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Effect of maleic hydrazide and pinching on growth and flowering behaviour of African marigold (*Tagetes erecta* L.)

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ABSTARCT

An experiment was carried out at Experimental Research Farm, R.B.S College Bichpuri, Agra (U.P.) during rabi season of 2016-18 to study the effect of pinching and Maleic Hydrazide on growth and flowering behavior of African marigold (Tagetes erectaL.). The experiment was laid out in factorial randomized block design with three replications comprising of four different concentrations of Maleic Hydrazide (0, 250,500 and 750 ppm) and three pinching levels viz., no pinching, pinching at 20 and 40 (DAT). The results revealed that the application of 750 ppmMH recorded significantly maximum value of diameter of main stem (2.0 cm), plant spread N-S and E-W (44.7cm and 47.5cm), primary branches/plant (11.1), length of flower (7.0 cm), diameter of flowers(7.3 cm),flower/plant (79.5), and flower yield (170.9 qha^{-1}), weight of flower/ plant (273.6 g), and dry matter content of plant (39.6g). The maximum plant height (72.4cm) and minimum days required for bud initiation (46.0days) were noticed under the control.Among the pinching treatments, pinching at 40 DAT recorded significantly maximum diameter of main stem (2.2 cm), plant spread N-S and E-W (47.0cm and 48.2cm), primary branches/plant (10.9), length of longest primary branches (38.6 cm), length of flower (7.6 cm), diameter of flowers(7.9cm),flower/plant (83.2), and flower yield (185.8qha^{-1}), weight of flower/ plant (275.4g)and dry matter weight of plant (38.2g). Themaximum plant height (69.5cm) and minimum days taken to first flower bud initiation (47.4days)were recorded under no pinching. The interaction (P_2xM_3)recorded maximumnumber of primary branches (11.2), number of flowers per plant (86.3), size of flower (8.0cm) and yield of flowers (195.48qha^{-1}) while minimumvalue were recorded under P_0M_0 treatment.

Keywords: Maleic hydrazide, pinching, growth behaviour, flower yield, African marigold

INTRODUCTION

Marigold (*Tagetes ecrecta* L.) is one of the most commonly grown flowers and used extensively on religious and social functions in different forms. It has gained popularity amongst gardeners and flowers dealer on account ofits habit of profuse flowering, short duration to produce marketable flowers. The wide spectrum of attractive colours, shape size and good keeping quality attracted the attention of producers and traders most therefore, the commercial vicinity of different cities and towns. The compounds which suppress or retard growth and development are maleic hydrazide (MH), 2-4 dichlorabenezyltribufyl-phosporium chloride (Phosphon), 2-chloro-ethyl trimenthyl-ammonium chloride (Cycocel), N-dimethyl-amino succinamic acid (B-nine) and N^6dexzyladexine. Knowledge of the biochemical effects of MH or the mechanism (s) of action of maleic hydrazide would be very useful in tying together many developmental and cytogenetic studies with some specific metabolic processes. The effects of MH on cell enlargement and division are reported along with attempts to prevent inhibition of cell division by MH with several metabolites.In general, both the stimulatory and the suppressive types of synthetic compound are widely used in many horticultural industries throughout the world. Pinching of shoot apex should be done 40 days after transplanting of the seedlings in the main field for obtaining more side branches and more number of flowers of uniform size with better quality. Pinching is done to give a bushy shape to the plants.In the light of above facts,the present investigation was plan out and carried out using African marigold as test crop.

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MATERIALS AND METHODS

The experiment was conducted at Research Farm, R.B.S College Bichpuri, Agra (U.P.) during rabi season of 2016-18. The experimental area is situated at 27.20 N latitude 78.50 East longitudes at height of 168m above the mean sea level. The climate of experimental site is sub-tropical with large variation between summer and winter temperature. During the summer, temperature ranges from 30°C to 46°C or even more during May and June whereas in winter, it ranges from 1°C to 22°C. Monsoon generally starts from June and recedes by the end of September with an annual rainfall of 700mm. The soil of the experimental field was well drained sandy loam in texture with good water holding capacity. The pH of the experimental soil was 7.5. The soil had 168.0 ha^{-1} available potassium,14.0 ha^{-1} available phosphorus and 147 ha^{-1}available N and3.0g kg^{-1} organic carbon. The experiment was laid out in factorial randomized block design with three replications comprisingfour concentrations ofmaleic hydrazide (MH 0, 250, 500 and 750ppm) and three pinching levels viz., no pinching, pinching at 20 days and pinching at 40 days after transplanting. Twenty-five days old uniform and healthy seedlings were transplanted at the spacing of 45×45 cm. Recommended dose of 100 kg N, 100 kg P_2O_5 and 100 kg$K_2O$$ha^{-1}$ were applied as basal through urea, diammonium phosphate and muriate of potash, respectively. Hand sprayer was used to spray Maleic Hydrazide uniformly. The operation of pinching was done with an alcohol sterilized sharp blade scissors 20 and 40 DAT respectively. Observations on growth parameters like plant height, diameter of main stem, plant spread N-S and E-W, number of primary branches, number of flowers per plant, flowering characters like days to flower bud initiation, number of flowers per plant, length of flower, weight of flower per plant and flower yield were recorded at peak stage. The data on various parameters were analysed statistically as suggested by Panse and Sukhatme (1995).

RESULTS AND DISCUSSION

Effect of maleic hydrazide

The study revealed an increase in almost all the vegetative growth and flowering parameters with the application of Malic hydrazide (Table 1 and 2). The maximum plant spread N-S and E-W (44.7cm and 45.5 cm), diameter of main stem (2.04cm), primary branches (11.1), fresh weight of plant biomass (344.16g) and dry weight of plant (38.28g) were recorded with the application of 750ppm MH followed by 500ppm MH. The application of MH caused growth arresting effect on plant height and maximum dwarfness in terms of plant height (72.4 cm) was recorded with highest level of MH (750ppm), over the control and other concentration of MH. The decrease in plant height with MH may be due to reduction in auxin activity. The growth parameters exhibited an increasing stand due to foliar application of MH up to 750ppm on account of a check in vertical growth of plant because of breaking to apical dominance resulting in maximum spread which may be attributed to forming the highest number of branches to develop plant canopy having heaviest fresh and dry weight at peak blooming stage. These results are in close conformity with those of Karki *et al.* (2021) and Wasiq*et al.* (2020) in African marigold. It is revealed from Table 2 that number of days taken to first flower bud initiation (46.0 DAT) was noted maximum under highest concentration of MH (750ppm) and minimum under control. More number of flowers per plant (79.5), fresh weight of flowers /plant (337.6g) and yield of flowers (170.9 qha-1) were recorded with the highest rate of MH (750ppm) application. Similarly the length of flowers (7.0cm), size of flowers (7.3cm) were also recorded maximum where MH was applied @750ppm. The findings of present study are in consonance with Karki *et al.* (2021) and Wasiq*et al.* (2020). It may be pointed out that almost all the growth parameters under various rates of MH application had a positive relationship with the production of flowers per plant and per hectare basis on this trail. The results are in close conformity with finding of Sikarwar and Vikram (2017) in African marigold.

Table 1: Response of Maleic Hydrazide and pinching on vegetative growth of African marigold (mean of 2 year)

Treatment	Plant Height (cm)	Stem Diameter (cm)	Plant spread (N-S) (cm)	Plant spread (E-W) (cm)	No of primary branches	Length of longest primary branch (cm)
mh (M) (ppm)						
0	72.4	1.50	40.3	42.2	9.72	47.1
250	66.5	1.80	44.3	45.2	10.32	43.5
500	64.4	1.90	44.7	47.1	10.96	42.7
750	62.8	2.30	44.7	47.5	11.14	39.3
CD (P=0.05)	1.96	0.10	1.59	1.88	0.93	2.53
			Pinching (P)			
No Pinching	69.5	1.30	38.0	39.8	9.96	44.6
Pinching at 20 DAT	67.0	2.10	45.2	47.5	10.65	46.1
Pinching at 40 DAT	63.1	2.20	47.0	48.2	10.99	38.6
CD(P=0.05)	1.70	0.08	1.38	1.63	0.81	2.19
			Interaction			
P_0M_0	73.2	1.10	36.4	37.7	9.18	42.8
P_0M_1	72.4	1.00	37.2	41.5	9.96	52.8
P_0M_2	68.3	1.60	37.8	40.5	10.41	40.1
P_0M_3	64.4	1.80	40.9	39.1	10.30	43.4
P_1M_0	78.3	2.10	42.9	44.2	8.66	53.3
P_1M_1	66.3	2.40	48.3	46.3	9.88	43.7
P_1M_2	61.1	1.60	46.5	54.8	12.25	44.6
P_1M_3	62.1	2.30	42.9	49.6	11.83	42.7
P_2M_0	65.4	1.50	41.8	45.3	11.32	45.3
P_2M_1	60.9	2.10	47.4	47.4	11.14	34.4
P_2M_2	63.6	2.70	49.7	45.8	10.24	43.3
P_2M_3	61.8	2.80	49.3	53.5	11.29	31.3
CD (P=0.05)	5.57	0.17	3.67	3.26	1.62	9.23

Effect of pinching

The data (Table 1) revealed that the pinching treatments responded markedly on different growth parameters and flowering characters. The maximum plant spread N-S and E-W (47.08 cm and 48.22 cm), diameter of main stem (2.20 cm), primary branches/plant (10.99), length of flower (7.69 cm), diameter of flower(7.92 cm), number of flower/plant (83.24), weight of flower/ plant(275.40 g), fresh weight of plant bio-mass (344.16 g), yield of flower (185.87 ha^{-1}) and dry weight of plant (38.25 g) were recorded under the treatment P2(40 days after transplanting) while maximum plant height (69.5 cm) and minimum days required for bud initiation (47.4days) were found under the treatment P0(no pinching).The plant height in general significantly reduced when plants were pinched at 40 DAT as compared to non-pinched plant (control) may be the apical portion was cut during pinching as compared to control where was no pinching involved. The results are in close conformity with findings of Rajput *et al.*(2020), Khan *et al.*(2018). The fact for increased growth parameters due to pinching might be attributed to the breaking of apical dominance and sprouting of auxiliary buds as observed in the present study. Similar results were also reported by Rajput *et al.* (2020) and Khan *et al.* (2018).

The increased in flowering and yield with the pinching application may be due to increase in yield attributing characters. The positive influence of pinching on the yield of flowers. The similar results were also found by Sharma *et al.* (2006) in marigold and Rajveer*et al.*(2009). It had been also found that the studies relating to development as the duration (days) taken to visibility of first flower bud with pinching at P2 treatment (40 days after transplanting) was recorded maximum (49.3) as compared to control (unpinched plants). The similar results were also found by Srivastava *et al.* (2002) in African marigold

Table 2: Response of Maleic Hydrazide and pinching on flowering parameters and yield of African Marigold (mean of 2 year)

Treatment	Days to first flower bud Initiation	Number of Flower per plant	Length of flower (cm)	Diameter of flower (cm)	Dry weight of plant (g)	Fresh weight of plant biomass (g)	Weight of flower plant (g)	Flower yield (q/ha^{-1})
mh (M) (ppm)								
0	46.0	74.4	6.64	6.47	31.3	326.2	240.0	143.6
250	48.3	74.6	6.71	6.74	37.6	328.5	247.1	152.8
500	49.2	74.5	6.79	7.18	37.7	334.7	267.1	158.7
750	50.3	79.5	7.03	7.39	39.6	337.6	273.6	170.9
CD (P=0.05)	1.52	2.25	0.54	0.56	1.88	1.71	2.25	2.00
Pinching (P)								
No Pinching	47.4	69.5	6.40	6.47	34.9	310.2	239.7	136.0
Pinching at 20 DAT	48.5	74.7	6.40	6.94	36.6	341.2	256.4	147.3
Pinching at 40 DAT	49.4	83.2	7.69	7.92	38.2	344.1	275.4	185.8
CD (P=0.05)	1.32	1.94	0.46	0.49	1.63	1.48	1.95	1.73
Interaction								
P_0M_0	44.1	68.1	6.50	6.43	30.56	303.8	188.6	124.9
P_0M_1	47.2	69.4	6.70	6.33	35.66	301.7	234.3	126.5
P_0M_2	48.7	68.4	6.13	7.46	34.47	318.1	268.4	144.9
P_0M_3	49.7	72.0	6.30	6.53	38.97	317.1	267.8	148.2
P_1M_0	46.7	75.5	6.83	6.30	32.11	336.9	235.8	127.4
P_1M_1	48.2	71.1	6.03	6.43	36.13	341.4	229.8	150.0
P_1M_2	49.1	71.8	6.16	6.62	36.70	339.6	279.9	143.7
P_1M_3	50.1	80.4	6.60	7.60	41.58	346.8	280.8	168.1
P_2M_0	47.1	79.6	6.59	6.70	31.40	338.0	297.4	178.6
P_2M_1	49.4	83.6	7.40	7.46	41.20	342.5	277.2	181.9
P_2M_2	49.9	83.4	8.10	7.46	42.20	346.4	253.1	187.4
P_2M_3	51.1	86.3	8.40	8.06	38.37	349.6	273.3	195.4
CD (P=0.05)	3.36	3.89	0.93	0.46	5.13	4.21	3.91	5.79

Interactions

The perused of data presented in Tables 1 and 2 reflects that the interaction of different levels of MH and pinching significantly affected growth and flowering of Marigold. The interaction of higher rates MH (750ppm) and pinching at 40 DAT Significantly increased diameter of stem (2.8cm),plant spread N-S and E-W (49.3 cm and 53.5 cm), number of primary branches (11.29), number of flowers per plant (86.3),length of flower(8.4cm) diameter of flower (8.06cm),fresh weight of flower / plant(349.69g) and yield of flower (195.48q/ha) as compared to control. Number of days taken to bud initiation were also influenced significantly due to interactions of MH and pinching and the combined applications of 750ppm MH + Pinching at 40 DAT resulted late flower bud initiation (51.18days) which was late by 7.07 days as compared to control. The height of plant also decreased significantly by interaction of treatments. The interaction of MH @ 750ppm + pinching at 40DAT decreasethe plant height by 11.36cm over control (73.20cm). The similar results were also found byKarki *et al.,* (2021) and Wasiq*et al.* (2020)

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