0.97	9.70
Lihocin 4000 ppm + Pinching	22.20	316.50	0.96	9.60
NAA 10 ppm +Pinching	27.43	381.42	1.22	12.23
NAA 20 ppm +Pinching	27.92	387.17	1.18	11.77
F- test	S	S	S	S
SEm (±)	2.17	10.97	0.10	1.02
CD (5%)	6.50	32.89	0.31	3.06

CONCLUSION

From the above results, it was concluded that application of GA_3 200 ppm +Pinching was found to be best by obtaining highest growth and yield. It was found more productive when compared to other treatments.

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