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Effective application of PGR on flowering characteristics of Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda

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Abstract
The present experiment "Effective application of PGR on flowering characteristics of Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda" was conducted out at Indira Gandhi Krishi Vishwavidyalaya, Raipur, during rabi 2017-18. The experiment was conducted in Randomised Block Design comprising 7 treatments of 3 levels of GA_3 (200, 300, 400 ppm), 3 levels of Ethrel (400, 500, 600 ppm) and replicated in three times. As regards to flowering characters, days taken to first flower bud initiation, days taken to open first flower and days taken to 50% flowering was significantly reduced by the application of GA_3 400 ppm. Duration of flowering was increased with the application of GA_3 400 ppm. Hence, on the basis of result obtained from the present investigation it can be concluded that foliar application of GA_3 400 ppm at 15 DAT and 30 DAT was found to play a major role in early flowering and increased duration of flowering with respect to flowering character of marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda.

Keywords: Marigold, GA_3, Ethrel, flowering characters

Introduction
Marigold is a very popular flower crop it is easy to cultivate, has wider adaptability, shorter in duration, wider colour range and good shelf life. Due to this eminence it widely used in landscaping. It is highly in demand as a loose flower as well as cut flower all throughout the year. This globular shaped flower is also used for various decoration purposes, as garlands, poultry feeds, food colouring agent, as neutrceuticals etc. The oil extracted from marigold is widely used in perfumery, cosmetics industry etc. Marigold is widely used as trap crop in tomato and suppresses the nematode population in soil. Plant Growth Regulators are the chemicals which effect the growth, differentiation of cells and cause early or late flowering in plants. They causes intracellular communication by acting as a chemical messenger. Gibberellins play a major role in improvising growth characters by enhancing cell elongation and division. It causes increase in photosynthesis and respiration which help in reduction of juvenile phase and hence cause early flowering in plants. Ethrel on the other hand shorten the plant height, increases branching and delay flowering.

Materials and Methods
The present experiment was conducted at Horticultural Research cum Instructional Farm, Department of Floriculture and Landscape Architecture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during Rabi season 2017- 18.The experiment was laid out in randomized block design (R.B.D.). Treatments were replicated three times and randomly assigned among the plot. Two growth regulators namely gibberellic acid (GA3) and (Ethrel) were taken. There were three levels of Gibberellic acid (200, 300 and 400 ppm) and three levels of Ethrel (400, 500 and 600 ppm) along with one control (water spray). Thus, in total there were 7 treatments. Seeds of African marigold were sown on 16 October 2017 in the nursery beds and seedlings were raised. For the preparation of beds soil was pulverized thoroughly and beds were dug. All the undesirable materials were removed from the soil. Seeds were placed in the bed and then covered by a thin layer of sieved leaf mould and then by another thin layer of soil followed by light sprinkling irrigation. Irrigation was done occasionally when required. Four weeks old seedlings were planted in the experimental field on 13 November, 2017. The operation of transplanting was carried out in the afternoon followed by a light irrigation to allow for proper establishment of seedlings. Growth regulator gibberellic acid was in powder form of 10g packet which was dissolved in 4grm NaOH per litre of water for the preparation of solution. Ethrel was dissolved in required amount of distilled water for preparation of solution. The spraying was done in the morning hours with

the help of hand sprayer. Two spraying were done, first spray 15 days after first spray and third spry 15 days after transplanting and second spray 15 days after first spray. Then observations were recorded at. The flowering parameters like days to bud appearance, days taken to open first flower, days taken to 50% flowering and duration of flowering (days) were taken.

Result and Discussion

Days to bud appearance

GA_3 400 ppm+ pinching required the minimum time (34.80 days) to initiate the buds followed by (36.80 days) under treatment GA_3 300 ppm+ pinching. Maximum time for bud initiation was taken by Ethrel 600 ppm+ pinching. Early bud initiation in GA_3 spray is because Gibberellin reduces juvenile period and cause early termination of juvenile phase. The enhancement in first flower bud formation in GA3 treatments may be because of increase in the endogenous level of gibberellin which by virtue of its flower inducing characteristics might have also promoted the first bud formation. These results are in close conformity with the study of Mishra (2017) [4] etc.

Days taken to first flower bud initiation

Treatments	Treatments Mean
T1 GA_3 200 ppm + pinching	38.600
T2 GA_3 300 ppm + pinching	36.800
T3 GA_3 400 ppm + pinching	34.800
T4 Ethrel 400 ppm + pinching	47.733
T5 Ethrel 500 ppm + pinching	54.267
T6 Ethrel 600 ppm + pinching	59.067
T7 (Control) + pinching	41.733
SE (m) ±	1.215
CD at 5%	3.786

Days taken to open first flower

Minimum days (44.700 days) taken for first flower opening GA_3 400 ppm+ pinching, followed by treatment GA_3 300 ppm+ pinching. GA_3 400 ppm significantly advances the number of days required for anthesis (by 13.2 days over control).Maximum days (75.933 days) was taken by Ethrel 600ppm+ pinching. Although gibberellin is not a flowering hormone, but when these are present in also activate genes, which control the synthesis of florigen and thus induce the early flowering. Another probable reason for earlier anthesis with the application of GA3 may be the ability of gibberellins to modify the photoperiodic requirements of plants which is essential for flower anthesis. These results are in close conformity with the study of Syamal *et al.* (1990) [8], Kulkarni (2003) [3], Pushkar and Singh (2012) [5], Rajhansa (2014) [6], Mishra (2017) [4].

Days taken to open first flower

Treatments	Treatments Mean
T1 GA_3 200 ppm + pinching	52.367
T2 GA_3 300 ppm + pinching	52.333
T3 GA_3 400 ppm + pinching	44.700
T4 Ethrel 400 ppm + pinching	59.967
T5 Ethrel 500 ppm + pinching	68.733
T6 Ethrel 600 ppm + pinching	75.933
T7 (Control) + pinching	57.900
SE (m) ±	2.135
CD at 5%	6.652

Days taken to 50% flowering

Earliest flowering (53.000 days) is found in GA_3 400 ppm+ pinching followed by GA_3 300 ppm+ pinching. Maximum days to 50% flower (74.000 days) was under treatment Ethrel 600ppm+ pinching. Early flowering with GA3 application 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 results were also reported by Badge *et al.* (2014), Kalmani *et al.* (2017)

Days taken to 50% flowering

Treatments	Treatments Mean
T1 GA_3 200 ppm + pinching	59.000
T2 GA_3 300 ppm + pinching	57.667
T3 GA_3 400 ppm + pinching	53.000
T4 Ethrel 400 ppm + pinching	65.333
T5 Ethrel 500 ppm + pinching	70.000
T6 Ethrel 600 ppm + pinching	74.000
T7 (Control) + pinching	61.667
SE (m) ±	1.794
CD at 5%	5.590

Duration of flowering (days)

The maximum duration of flowering (61.667 days) was observed at GA_3 400 ppm+ pinching, followed by GA_3 300 ppm+ pinching respectively as compared to control (33.00 days).Lowest duration was evident in ethrel (42.667 days) at Ethrel 600ppm+ pinching. This significant increase in the bloom duration with GA3 might be due to early initiation of anthesis; hence more time was available for flower formation. Another probable reason for this increased bloom duration may be the availability of optimum quantity of GA3 under these treatments as a result flowering period might have significantly increased. Similar results were also reported by Singh *et al*. (1992) [7], Kalmani *et al.* (2017), Mishra (2017) [4].

Duration of flowering (days)

Treatments	Treatments Mean
T1 GA_3 200 ppm + pinching	50.667
T2 GA_3 300 ppm + pinching	52.333
T3 GA_3 400 ppm + pinching	61.667
T4 Ethrel 400 ppm + pinching	47.000
T5 Ethrel 500 ppm + pinching	43.000
T6 Ethrel 600 ppm + pinching	42.667
T7 (Control) + pinching	33.000
SE (m) ±	1.485
CD at 5%	4.628
CV	5.452

Conclusion

On the basis of the result obtained from this experiment it can be concluded that spray of GA_3 400 ppm at 15 DAT and 30DAT along with pinching was very effective with respect to the flowering character of marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda.

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