Indian J. Hort. 67(Special Issue), November 2010: 362-366

Effect of GA_3 and ethrel on growth and flowering of African marigold cv. Pusa Narangi Gainda

Ramesh Kumar*, Mohan Ram and G.S. Gaur
Department of Horticulture, Chrandra Shekhar Azad University of Agriculture and Technology, Kanpur 208002

ABSTRACT

An experiment was conducted at department of horticulture CSAUA&T, Kanpur with nine treatments viz., four concentration each of GA_3 (25, 50,100 and 200 ppm) and Ethrel (100,200,300 and 400 ppm) and with control (distilled water) in R.B.D. with three replication on African marigold cv.- Pusa Narangi Gainda to study their effect on regulation of growth and flowering during winter season (2006-2007). The result of experiment revealed that GA_3 at 50,100 and 200 ppm significantly increased the plant height, number of main branches, basal diameter of plant, number of flower per plant, weight and size of flower and flower yield per plant over control. GA_3 at all concentration caused early flowering and long duration of flowering, while ethrel at all concentration reduced plant height ,increased number of main branches , basal diameter of stem and caused late flowering than control. Ethrel at 100 and 200 ppm increased the number of flower per plant, diameter of flower, fresh weight of flower and flower yield per plant than control. Among all treatments GA_3 at 200 ppm significantly superior and registered maximum flower yield per plant (639.18 gm) with longest duration of flowering (87.18 days) as compared to control (406.13 gm and 80.26 days) respectively.

Key Words: GA_3, ethrel, marigold, growth and flowering.

INTRODUCTION

Marigold becomes one of the most popular flowers in our country on account of its easy culture wider adaptability and lucrative returns. Its habit of free flowering, short duration to product marketable flowers, and wide range of colours, shape, size and good keeping quality attracted the attention of flower growers. In India, it is in great demand as loose flower throughout year and commonly used for decoration, making garlands for religious and social functions. Globular shaped flower with long stalks are used for cut-flower purposes. In gardens marigold provides beautification of beds and borders. An orange pigment extracted from petals is in great demand for poultry feed. Application of plant growth regulator in floriculture played important role in vegetative propagation, inhibition of abscission, prevention of bud dormancy, growth control, and promotion of flowering, prolonging the vase life of flowers and retarding senescence. Gibberellic acid play important role in elongation of shoot, flower induction, flower and seed development and mobilization of storage reserves. Ethrel (2-chloroethyl phosphonic acid) helps in promoting epinasty, proliferation, shoot and root growth, differentiation, adventitious root formation, inhibit growth, leaf abscission, flower induction, flower opening, flower and leaf senescence etc. Therefore, this study was undertaken with the objective to get standardized concentration of GA_3 and ethrel on growth and flowering of African marigold under central Uttar Pradesh conditions.

*Corresponding author

MATERIALS AND METHODS

The present study was carried out in the research block the Garden of the Department of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (U.P.), which extends 25^0.26' to 26^0.58' N latitude and 79^0.31' to 80^0.34' E longitude , 127.12 meter above mean sea level and comes under subtropical zone. The soil in the farm is sandy loam with pH (7.2), organic matter (0.87 %), available nitrogen (80.10 ppm), available phosphorus (15.56 ppm) and available potassium (75.54 ppm). During growing period mean maximum (29.6°C) and minimum (15.8°C) temperature, relative humidity (65.2 %) and rain fall (144.2 mm) was recorded. Nine different treatments with four concentration of each of GA_3 (25, 50,100 and 200 ppm) and Ethrel

(100,200,300 and 400 ppm) including control (distilled water)was laid out in randomized block design with three replication on African marigold cv.- Pusa

Narangi Gainda One month old uniform and healthy seedling were transplanted at the spacing of 45×45 cm on October 30, 2006 and 10.5 kg FYM, 30 g N, 20 gm each P_2O_5 and K_2O per square meter was applied in experimental block. The full dose of well rotten FYM,P_2O_5, K_2O and half dose of N mixed in beds before transplanting. The remaining dose of N was applied one month after transplanting.

Hand automizer was used to spray the growth regulators uniformly. The growth regulators were applied through two sprays, first spraying was done on 30th November and second spraying was applied one month after first spray. Observation on vegetative parameters like plant height, number of main branches, number of leaves per plant, plant basal diameter, leaf size and plant spread was recorded and presented in Table 1.Various floral characteristic viz., days to first flowering, duration of flowering, number of flower per plant, diameter of flower, fresh weight of flower, flower yield and test weight of seed was also recorded and presented in Table 2.Five plant were selected randomly and tagged for different treatments in each replication for taking observations. Basal diameter of plant was measured with the help of digital Vernier Calliper. The days to first flowering was counted from date of transplanting and fresh weight of flowers was taken at 15 days interval during the flowering period. The test weight of seed was taken by weighing 1000 seeds after cleaning, sieving and winnowing. The statistical analysis was carried out to know the variance for each parameter and effect of treatments using the standard procedure.

RESULTS AND DISCUSSION

Plant height was significantly increased by

Table 1. Effect of GA_3 and Ethrel on vegetative attributes of African marigold cv. - Pusa Narangi Gainda.

Treatment	Plant height (cm)	Number of main branches	No. of leaves/ plant	Plant basal diameter (cm)	Size of leaf (length cm)	Plant spread (cm)
GA_3 25 ppm T_1	77.63	11.81	60.35	1.45	9.43	40.59
GA_3 50 ppm T_2	79.09	12.72	63.21	1.48	11.63	43.35
GA_3 100 ppm T_3	81.60	13.67	70.21	1.51	13.27	43.88
GA_3 200 ppm T_4	84.52	15.24	72.17	1.58	15.87	46.37
Ethrel 100 ppm T_5	73.36	13.07	60.18	1.46	13.58	43.13
Ethrel 200 ppm T_6	71.21	12.01	58.38	1.44	12.31	42.87
Ethrel 300 ppm T_7	68.73	11.12	52.00	1.42	11.36	36.63
Ethrel 400 ppm T_8	66.12	10.71	51.20	1.41	10.20	33.29
Control T_9 (distilled water)	74.67	09.23	58.36	1.39	9.07	42.38
CD at 5 %	3.357	1.331	2.570	0.026	0.8580	2.223

Table 2. Effect of GA_3 and Ethrel on flowering attributes of African marigold cv.- Pusa Narangi Gainda.

Treatments	Days to first flowering	Duration of flowering (days)	Number of flowers per plant	Diameter of flower (cm)	Fresh weight of flower (gm)	Flower yield per plant (gm)	Test weight of seed (g)
GA_3 25 ppm T_1	67.83	80.27	46.21	5.80	9.31	430.20	1.90
GA_3 50 ppm T_2	65.28	82.13	49.37	6.03	9.82	484.79	2.25
GA_3 100 ppm T_3	62.04	84.87	54.09	6.43	10.67	577.15	2.58
GA_3 200 ppm T_4	60.38	87.18	57.81	6.88	11.04	639.18	2.97
Ethrel 100 ppm T_5	68.32	85.86	53.23	5.96	9.75	518.99	2.30
Ethrel 200 ppm T_6	69.01	84.03	48.78	5.85	9.36	456.18	2.16
Ethrel 300 ppm T_7	70.19	82.92	44.18	5.23	8.91	393.70	2.08
Ethrel 400 ppm T_8	70.93	80.01	42.36	4.90	8.58	363.55	1.96
Control T_9 (distilled water)	68.22	80.26	43.67	5.82	9.30	406.13	2.15
CD at 5 %	1.260	1.081	2.205	0.157	0.491	38.958	0.119

successive increase in concentration of GA_3. The maximum plant height (84.52 cm) was recorded with T_4 treatment (200 ppm GA_3) followed by T_3, T_2 and T_1. The result reveals that the higher concentration of GA_3 is most effective in multiplication of cells as well as elongation of young tissues whereas the lower concentration were less desirable. The promotive effect of gibbrellins on growth may be by increasing the auxin level of tissue or enhance the conversion of tryptophan to IAA, which cause cell division and cell elongation (Kuraishi and Muir, 7). Ethrel had dwarfing effect on plants. A significant decrease in plant height from control was recorded with successive increase in Ethrel concentration. Maximum height (73.36 cm) was recorded with the spray of 100 ppm Ethrel which was significantly superior over T_7 and T_8, but statistically at par with T_9 (control). Ethrel lower concentration was less effective in reducing height but higher concentration (400 ppm) significantly reduced plant height (66.12 cm). Similar result noted by Gautam *et al.* (4) in chrysanthemum with ethrel.

The number of main branches per plant increased with successive increase in GA_3 concentration. The maximum number of branches (15.24) per plant was observed with treatment T_4 (200 ppm GA_3), the least number of branches (11.81) was noted by the application of 25 ppm GA_3. while in case of Ethrel treatment T_5 (100 ppm Ethrel) induced maximum number of branches (13.07) and T8 (400 ppm ethrel) was least effective (10.07). Hyper elongation of internodal length caused extension in plant height while increase in nodal count on main axis consequently increased number of dormant buds from where primary branches originates. Ko Jae Young *et al.,* (6) observed that the number of branches increased in *Lychnis cognata* treated with ethephon.

The diameter of main shoot was noted highest 1.58 cm and 1.46 cm with spray of 200 ppm GA_3 and 100 ppm Ethrel, respectively. The minimum diameter was recorded 1.45 cm and 1.41 cm with 25 ppm GA_3 and 400 ppm Ethrel, respectively but these were more than control (1.39 cm). Increasing concentration of GA_3 increased the diameter of main shoot but reverse in the case of Ethrel. When the plant height increases the diameter increases proportionately. Therefore, with the increase in the concentration of GA_3 the diameter increases due to a reflection of the stimulation of cambium and its immediate cell progeny (Scurfield and Moor, 10). Significant improvement in stem diameter happened with Ethrel because it check cell division in apical meristem only, resulting in alleviation of vascular synthesis beneath the apical meristem, but the cambial and vascular cells continue to divide over a longer period and this result increases in thickness of the stem (Sachs, 9). Similar results were also reported by Gautam *et al.,* (4) in chrysanthemum by the application of GA_3 and Ethrel.

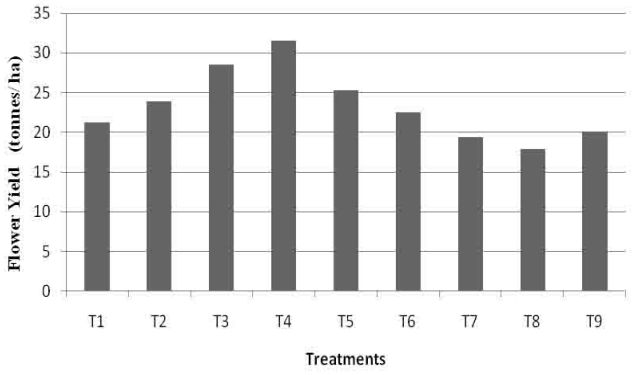

Fig. 1. Effect of GA_3 and ethrel on flower yield of African marigold cv. Pusa Narangi Gainda (tones/ha).

The number of leaves per plant increased with successive increase in GA_3 concentration and maximum number of leaves per plant (72.17) was recorded in 200 ppm GA_3. Ethrel decreased number of leaves per plant with its increasing concentration. The largest size of leaf (15.87 cm) was noted in plant treated with 200 ppm GA_3 as compared to control (9.07 cm). Ethrel at 100 ppm also produced largest leaf size (13.58 cm). Both growth regulators significantly affected the size of leaf. Similar results have been reported by Sebanek (11) and Johnson & Smith (5) in tulip and *I. balsamina,* respectively. The plant spread was increased with increase in concentration of GA_3, while Ethrel decreased it with its increased concentration. The plant spread was noted maximum 46.37 cm with treatment T4 (GA_3 200 ppm) and minimum 40.59 cm with treatment T1 (GA_3 100 ppm) ,while in case of Ethrel, it was maximum 43.13 cm with treatment T5 (ethrel 100 ppm)and minimum 33.29 cm with treatment T8 (Ethrel 400 ppm) but it was 42.38 cm with control.

Plant hormone have significant effect on flowering attributes of marigold (Table 2). The development of flower primordial was greatly influenced by the growth regulators. Each increment of concentration of GA_3 brought up early flowering and long duration of flowering but effect was vice-versa with Ethrel spraying. And the delaying of flowering by Ethrel was not significant. The different treatments of GA_3 on marigold was effective regarding the earliness of first flowering, with the increase in GA_3 level days to first flowering decreased progressively. Among all the treatments of GA_3 T_4 (200 ppm GA_3) was found most effective (60.38 days) followed by T_3, T_2 and T_1. Ethrel delayed days to first flower with successive increase in its concentration. Ethrel at 400 ppm resulted in 70.93 days to first flowering as against

68.22 days in control. Singh *et al.,* (2) observed the similar result with the application of GA_3 and Ethrel in African marigold cv. - Sunset Gaint. Early flowering owing to GA_3 may be due to gibberellins reduce juvenile period. Delayed flowering owing to Ethrel was because of Ethrel to prevent biosynthesis of gibberellins like substances, the delay in flower formation may result from reduction of endogenous gibberellin content.

Duration of flowering was significantly increased by successive increase in GA_3 concentration and maximum duration of flowering (87.18 days) was recorded with T4 treatment (200 ppm GA_3). On the other hand Ethrel significantly increased the duration of flowering but trend was just reverse of GA_3 concentrations and maximum duration of flowering (85.86 days) was recorded with T_5 (100 ppm Ethrel). Shortest flowering duration with Ethrel 400 ppm may be due to additive effect of ethylene on senescence. Namika *et al.,* (8) reported that application of Ethrel on chrysenthemum delayed flowering and extended duration of flowering.

The number of flowers per plant enhanced progressively with the increasing level of GA_3 and maximum number of flowers per plant (57.81) was noted with the application of 200 ppm GA_3 (T_4). Lower concentration of Ethrel was observed to increase the number of flowers per plant. The maximum number of flowers per plant (53.23) was recorded with T_5 (100 ppm Ethrel) and lowest number of flower per plant (42.36) was noted with T_8 (Ethrel 400 ppm).Similar findings also obtained by Singh *et al.* (11) in African marigold, Tripathi *et al.* (14) in French marigold, Talukdar and Paswan (13), Deotale *et al.* (2) and Dutta *et al.* (3) in chrysanthemum.

The diameter of flower increased with successive increase in concentration of GA_3. The maximum (6.88 cm) and minimum (5.80 cm) diameter was recorded with 200 ppm GA_3 (T_4) and 25 ppm GA_3 (T_1) respectively and reverse was the case with Ethrel , it was maximum (5.96 cm) with T_5 (100 ppm Ethrel) and minimum with T_8 (400 ppm Ethrel) . Fresh weight of flowers increased with successive increase in GA_3 concentration. The maximum weight of flower (11.04 gm) recorded with T_4 treatment (200 ppm GA_3). Ethrel decreased the weight of flower with successive increase in concentration. The maximum weight of flower was obtained with T_5 (100 ppm Ethrel). Similar results have also been reported by Dehale *et al.* (1) in chrysanthemum.

Maximum yield of flower per plant (639.18 gm) was recorded at 200 ppm GA_3 followed by 100 ppm, 50 ppm and 25 ppm GA_3. Lower concentration of Ethrel (100 ppm and 200 ppm) increased flower yield (518.99 gm and 456.18 gm, respectively) per plant but higher concentration (300 ppm and 400 ppm), decreased flower yield per plant (393.70 g and 363.55 g, respectively) as compared to control (406.13 g).Tripathi *et al.,* (14) reported that spraying of GA (100, 200 and 400 ppm) on French marigold increased flower yield per plant with successive increase in its concentration. It is evident from finding that except higher concentration of Ethrel (300 and 400 ppm) all the treatments showed positive response on flower yield. This is attributed to the production of large number of laterals at early stage of growth, which then had sufficient time to accumulate carbohydrates for proper flower bud differentiation.

Test weight of seed (1000 seed weight) progressively increased with increasing concentration of GA_3 but increasing concentration of Ethrel reduced it. Maximum test weight (2.97 g) was recorded with T_4 (200 ppm GA_3) followed by T_3, T_2 and T_1. The test weight of seed decreased with successive increase in Ethrel concentration. Maximum test weight (2.30 g) was recorded with T_5, which was significantly superior over T_6. The same results have also been reported by Singh *et al.* (12) in African marigold.

REFERENCES

1. Dehale, M.H., Deshmukh, P.P. and Moharkar, V.K. 1993. Influence of foliar application of GA_3 on quality of chrysanthemum. *J. Soil Crops,* **3**:135-37.
2. Deotale, A.B., Belorkar, P.Y., Patil, Zade, V.N. and Keche, M.B. 1994. Effect of date of planting and foliar spray of GA_3 on flowering and yield of chrysanthemum. *J. Soil and Crops,* **4**: 148-51.
3. Dutta, J.P., Khadre, Md. Abdul and Ramadas, S. 1998. Regulation of flowering in chrysanthemum cv. Co. 1 by artificial photoperiod and gibberellic acid. *Karnataka J. Agri. Sci.* **11**: 251-53.
4. Gautam, S.K., Sen, N.L., Jain, M.C. and Dashora, L.K. 2006. Effect of plant regulators on growth, flowering and yield of *chrysanthemum morifolium* Ram. *Orissa J. Hort.* **34**: 25-26.
5. Johnson, C.R. and Smith, G.S. 1977. Combinations of ancymidol and ethephon on growth and rooting of Impatiens. Proceedings of the Florida State. *Hort. Soc.* **89**: 290-91
6. Ko Jae Young and Lee Kyeong Koog. 1996. Effect of plant growth regulators on growth and flowering of potted *Lychnis cognata, Aster Koraiensis* and *Companular takesimana*. R.D.A. *J. Agri. Sci. Hort*. **38**: 627-32.
7. Kuraishi, S. and Muir, R. M. 1964. The mechanism of gibberellin action in the dwarf pea. *Pl. Cll. Physiol*. **5**: 259.
8. Namika, Arora, J.S., Singh, K. and Sidhu, G.S.

2002. Effect of ethrel and alar on chrysanthemum. **In**: *Flori. Res. Trend in India*. Mishra, R.L. and Mishra, S. (Eds.). *Proceeding of National Symposium on Indian Floriculture in the New Millennium*, held in Bangalore, during 25-27 Feb., pp. 139-42.

9. Sachs, R.M., Lang, A., Bretz, C.F. and Roach, J. 1960. *Amer. J. Bot.* **47**: 260-66.

10. Scurfield, M.E. and Moor, C.P. 1958. Effect of GA on species of Eucalyptus. *Nature*, **181**: 1776.

11. Sebanek, J.F., Kopecky and Sleby, K. 1976. The influence of gibberellins, cytokinins and ethrel on the growth and development of tulips and hyacinths. *Acta Uni. Agri. Brno A.* **24**: 387-97.

12. Singh, R.P., Singh, M.P. and Singh, G.N. 1991. Effect of GA_3 and Ethrel on the growth and flowering of African marigold (*Tagetes erecta*). *Haryana J. Hort. Sci.* **20**: 81-84.

13. Talukdar, M.C. and Paswan L. 1994. Effect of GA_3 and CCC on growth and flowering of chrysanthemum (*Dendranthema grandiflora* Tzvelev) cultivar Tumruli. *Hort. J.* **7**: 141-44

14. Tripathi, A.N., Tripathi, S.N., Shukla, R.K. and Pandey, G. 2003. Effect of GA_3 NAA and CCC on growth and flowering of French marigold. *J. Applied Horti.* **5**: 112-13.

Received: July, 2008; Revised: January, 2010
Accepted: September, 2010