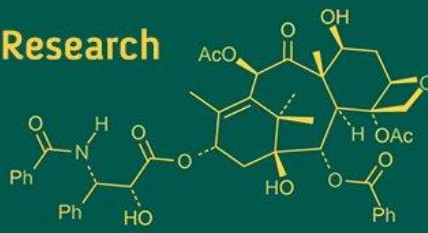


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(9): 872-875
www.biochemjournal.com
Received: 01-07-2026
Accepted: 05-08-2026

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Effect of plant growth retardant on vegetative growth and flowering of African marigold (*Tagetes erecta* L.)

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i9Sk.9933>

Abstract

The experiment effect of plant growth retardant on vegetative growth and flowering of African marigold (*Tagetes erecta* L.) was conducted during *rabi* season in 2025-26 at Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, (C.G.). The experiment was laid under Randomized Block Design (RBD) with seven treatments and replicated thrice *i.e.* (Control) T₀, (Single spray of CCC @ 500 ppm) T₁, (Single spray of CCC @ 750 ppm) T₂, (Single spray of CCC @ 1000 ppm) T₃, (Double spray of CCC @ 500 ppm) T₄, (Double spray of CCC @ 750 ppm) T₅ and (Double spray of CCC @ 1000 ppm) T₆. The result of experiment showed that among different treatments Double spray of CCC @ 1000 ppm (T₆) gave best results in terms of vegetative growth and flowering attributes *i.e.* reduced plant height (46.33 cm), maximum plant spread in the E-W (56.64 cm) and N-S (55.59 cm) directions, maximum number of primary (19.77) and secondary branches (34.50) plant⁻¹, thicker stem diameter (2.75 cm), maximum flower diameter (7.00 cm), minimum days to 50 % flowering (69.91 days) and increased duration of flowering (76.87 days). The findings observed that double foliar application of CCC @ 1000 ppm was most effective treatment for producing compact and well-branched plants, promoting early and prolonged flowering of African marigold.

Keywords: CCC, single spray, double spray, vegetative growth, flowering, African marigold

Introduction

Marigold is an important flower crop in India, which belongs to family Asteraceae. The name *Tagetes* was given after Tages, a demigod, known for his beauty. It is native to Central and Southern America specially Mexico. The two commercially important species are *T. erecta* L. commonly called African marigold and *T. patula* popular as French marigold. There are about 33 species of the genus *Tagetes*. Plants of *T. erecta* are hardy annual, tall about 90 cm, erect and branched. Leaf is pinnate, divided and leaflets are lanceolate and serrated. It has single or double flowers and large sized globular heads. The chromosome number in diploid species *i.e.* (*T. erecta*) is 2n = 24. Recently, the demand for marigold flowers is growing, for extraction of perfumes, natural colours and pigments. African marigold is recognized as a potential source of carotenoid pigments such as lutein and zeaxanthin perfumes, natural colours and pigments. African marigold is recognized as a potential source of carotenoid pigments such as lutein and zeaxanthin. They are currently used as food colorants, nutritional supplements and poultry feed additives to improve the colour of egg yolk and poultry skin colour (Hadden *et al.*, 1999) [5] and in ophthalmology for the treatment of diseases like cataract and age-related macular degeneration (ARMD). Some carotenoids act as precursors of vitamin A and protect the body from damaging reactions by acting as physiological antioxidants and thus improving the immunity of body. They also help to slow down the growth of induced skin tumors, other dermatological diseases and lowering overall risk of cancer in human beings (Gupta, 2014) [4]. The growth and yield of any plants are mainly affected by three major factors viz. genetic factor, environmental factor and management factor however, regulating plant growth and flowering by using the exogenous application of plant growth regulators might be helpful in regulating plant growth and flowering. Plant growth regulators constitute one of the fourth most important advances in agro-technology for improving plant growth, flowering and quality attributes in flower crops (Nuvalle *et al.*, 2010 and Kumar *et al.*, 2015) [13, 9].

Growth retardants control excessive vegetative growth by preventing excessive stem elongation and reducing internodal length in plants. Besides controlling plant height, application of growth retardant also helps to increase the number of lateral branches, suppress excessive vegetative growth, resulting in larger number of inflorescences (Latimer and Whipker, 2013) ^[11]. For the production of good quality Marigold and achieving higher economical yield. It has been found that the use of growth retardant such as of Chloreomequat Chloride and Daminozide were effective in many floriculture crops to induce lateral branches and to increase flower yield (Bailey and Whipker, 1998) ^[3]. Sachs *et al.* (1960) ^[16] reported that application of CCC retarded stem elongation by preventing cell division in the sub-apical meristem, usually without similarly affecting the apical meristem. CCC enforce stop the vertical growth consequently induces the lateral or horizontal growth. It is very important for establishing source and sink relationship, which could be artificially induced by using PGRs for the proportionate vegetative and reproductive growth.

Materials and Methods

The study effect of plant growth retardant on vegetative growth and flowering of African marigold (*Tagetes erecta* L.) was conducted at Horticultural Farm, Department of Floriculture and Landscaping, IGKV, Raipur (C.G.), during 2025-26. (Control) T₀, (Single spray of CCC @ 500 ppm) T₁, (Single spray of CCC @ 750 ppm) T₂, (Single spray of CCC @ 1000 ppm) T₃, (Double spray of CCC @ 500 ppm) T₄, (Double spray of CCC @ 750 ppm) T₅ and (Double spray of CCC @ 1000 ppm) T₆. The experiment was laid under Randomized Block Design (RBD) with three replications and seven treatments *i.e.* The single foliar spraying was applied at 40 DAT and double foliar spraying was done after 55 DAT. The foliar spray was done during afternoon hours by dissolving of 2 ml, 3 ml and 4 ml of CCC in a two liter of hand sprayer for 500 ppm, 750 ppm and 1000 ppm.

Results and Discussion

Vegetative growth parameters

Plant height (cm) - The reduced plant height (46.33 cm) was recorded in treatment (T₆) Double spray of CCC @ 1000 ppm which is *at par* Double spray of CCC @ 750 ppm (T₅) and Double spray of CCC @ 500 ppm (T₄) this may be due to reduction in plant height with CCC application may be attributed to its growth-retarding action. CCC suppresses excessive elongation of the stem and internodes, resulting in a shorter and more compact plant. Similar findings were reported by Khandelwal *et al.* (2003) ^[7], Sasikumar *et al.* (2015) ^[17], Majeed *et al.* (2017) ^[12], Khobragade *et al.* (2019) ^[8] and Kumar *et al.* (2026) ^[10] in African marigold.

Plant spread (E-S and N-S): Plant spread was significantly greater at (56.64 cm E-W) and (55.59 cm N-S) was recorded in the treatment Double spray of CCC @ 1000 ppm (T₆) which is *at par* Double spray of CCC @ 750 ppm (T₅) and Double spray of CCC @ 500 ppm (T₄) this may be due to the cycocel suppresses apical dominance, reducing plant height and promoting lateral vegetative bud growth by potentially disrupting carbohydrate metabolism through its anti-auxin activity. Similar findings were reported by Khan *et al.* (2012) ^[6], Sasikumar *et al.* (2015) ^[17], Wadgave *et al.* (2016) ^[19], Majeed *et al.* (2017) ^[12], Khobragade *et al.*

(2019) ^[8] in African marigold and Saiyad *et al.* (2010) ^[15] in gaillardia.

Number of primary branches per plant: Maximum number of primary branches plant⁻¹ (19.77) was recorded in the treatment of Double spray of CCC @ 1000 ppm (T₆) which was *at par* to treatment Double spray of CCC @ 750 ppm (T₅) this may be due to the elongation of the main shoot is restricted, lateral buds receive a greater opportunity to develop, resulting in more branched plant. The progressive increase with concentration and repeated spraying indicates that CCC exerted a stronger branching response at higher dose and with repeated application. Whereas, minimum number of primary branches plant⁻¹ (9.84) was recorded in control (T₀). Similar results were reported by Khandelwal *et al.* (2003) ^[7], Khan *et al.* (2012) ^[6], Pushkar and Singh (2012) ^[14], Sasikumar *et al.* (2015) ^[17], Majeed *et al.* (2017) ^[12], Wadgave *et al.* (2016) ^[19] and Khobragade *et al.* (2019) ^[8] in African marigold.

Number of secondary branches per plant: The maximum number of secondary branches plant⁻¹ (34.50) was recorded in the treatment of Double spray of CCC @ 1000 ppm (T₆) which is *at par* Double spray of CCC @ 750 ppm (T₅) and Double spray of CCC @ 500 ppm (T₄), Single spray of CCC @ 1000 ppm (T₃) and Single spray of CCC @ 750 ppm (T₂). Suppression of excessive shoot elongation and increased lateral growth for secondary branch formation. Similar findings were reported by Wadgave *et al.* (2016) ^[19], Majeed *et al.* (2017) ^[12], Sikarwar *et al.* (2017) ^[18] and Khobragade *et al.* (2019) ^[8] in African marigold.

Stem diameter (cm): Thicker stem diameter (2.75 cm) was recorded in the treatment of Double spray of CCC @ 1000 ppm (T₆) which is *at par* Double spray of CCC @ 750 ppm (T₅) and Double spray of CCC @ 500 ppm (T₄) this happened because CCC altered the stem growth by stopping excessive lengthwise elongation, making the plants sturdier and more compact. Whereas, minimum stem diameter (1.99 cm) was recorded in control (T₀). Similar findings were reported by Chauhan *et al.* (2016) ^[11] in African marigold.

Flowering parameters

Flower diameter (cm): The largest flower diameter (7.00 cm) was recorded in the treatment of Double spray of CCC @ 1000 ppm (T₆) which was *at par* Double spray of CCC @ 750 ppm (T₅) and Double spray of CCC @ 500 ppm (T₄). The larger flower diameter under CCC treatment may be associated with the favourable redistribution of plant growth and assimilates towards reproductive organs. While, minimum flower diameter (4.68 cm) was recorded in control (T₀). The similar findings were reported by Khan *et al.* (2012) ^[6], Majeed *et al.* (2017) ^[12] and Sikarwar *et al.* (2017) ^[18] in African marigold.

Days to 50% flowering: The minimum days (69.91 days) taken for flowering to 50 % was noticed under treatment Double spray of CCC @ 1000 ppm (T₆) which is *at par* Double spray of CCC @ 750 ppm (T₅) and Double spray of CCC @ 500 ppm (T₄). The earlier flowering under CCC may indicate that appropriate growth retardation promoted a faster shift towards reproductive development. The stronger response under repeated application suggests that the sustained growth-modifying effect of CCC helped plants

reach the reproductive stage earlier. Whereas, maximum number of days taken for 50 % flowering (80.40 days) was recorded in control (T₀). The similar finding was reported by Sikarwar *et al.* (2017) ^[18], Chundawat *et al.* (2025) ^[2] in African marigold.

Duration of flowering (days): Extended flowering duration significantly greater (76.87 days) was recorded under

treatment Double spray of CCC @ 1000 ppm (T₆) which is *at par* Double spray of CCC @ 750 ppm (T₅). The prolonged flowering period may be this may be due to the greater number of primary and secondary branches produced under CCC. While minimum flowering duration (53.71 days) was observed in control (T₀). Similar results were reported by Sasikumar *et al.* (2015) ^[17] and Wadgave *et al.* (2016) ^[19] in African marigold.

Table 1: Effect of plant growth retardant on plant height (cm), plant spread (cm), number of primary and secondary branches and stem diameter (cm) of African Marigold (*Tagetes erecta* L.)

Tr. No.	Treatments	Plant height (cm)	Plant spread (cm)		No. of primary branches	No. of secondary branches	Stem diameter (cm)
			E-W	N-S			
T ₀	Control (water spray)	60.29	34.92	33.32	9.84	26.99	1.99
T ₁	Single spray of CCC @ 500 ppm	55.76	42.61	40.29	13.20	29.37	2.08
T ₂	Single spray of CCC @ 750 ppm	53.98	44.12	42.49	14.91	30.57	2.31
T ₃	Single spray of CCC @ 1000 ppm	52.28	45.53	45.49	15.87	30.96	2.41
T ₄	Double spray of CCC @ 500 ppm	49.85	50.08	50.04	16.67	31.76	2.56
T ₅	Double spray of CCC @ 750 ppm	48.00	54.86	51.13	17.81	32.87	2.62
T ₆	Double spray of CCC @ 1000 ppm	46.33	56.64	55.59	19.77	34.50	2.75
	SEm (±)	1.54	1.56	1.79	0.68	1.39	0.11
	CD (p=0.05)	4.73	4.8	5.5	2.09	4.28	0.34
	CV (%)	5.08	5.75	6.8	7.63	7.76	0.72

Table 2: Effect of plant growth retardant on flower diameter (cm), days to 50 % flowering and duration of flowering (days) of African Marigold (*Tagetes erecta* L.)

Tr. No.	Treatments	Flower diameter (cm)	Days to 50 % flowering	Duration of flowering (days)
T ₀	Control (water spray)	4.68	80.40	55.71
T ₁	Single spray of CCC @ 500 ppm	5.53	78.73	57.75
T ₂	Single spray of CCC @ 750 ppm	5.60	76.51	59.92
T ₃	Single spray of CCC @ 1000 ppm	5.94	73.26	62.85
T ₄	Double spray of CCC @ 500 ppm	6.43	72.83	67.61
T ₅	Double spray of CCC @ 750 ppm	6.90	71.62	70.87
T ₆	Double spray of CCC @ 1000 ppm	7.00	69.91	76.87
	SEm (±)	0.12	2.23	2.34
	CD (p=0.05)	0.63	6.88	7.21
	CV (%)	5.93	5.17	6.30

Conclusion

On the basis of the experimental findings, it may be concluded that the application of treatment of Double spray of CCC @ 1000 ppm (T₆) was found to be more effective for the performance of different attributes such as reduced plant height (46.33 cm), maximum number of primary branches plant⁻¹ (19.77) and number of secondary branches plant⁻¹ (34.50), plant with more spreading (56.64 cm E-W) (55.59 cm N-S), thicker stem diameter (2.75 cm), maximum flower diameter (7.00 cm), minimum days to 50 % flowering (69.91 days) and increased duration of flowering (76.87 days) as compared to other applied treatments.

Acknowledgments

It is my privilege to conduct my research under Dr. S.K. Tamrakar (major advisor), Assistant Professor, Department of Floriculture and Landscaping, College of Agriculture, Raipur (C.G.), who provided me the research insight, illuminating, meticulous guidance and sustained support and heartiest thanks to nursery labourer's of horticultural farm for their active help during the entire course and experimental period.

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