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Analyzing the Effect of Different Doses of Cycocel and Maleic Hydrazide on Growth and Flowering of *Tagetes erecta* L. cv. Pusa Narangi Gainda (African Marigold)

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Authors' contributions

This work was carried out in collaboration among all authors. Author KW designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SP and BS managed the analyses of the study. Author RS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was carried out to access the effect of different doses of Cycocel and Maleic hydrazide on growth and flowering of African marigold (*Tagetes erecta* L.) cv. Pusa narangi gainda at Horticultural Research Center (HRC) of Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh during the year 2019-2020. The investigation was laid out in Randomized Block Design (RBD) with nine treatments and three replications. The results indicated that among the treatments, minimum plant height with the application of MH 250 ppm (57.03 cm), plant spread of east to west (45.17 cm), plant spread north to south (46.40 cm), the number of branches per plant (37.61), Days taken to first flower bud initiation (54.60 days), days has taken to opening of first flower (67.21 days), days have taken to opening of 50% flowering (83.72 days), duration of flowering (78.22 days), The study revealed that the number of branches and flowering duration significant higher than control and other treatment the height of plant also decrease.

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1. INTRODUCTION

Marigold is a member of the family Asteraceae, it is native to Central and South America especially Mexico. The genus comprises thirty species of strongly scented annual and perennial herbs. Cultivated genera include *Tagetes erecta* L. commonly referred to as African marigold. In addition the genus is recognized as a source of natural colorant, essential oil, and thiophenes [1]. There are around 33 species in genus Tagetes. The important species are *Tagetes erecta* L. (African marigold), *Tagetes spatula* L. (French marigold), *Tagetes sarmentosa* (climbing marigold), *Tagetes tenuifolia* Barti. Synon, Tagetes signata (Bush marigold), and *Tagetes lemmonis*. Among these species, *Tagetes erecta* L. and *Tagetes patula* L are the most important species and used for commercial cultivation. Among the flower crops, African marigold gained popularity amongst gardeners and flower growers on account of its simple culture and wide adaptability. It is an annual plant with a hardy vigorous and erect stem, which are bushy and branching towards the apex. Leaves are profussed, brilliant green, elegantly divided into dentate lanceolate segments and inflorescence varied from 5-12 cm in diameter. Flower colour of marigold is lemon yellow to yellow, golden yellow, orange or bronze.

The flower buds are conspicuous, well- shaped with longitudinal goves. According to the flower shape, it can be grouped into three categories i.e. carnation flowered, chrysanthemum flowered and peony flowered type. Marigolds are used as colour edging along with flower beds and walkways. The tall varieties, such as “Snowball” with its white blooms, work well as backdrops for other plants. The plant makes an excellent companion plant in hanging baskets and planters. At one time, it was believed that marigold repelled insects, while the strong scent of the heirloom varieties may keep rabbits and other wildlife away. It has been noticed that marigold highly effective in controlling the nematodes population. Marigold is also grown as a trap crop for the management of *Helicover paarmigera* (Hubber) in crops like tomato and tobacco and used as an eco- friendly component of IPM [2]. Commercially the plant growth retardants are used for suppressing apical dominance, retarding vegetative growth, lateral buds induction and production of a large number of flowers in various crops resulting in higher flower yield and easy cultivation [3]. The experiment was carried out to know the optimum.

2. MATERIALS AND METHODS

An experiment was carried out to access the effect of different doses of Cycocel and Maleic Hydrazide on growth and flower yield of African marigold (*Tagetes erecta* L.) at Horticultural Research Centre (HRC) of Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut, Uttar Pradesh during the year 2019-2020. The experiment was laid out in a randomized block design with three replication having a plot size of (2.6×2.6) m^2. The seedling of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda was transplanted 30 Days after seed sowing in the evening at a distance of 40×40 cm. The recommended dose of fertilizers i.e 120:80:80 kg/ha NPK was applied in the experimental field where the half dose of nitrogen, the full dose of phosphorus and potash was thoroughly mixed in the soil at the time of preparation of bed. The remaining half dose of nitrogen was applied one month after transplanting of seedlings. Irrigation was done just after transplanting and subsequent light watering was done for better establishment of all seedlings. After the establishment of plants, the field was irrigated at 15 days interval throughout the cropping period, harvesting of marigold fully open flowers during cool hours either in morning or evening time. The treatment included four levels of CCC (700, 800, 900 and 1000 ppm) and Maleic Hydrazide (100, 150, 200 and 250 ppm). Spraying of growth regulators were done 25 days after transplanting.

The vegetative characters such as height of plant, spread and number of branches per plant and flowering characters includes days taken to first flower bud initiation, day taken to opening of first flowers, days taken to opening of 50% flowering, duration of flowering, were recorded in five randomly selected plants per replication in each treatment. Data were analyzed by ANOVA.

3. RESULTS AND DISCUSSION

Vegetative Growth Attributes Performance of Vegetative growth attributes of African marigold cv. Pusa Narangi Gainda of different treatments given in Table 1.

3.1 Height of Plant

The results revealed that the minimum plant height (57.03 cm) was recorded with the application of MH 250ppm followed by MH@ 200ppm (58.70 cm) the plant height was found to be maximum (68.17 cm) with treatment T_1 control. The probable reason for decreasing plant height was primarily that these growth regulators are synthetic growth retardant which acts in a variety of way in natural growth mechanism of the plant. They either decrease cell division or inhibit cell elongation and reduce plant height acting in sub- apical system consequently, the plant becomes dwarfing as the internodes fail to elongate. Similar results were also reported by Singh [4] and Saiyed et al. [5].

3.2 Spread of Plant

The maximum spread of plant (45.17 cm) east to west and (46.40 cm) north to south was observed with the application of MH@ 250 ppm followed by application of CCC@ 1000 ppm (42.07 cm) east to west and (40.58 cm) north to south and a minimum spread of plant was found to be in treatment T_1 (31.18 cm) east to west and (31.03 cm) north to south with control. This is probably due to which MH has been known as an effective chromosome breaking agent in higher plants. MH on plant growth was mainly considered to result from the suppression of plant metabolism (inhibition of enzymic activity) and interference of the compound with plant hormones and growth regulators. MH acts as an inhibitor of the synthesis of nucleic acids and proteins. Plants can break down MH into several products, one of which, hydrazine, is a well-known mutagen and carcinogen. These results are in close conformity with the study of Khan et al. [6] and Naidu et al. [3].

3.3 Number of Branches

The number of branches per plant the maximum number of branches per plant (37.61) was observed in the treatment T_9 with (MH 250 ppm) followed by treatment T_7 with MH 150 ppm(35.64).The number of branches per plant was found to be minimum (24.02) in the treatment T_1 with control. MH severely inhibited the growth of the plant. At low doses, MH broke apical dominance and side branches were developed. The suggestion is made that the inhibition of shoot induced by MH is due to primarily blocking the activity of the hormones. Similar results were also reported by Khandelwal et al. [7] and Navale et al. [8].

3.4 Days Taken to First Flower Bud Initiation

The number of days for flower bud initiation was found to be (54.60) in the treatment T_9 with (MH 250 ppm) followed by treatment T_8 with MH 200ppm (53.79), the number of days for flower bud initiation were found to be maximum (48.91) in the treatment T_1 with control. This results in the production of buds in the shoot apical meristem of the branches instead of producing leaves Pawar et al. [9] and Kumar et al. (2014).

3.5 Days Taken to Opening of First Flower

The days of first flowering was found to be (67.21 days) in the treatment T_9 with (MH 250 ppm) followed by treatment T_1 with CCC 1000ppm (64.81 days). The number of days for first flowering was found to be minimum (61.24 days) in the treatment T_1 with control. This may be probably due to Cycocel slows down the cell division and cell elongation in meristematic tissues of the shoot and regulate the plant height without formative effect and change the morphology and physiology of the plant. A similar result was observed by Pawar et al. [9] and Malik et al. [10].

3.6 Days Taken to Opening of 50% of Flowering

The treatment T_9 with MH 250ppm was found to be (83.72 days), followed by treatment T_8 with MH 200 ppm (79.45 days). The number of days to the opening of 50% Flowering was found to be maximum (74.31 days) in the treatment T_1 with control. These results are in close conformity with the study of Mishra and Pandey [11] and Pawar et al. [9].

3.7 Duration of Flowering

MH was most found effective in extending the flowering duration (78.22 days) especially with MH 250 ppm followed by CCC@ 1000 ppm (76.08 days) and similar result was observed by Sharifuzzaman et al. [12] and Khan et al. [6].

Table 1. Effect of different doses of CCC & MH on growth and flowering of African marigold

Treatments		Height of plant (cm)	Spread of plant (cm)		Number of branches	Days taken to first flower bud initiation	Days taken to opening of first flower	Days taken to opening of 50% of flowering	Duration of Flowering
			E-W	N-S					
T_1	Control	68.17	31.18	31.03	24.02	48.91	61.24	74.31	53.64
T_2	CCC 700 ppm	67.33	33.67	33.05	30.69	50.45	61.84	75.14	70.87
T_3	CCC 800 ppm	67.13	34.88	37.07	32.70	50.71	63.97	75.94	73.07
T_4	CCC 900 ppm	65.07	36.73	38.11	34.83	51.97	64.10	76.57	73.17
T_5	CCC 1000 ppm	64.93	42.07	40.58	35.45	52.76	64.81	76.84	76.08
T_6	MH 100 ppm	63.60	35.47	37.40	32.63	52.43	62.16	75.24	73.43
T_7	MH 150 ppm	62.60	36.07	38.37	35.64	53.76	62.97	76.74	74.08
T_8	MH 200 ppm	58.70	39.93	40.09	35.17	53.79	64.81	79.45	75.57
T_9	MH 250 ppm	57.03	45.17	46.40	37.61	54.60	67.21	83.72	78.22
SEm±		**1.52**	**2.28**	**1.59**	**1.12**	**0.73**	**1.03**	**0.94**	**1.27**
CD at 5%		**4.62**	**6.91**	**4.82**	**3.38**	**2.23**	**3.14**	**2.86**	**3.84**

4. CONCLUSION

Based on results obtained from the present investigation, it may be concluded that among the Treatment Maleic Hydrazide 250 ppm was found to be the most suitable for increasing the number of branches, Days taken to first flower bud initiation, Days taken to opening of the first flower, Days taken to opening of 50% of flowering duration of flowering and decrease height of the plant African marigold (*Tagetes erecta* L.) cv. Pusa narangi gainda. This can be used to maximize the return from African marigold cultivation in the western region of U.P.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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