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Effect of plant growth regulators on growth, flowering and yield of African marigold (*Tagetes erecta* L.) cv. PUSA NARANGI GAINDA

■ AMIT KUMAR[1], JITENDRA KUMAR[1], BRAJ MOHAN[2], J.P. SINGH, RAJBEER[1] AND NATHI RAM[1]

Associated Authors:
[1]Department of Horticulture, C.C.S. University, MEERUT (U.P.) INDIA
[2]Department of Horticulture, Sardar Vallabh Bhai Patel University of Agriculture and Technology, MEERUT (U.P.) INDIA

Author for correspondence :
J.P. SINGH
Department of Horticulture, Gochar Mahavidyalaya, Rampur, Maniharan, SAHARANPUR (U.P.) INDIA

Abstract : The present investigation was conducted at Horticulture Research Farm, Department of Horticulture, Choudhary Charan Singh University, Meerut, during the year 2007-2008.The experiment was laid out in Randomized Block Design, consisted of 9 treatments with control.Two growth regulators namely gibberellic acid (GA_3) and cycocel (CCC) were taken. There were four levels of GA_3, *i.e.* 200 ppm, 250ppm, 300ppm and 350 ppm and four levels of cycocel, *i.e.* 1200ppm, 1600ppm, 2000 ppm and 2400 ppm along with one control (water spray), were taken for both the growth regulators. Gibberellic acid application at 350 ppm was found most effective as it gave highest flower yield per plant, maximum fresh weight per flower and highest number of flowers per plant and earlier flower bud initiation and flowering and also increased number of leaves as well as with maximum height of the plant. Cycocel application at 2400 ppm was found most effective as it gave highest number of leaves per plant and maximum number of main branches per plant. Application of cycocel 2000 ppm was also beneficial as it gave 28.71 per cent more flower yield (*i.e.* 229.68g/plant) as compared to control (*i.e.* 178.44g/plant) with increasing number of flowers per plant without affecting initiation of flower bud and commencement of flowering.Thus the present investigation clearly indicate that the application of gibberellic acid at 350 ppm was best treatment in all respect as it enhanced vegetative growth and flower. Further, cycocel at 2000 ppm was also beneficial as it increased flower yield and reduced vegetative growth without affecting initiation of flower bud and commencement of flowering.

Key words : Marigold, Pusa Narangi Gainda, Gibberellic acid (GA_3), Cycocel, CCC

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Ornamental plants play an important role in the development of aesthetic sence and in environment planning of urban and rural areas for overcoming pollution, social and rural forestry, wasteland development, outdoor and indoor landscaping. The flowers are used for decorating homes by all classes of people, and they express beauty and extend the love. In our country flowers are commonly used in worship in homes and temples. Flowers also adorn the hair of women, particularly in South India and flowers are important for their economic uses, such as for cut blooms, for extraction of perfumes and other products. Marigold belongs to family compositae (asteraceae) a genus of dicotyledonous plants, is an important commercial annual, one of the most commonly grown flowers in India. There are two important cultivated species of Tagetes *i.e. Tagetes erecta* L. which is commonly known as African marigold, which is tall in habit and *Tagetes patula*L. is commonly known as French marigold and is dwarf in habit.Marigold is one of the oldest cultivated ornamental plants, being very popular in tropical and sub-tropical countries as a garden plant for beautification. The use of plant growth substances has been found to be of great significance in the commercial cultivation of many ornamental crops. In our country, their use is very limited but in many Westerncountries they are creating many excitements in the field of agriculture. Gibberellic acid and cycocel are very important plant growth regulators and are widely used in agriculture and horticulture. The GA_3 regulation of growth itself is involved with both cell division and cell

enlargements without cell division (Haberand and Leopold, 1960). The GA_3 has manifold effects, it affects the seed dormancy, seed germination, stem growth, root growth, flowering etc. (Rappaport and Singh, 1960). Sachs *et al.* (1960) reported that application of CCC retarded stem elongation by preventing cell division in the sub-apical meristem, usually without similarly affecting the apical meristem. Cycocel treatments have been found effective in the direction of earliness in flowering and fruiting.

RESEARCH METHODS

The present experiment was conducted at the Horticulture Research Farm,Department of Horticulture, Ch. Charan Singh University Campus, Meerut (U.P.) during 2007-2008.The experiment was laid out in randomized block design (R.B.D.). All treatments were randomly allocated among the plot and replicated three times.Two growth regulators namely gibberellic acid (GA_3) and cycocel (CCC) were taken. There were four levels of GA_3, *i.e.* 200 ppm, 250ppm, 300ppm and 350 ppm and four levels of cycocel, *i.e.* 1200ppm, 1600ppm, 2000 ppm and 2400 ppm along with one control (water spray), were taken for both the growth regulators. Thus, in all there were 9 treatments.Seedlings of African marigold were raised in the beds of the nursery. The beds were dug and prepared thoroughly to make the soil pulverized. All the undesirable materials were removed from the soil. Seeds were sown on 22 September 2007 in the beds. After drilling, the seeds were covered by a thin layer of sieved leaf mould and then by another thin layer of the dried grass, sprinkling irrigation was done as and when necessary. The dry grass was removed after seed germination, weeds in the nursery beds were occasionally removed carefully without disturbing the seedlings.Four weeks old seedlings were planted in the experimental field on 20 October, 2007. 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 alcohol for the preparation of stock solution. Cycocel was in white crystalline form which was highly volatile and sold in market in 25 g of packet. Cycocel was dissolved in required amount of distilled water for preparation of stock solution and then diluted before spraying. The spraying was done in the morning hours with the help of hand sprayer. Three spraying were done, first spray one week after transplanting, second spray 15 days after first spray and third spry 15 days after second spray. Observations were recorded at 45 and 90 days after transplanting. The various growth parameters like height of plant (cm), number of leaves and main branches per plant were recorded for observation. The flowering parameters like emergence of first flower bud, commencement of flowering (days), the yield parameters like number of flowers per plant, fresh weight per flower (g) and flower yield per plant (g) were also recorded.

RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarised under following heads:

Effect of gibberellic acid:

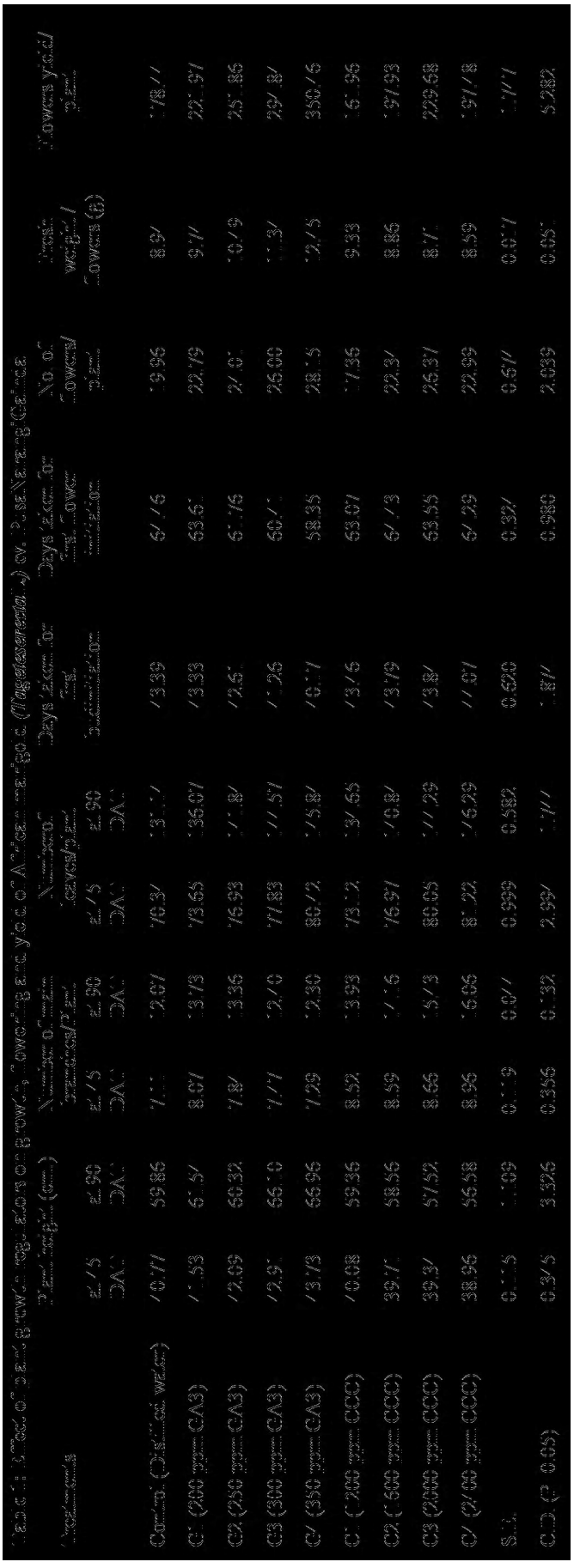
Growth parameters:

The present findings show (Table 1) that the application of GA_3 markedly increased the plant height. The maximum plant height (43.73 cm and 66.96 cm) was attained by the plant with the application of GA_3 (350 ppm) which was significantly more as compared to control plants (40.77cm and 59.86 cm) at 45 and 90 days after transplanting, respectively. The increased plant height with the application of GA_3 may be due to enhanced cell division and cell enlargement. Similar results were also reported by Shanmugan *et al.* (1973) in chrysanthemum,Lal and Mishra (1986) in marigol and Swaroop *et al.* (2007) and Sunitha *et al.* (2007) in African marigold.

The present findings indicate that the application of GA_3 at various levels had highly significant influence on number of main branches and number of leaves per plant in African marigold. Maximum number of branches/plant (*i.e.* 7.29 and 12.30 compared with 7.11 and 12.07 for control, respectively) and the number of leaves per plant were recorded (*i.e.* 80.42 and 145.84) with GA_3 treatment at 350 ppm whereas, minimum in control plants (70.34 and 131.14) at 45 and 90 days, respectively, after transplanting. The increase in number of leaves with the application of GA_3 was a result of enhanced induction of leaf initial breaks *i.e.* differentiation of leaf primordial in the apical growing region. Similar result was also reported by Pal *et al.*(1986) in lilies.

Flowering parameters :

Present investigation shows that the GA_3 treatment at various levels had marked effect on initiation of flower buds and emergence of flowers. Flower bud initiation was recorded earliest *i.e.* 40.17 days after transplanting in GA_3 treated plants at 350 ppm, while in control plants it was found 43.39 days after transplanting. Flowering was also recorded earliest *i.e.* 58.35 days after transplanting in African marigold with the same treatment at similar level whereas, it was found 64.46 days after transplanting in



control plants (Table 1). Early budding and flowering in GA_3 spray may be due to increase in the endogenous gibberellins level in the plants, as gibberellins are well known for inducing early budding and flowering in several crop plants. Similar results were also reported by Bhattacharjee (1984) in dahlia and Dutta (1992) in chrysanthemum.

Yield parameters:

The experimental findings indicate that the GA_3 applications at various concentrations had highly significant influence on number of flowers per plant in African marigold. The maximum number of flowers was recorded in the plants treated with GA_3 at 350 ppm *i.e.* 28.15 flowers per plant compared with 19.96 flowers per plant for control. Increase in number of flowers/plant with the application of GA_3 treatments resulted in marked increases in the plant height and number of leaves per plant (Table 1).

Fresh weight per flower was also found significantly influence with the treatment of GA_3 at various levels in African marigold. The maximum fresh weight per flower were recorded in the plants treated with GA_3 at 350 ppm *i.e.* 12.45 g compared with 8.94 g for control plants. It has been demonstrated that GA_3 might be responsible for continuous supply of food at the time of flowering from the higher leaves. Similar results were also reported by Talukdar and Paswan (1996) in chrysanthemum and Swaroop *et al.* (2007) in African marigold.

Experimental findings indicate that the flower yield per plant was highly affected with the various concentrations of GA_3 at 350 ppm *i.e.* 350.46 g per plant compared with 178.44g per plant for control. The increase in yield and yield parameters with GA_3 spray may be due to better crop growth, leaves and more number of flowers per plant and maximum fresh weight per flower thus ultimately increased the flower yield/plant. Further it can be ascribed due to better translocation of more metabolities from source to sink. Similar results were also reported by Syamal *et al.* (1990) in African marigold and Tripathi *et al.* (2003) in French marigold.

Effect of cycocel:

Growth parameters:

Observations collected from experimentation in Table 1 indicated that the applications of CCC at various levels were found highly effective to influence the height of plant. Maximum retardation in plant height was recorded with CCC at 2400 ppm *i.e.* 38.96 cm and 56.58 cm compared with 40.77cm and 59.86cm for control, at 45 and 90 days after transplanting, respectively. The

reduction in plant height with the application of cycocel may be due to inhibitory role of growth retardants on cell division and cell elongation of apical meristematic cells and also on gibberellins synthesis. Similar results were also reported by Girwani *et al.* (1990) in African marigold.

Experimental findings indicate that the application of CCC at various concentrations had marked influence on number of main branches and number of leaves per plant in African marigold. Maximum number of branches/ plant (*i.e.* 8.96 and 16.06 compared with 7.11 and 12.07 for control, respectively) and maximum number of leaves per plant (*i.e.* 81.22 and 146.29 compared with 70.34 and 131.14 for control, respectively) were recorded at 45 and 90 days after transplanting with the application of 2400 ppm CCC. The increase in number of leaves/plant with cycocel treatments might be due to reduction in shoot growth and increase in number of branches per plant. Similar results were also reported by Bhattacharjee and Das (1979) in gypsophila and Biswas (1981) in African marigold.

Flowering and yield parameters:

Experimental findings also show that the number of flowers per plant in African marigold was significantly affected with CCC applications at various concentrations, without affecting the initiation of flower bud as well as commencement of flowering (Table 1). Maximum number of flowers per plant was recorded with CCC at 2000 ppm (*i.e.* 26.37 flowers per plant as compared with 19.96 flowers per plant for control). The increase in number of flowers/plant with the application of cycocel may be due to increased mobilization of biomass to flowers from sources. Similar results were also reported by Narayana Gawda and Jayanthi (1993) and Yadav (1997) in African marigold.

The present findings indicate (Table 1) that the CCC application at various levels had highly significant effect on the flower yield per plant in African marigold. Maximum flower yield was recorded with CCC treated plants at 2000 ppm (*i.e.* 229.68 g per plant as compared with 178.44g per plant for control). The increase in yield with CCC spray may be due to more number of branches and leaves per plant and also increase the number of flowers per plant thus ultimately increased the flower yield per plant. Similar results were also reported by Girwani *et al.* (1990) and Narayana and Jayanthi (1993) in African marigold and Aswathi *et al.* (1993) in China aster.

Conclusion:

Thus the present investigation clearly indicate that the application of gibberellic acid at 350 ppm was best treatment in all respect as it enhanced vegetative growth and flower yield. Further, cycocel at 2000 ppm was also beneficial as it increased flower yield and reduced vegetative growth without affecting initiation of flower bud and commencement of flowering.

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