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GROWTH AND YIELD OF SUMMER AFRICAN MARIGOLD AS INFLUENCED BY PINCHING AND GIBBERELLIC ACID

Shalini Badge[1], D. M. Panchbhai[2] and V.N. Dod[3]

ABSTRACT

A field experiment was conducted at Main garden, Department of Horticulture, Dr. PDKV, Akola to study the effect of pinching and foliar application of gibberellic acid on growth and yield of African marigold. Experiment comprising four levels of pinching i.e. no pinching, pinching at 15 DAT, pinching at 22 DAT and pinching at 30 DAT and four levels of gibberellic acid i.e. 100 ppm, 200 ppm , 300 ppm and water spray (control) during summer season of the year 2010-11 and 2011-12. Among the pinching treatments, significantly more reduction in height of plant was recorded in the treatment pinching at 22 DAT whereas, pinching at 15 DAT was found to be best for improving other growth parameters viz., number of branches plant^{-1} , diameter of main stem and leaf area at 50% flowering stage and flower yield parameters viz., number of flowers plant^{-1}, flower yield plant^{-1}, plot^{-1} and ha^{-1}. In respect of foliar application of gibberellic acid, gibberellic acid 300 ppm was recorded significantly maximum vegetative growth parameters viz., height of plant, number of branches plant^{-1} , diameter of main stem and leaf area at 50% flowering stage and flower yield parameters viz., number of flowers plant^{-1}, flower yield plant^{-1}, plot^{-1} and ha^{-1}.

(Key words: Pinching, gibberellic acid, growth, foliar application)

INTRODUCTION

In past years, flowers were not of much economic importance. Today floriculture is recognized as a lucrative business since it has higher potential unit^{-1} area than most of the field crops and even horticultural crops both for domestic market and export. Among commercial important flowers, marigold (*Tagetes erecta* Linn.), a member of Asteraceae family, is one of most important annual flowers, cultivated commercially in India as bedding plants, loose flower for making garland, wreath, religious offering, natural colour pigments, insect and nematodes repellants, nutrient supplement for poultry feed and cut flower purpose. It occupies special importance due to its hardiness, easy culture, low pest attack and wider adaptability to varied agro–climatic condition.

In case of pinching, if the terminal portion of shoot is removed early, the emergence of side branches starts earlier and more number of flowers are produced. In recent years, a number of plant growth regulators have been used in the field of agriculture in specially horticulture for increasing, reducing or modifying the physiological process within plant and which ultimately affect the growth, flowering and yield. Gibberellins fall in growth promoter groups. The most drastic effect of gibberellins is the transformation of dwarf plants into tall ones by increasing in stem elongation. Effect of pinching and using gibberellic acid was ascertained for improving the flower production in African marigold during summer season. The proper time of pinching of terminal shoot and use of proper concentration of gibberellic acid as a foliar spray can be helpful in achieving the twin objectives of proper vegetative growth and maximum flower production during summer season. Accordingly, the present investigation was undertaken to find out the appropriate pinching time and suitable concentration of gibberellic acid on vegetative growth and flower yield in African marigold during summer season under Vidarbha conditions.

MATERIALS AND METHODS

Field experiment was conducted during summer season of the year 2010–11 and 2011–12 at main garden, University Department of Horticulture, Dr. P.D.K.V., Akola with the objective to study the effect of pinching and foliar application of gibberellic acid on growth and flower yield in African marigold.

The experiment was laid out in Factorial randomized block design with sixteen treatment combinations replicated thrice. Treatment comprising of four pinching levels viz., P_0 – no pinching, P_1 –pinching at 15 DAT, P_2 –pinching at 22 DAT and P_3 – pinching at 30 DAT and four concentrations of gibberellic acid viz., G_0 –control, G_1 –100 ppm, G_2 –200 ppm and G_3 –300 ppm. Seeds of African marigold var. African Double Orange were procured from market. The raised beds were prepared

1. Asstt. Professor, Horticulture Section, College of Agriculture, Nagpur
2. Professor, Horticulture Section, College of Agriculture, Nagpur
3. Professor and Head, Deptt. of Horticulture, Dr. PDKV., Akola

after mixing the well rotten FYM. The seeds were sown on bed at a distance of 10 cm between the row and 2 to 3 cm within the row. Four weeks old healthy, stocky seedlings were used for transplanting. Transplanting was done at spacing of 45 cm x 30 cm. The recommended dose of fertilizers ($N:P_20_5:K_20$ @ 100:50:25 kg ha^{-1}) were applied in the form of urea, single supper phosphate and muriate of potash. Full dose of single supper phosphate and muriate of potash and ½ dose of urea was applied at the time of transplanting and remaining ½ dose of urea was applied at one month after transplanting.

Regarding pinching treatments, 4-5 cm terminal portion of growing tip was nipped out as per treatment time i.e. 15, 22 and 30 DAT. The foliar application of gibberellic acid was done twice at 15 DAT and 30 DAT as per treatment concentration. The observations regarding growth parameters viz., height of plant, number of branches $plant^{-1}$, diameter of main stem were recorded at 90 DAT and leaf area was recorded at 50% flowering stage and yield parameters like number of flower $plant^{-1}$, flower yield $plant^{-1}$, $plot^{-1}$ and ha^{-1} were recorded at the time of harvesting. Collected data was statistically analyzed as per Gomez and Gomez (1984). The appropriate standard error of mean SE(m) and the critical difference (CD) were calculated at 5% level of probability.

RESULTS AND DISCUSSION

The results obtained from present investigation are presented below on the basis of pooled mean of two years experimentation (2010-11 and 2011-12).

Effect of pinching

Growth parameters

The data presented in table 1 revealed that, pinching treatments reduced plant height. Significantly maximum reduction in plant height (75.49 cm) was recorded in pinching at 22 DAT followed by treatment of pinching at 15 DAT and 30 DAT. The treatment of no pinching had recorded significantly maximum plant height (92.12 cm). The reduction in the plant height in pinched plant might be due to the removal of apical meristematic tissue which inhibits the apical dominance and diverts plant metabolites from vertical growth to horizontal growth. The similar results were quoted by Pushkar and Singh (2012) in African marigold. They found that pinching at 20 DAT had recorded maximum reduction in plant height in African marigold.

As regards number of branches (18.70), diameter of stem (1.81cm) and leaf area (25.05 cm^2) had recorded significantly maximum with pinching at 15 DAT followed by pinching at 30 DAT and pinching at 22 DAT. However, no pinching treatment was recorded significantly minimum number of branches (16.52), diameter of main stem (1.72 cm) and leaf area (21.35 cm^2). This might be due to in pinching, apical portion of main stem was pinched out which arrested vertical growth and reduced the plant height, increased side branches, thicker stem diameter and also increased leaf area. These results are also closed conformity with earlier studied quoted by Sharma *et al*. (2012) and Maharnor *et al*. (2011) who quoted that early pinching i.e. at 30 DAT had more effective for increasing number of branches and stem diameter in African marigold.

Yield parameters

Data regarding yield parameters are presented in table 2. Significantly maximum number of flowers $plant^{-1}$(32.60), yield of flowers $plant^{-1}$ (231.80 g) $plot^{-1}$ (6.95 kg) and $hectare^{-1}$ (17.16 t) were registered under the treatment of pinching at 15 DAT followed by pinching at 22 DAT and pinching at 30 DAT. Whereas, minimum number of flowers $plan^{-1}$ (24.68), yield of flowers $plant^{-1}$(182.55 g), $plot^{-1}$(5.47 g) and $hectare^{-1}$(13.51 t) were recorded in no pinching treatment. This might due to the early pinching produced more number of branches due to development of large auxiliary shoots with flowers located terminally. The results are in agreements with Pushkar and Singh (2012) in marigold who reported that pinching of marigold plant at 20 DAT was more effective for increasing yield of marigold flower.

Effect of foliar application of gibberellic acid

Growth parameters

Pooled data of two years of experiment showed that, gibberellic acid treatment resulted in outstanding increase in all vegetative growth parameters studied under the experiment. The growth parameters such as height of plant (89.14 cm), number of branches $plant^{-1}$(18.82), diameter of stem (1.83 cm) and leaf area (26.13 cm^2) were recorded significantly maximum with foliar application of gibberellic acid 300 ppm followed by foliar

Table 1. Growth parameters of summer African marigold as influenced by pinching and gibberellic acid

Treatments	Height of plant at 90 DAT (cm)			Number of branches plant^{-1} at 90 DAT			Diameter of main stem at 90 DAT (cm)			Leaf area at 50 % flowering stage (cm^2)		
	2010-11	2011-12	Pooled mean	2010-11	2011-12	Pooled mean	2010-11	2011-12	Pooled mean	2010-11	2011-12	Pooled mean
Factor A – Pinching (P)												
P_0 – No pinching	89.15	95.10	92.12	16.33	16.70	16.52	1.70	1.74	1.72	21.07	21.40	21.35
P_1 – Pinching at 15 DAT	79.45	79.11	79.28	18.60	18.70	18.65	1.79	1.82	1.81	25.03	25.08	25.05
P_2 – Pinching at 22 DAT	75.46	75.52	75.49	17.19	17.03	17.11	1.74	1.75	1.75	22.98	23.26	23.12
P_3 – Pinching at 30 DAT	85.52	84.24	84.88	18.03	17.35	17.69	1.76	1.78	1.77	23.98	24.12	24.05
SE (m)±	0.91	1.19	1.17	0.26	0.10	0.13	0.008	0.006	0.007	0.40	0.34	0.263
CD at 5%	2.63	3.45	3.41	0.76	0.31	0.35	0.023	0.018	0.019	1.17	1.01	0.745
Factor B – Gibberellic acid foliar spray (G)												
G_0 – Control (Water spray)	73.99	75.01	74.50	15.73	16.61	16.17	1.69	1.72	1.71	17.83	18.14	17.98
G_1 – GA_3 100 ppm	81.11	82.75	81.93	17.14	17.16	17.15	1.73	1.76	1.75	24.02	24.18	24.10
G_2 – GA_3 200 ppm	84.68	86.33	85.51	17.98	17.68	17.83	1.76	1.78	1.77	25.25	25.33	25.29
G_3 – GA_3 300 ppm	88.40	89.88	89.14	19.30	18.33	18.82	1.81	1.84	1.83	25.95	26.31	26.13
SE (m)±	0.91	1.19	1.17	0.26	0.10	0.13	0.008	0.006	0.007	0.40	0.34	0.26
CD at 5%	2.63	3.45	3.41	0.76	0.31	0.35	0.023	0.018	0.019	1.17	1.01	0.74
Interaction effect (A X B)												
SE (m)±	1.82	2.39	2.01	0.53	0.21	0.34	0.016	0.013	0.012	0.81	0.69	0.52
CD at 5%	–	–	–	–	–	–	–	–	–	–	–	–

Table 2. Yield contributing parameters of summer African marigold as influenced by pinching and gibberellic acid

Treatments	Number of flowers plant^{-1}			Flower yield plant^{-1} (g)			Flower yield plot^{-1} (kg)			Flower yield ha^{-1} (t)		
	2010-11	2011-12	Pooled mean	2010-11	2011-12	Pooled mean	2010-11	2011-12	Pooled mean	2010-11	2011-12	Pooled mean
Factor A – Pinching (P)												
P_0 – No pinching	24.35	25.01	24.68	184.54	180.55	182.55	5.53	5.41	5.47	13.66	13.37	13.51
P_1 – Pinching at 15 DAT	31.10	34.10	32.60	228.30	235.31	231.80	6.84	7.06	6.95	16.90	17.43	17.16
P_2 – Pinching at 22 DAT	27.98	32.21	30.09	200.36	206.75	203.55	6.01	6.20	6.10	14.84	15.31	15.07
P_3 – Pinching at 30 DAT	29.69	32.62	31.15	192.05	197.33	194.69	5.76	5.91	5.83	14.22	14.61	14.41
SE (m)±	0.36	0.35	0.25	2.50	2.93	1.96	0.14	0.16	0.11	0.18	0.29	0.19
CD at 5%	1.04	1.03	0.77	7.23	8.47	5.55	0.40	0.47	0.31	0.54	0.84	0.56
Factor B – Gibberellic acid foliar spray (G)												
G_0 – Control (Water spray)	24.65	28.29	26.47	165.90	174.81	170.36	4.97	5.24	5.11	12.28	12.94	12.61
G_1 – GA_3 100 ppm	26.74	29.89	28.31	186.92	194.60	190.76	5.60	5.83	5.71	13.84	14.41	14.12
G_2 – GA_3 200 ppm	29.18	32.19	30.68	212.48	215.39	213.93	6.37	6.46	6.41	15.73	15.95	15.84
G_3 – GA_3 300 ppm	31.74	33.17	32.45	239.94	235.16	237.55	7.19	7.05	7.12	17.77	17.41	17.59
SE (m)±	0.36	0.35	0.25	2.50	2.93	1.96	0.14	0.16	0.11	0.18	0.29	0.19
CD at 5%	1.04	1.03	0.77	7.23	8.47	5.55	0.40	0.47	0.31	0.54	0.84	0.56
Interaction effect (A X B)												
SE (m)±	0.72	0.71	0.51	5.01	5.87	3.92	0.28	0.32	0.21	0.37	0.58	0.38
CD at 5%	–	–	–	–	–	–	–	–	–	–	–	–

application of gibberellic acid 200 and 100 ppm. Whereas, minimum height of plant (74.50 cm), number of branches plant^{-1}(16.17), diameter of stem (1.71 cm) and leaf area (17.98 cm^2) were recorded in control treatment.

Thus, from above results, it was found that plant growth parameters increased with the increase in gibberellic acid concentrations. This might be due to the fact that gibberellic acid increased the growth of plant by increasing internodal length and cell enlargement and enhanced the apical dominance indirectly by increasing auxin content. The increasing leaf area might be due to increasing plant height and number of branches. Similar results were recorded by earlier workers Taygi and Kumar (2006), Swaroop *et al. (*2007) and Ramesh Kumar *et al.* (2010) in marigold. They found that GA_3 200 ppm had recorded maximum vegetative growth parameters in African marigold plant.

Yield parameters

The data from table 2 showed that, significantly maximum number of flowers plant^{-1} (32.45), yield of flowers plant^{-1}(235.16 g), plot^{-1}(7.12 kg) and hectare^{-1}(17.59 t) were registered under foliar application of gibberellic acid 300 ppm followed by foliar application of gibberellic acid 200 ppm and 100 ppm. The minimum number of flowers plant^{-1} (26.67), yield of flowers plant^{-1}(170.36 g), plot^{-1} (5.11 kg) and hectar^{-1}(12.61 t) were harvested in control treatment. The increase in yield and yield parameters with GA_3 spray might be due to better crop growth, number of branches plant^{-1}, leaf area and maximum number of flowers plant^{-1} and thus ultimately increased the flower yield. Further it can be said that it might be due to better translocation of more metabolites from source to sink. Similar results were also reported by Amit Kumar *et al.* (2012) in marigold who reported that foliar application of 350 ppm GA_3 was more effective for increasing all flower yield parameters in African marigold.

Interaction effect

The pooled data presented in table 1 and table 2 exhibited non–significant differences for all growth and yield parameters due to an interaction of the pinching and foliar treatment of gibberellic acid.

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