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Studies on effect of pinching and spacing on growth and flowering of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda

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Abstract
The field experiment was conducted to study the "effect of pinching and spacing on growth and flowering of African marigold (*Tagetes erecta* L.) *cv.* Pusa Narangi Gainda." was carried out during rabi season in the year 2022-23 at Pt. KLS College of Horticulture and Research Station, Rajnandgaon, (C.G.) with three level of spacing and 3 level of pinching. The double pinching (40 DAT) showed significantly maximum stem diameter, maximum number of primary branches per plant, maximum number of secondary branches per plant, maximum plant spread and maximum number of leaves per plant, maximum number of flowers per plant, maximum flower diameter and maximum individual flower weight. While minimum days of first flower bud appearance, minimum days to first flowering, minimum days to taken 50% flowering maximum plant height, maximum flower yield per plot and hectare was recorded under no pinching.

Keywords: African marigold, pinching, spacing

Introduction
African marigold (*Tagetes erecta* L.) belongs to the family of Asteraceae. This family, which is native to North and South America, including Mexico. It has 1,600 genera and 2300 species, including herbs, shrubs, climbers, and medicinal plants (Hussain and Latif 2012) [6]. Portuguese colonists brought it to India. Despite the fact that flowers are grown nationwide, only a few states have major commercial flower farms. (Bhardwaj *et al.*, 2001) [2]. Different agro techniques, such as planting distance, pinching, weeding, fertilizer application, etc., have a considerable impact on the marigold's development and flowering patterns. The individual plant may have enough space during broad planting for growth and development. In contrast, closer spacing gives the plants little space to grow, which results in a severe loss in output per unit of space planted. This is because broad spacing results in higher production per unit of space planted. Therefore, planting spacing should be taken into account to mass produce enough blooms of high quality in African marigolds. Pinching play important role to divert assimilates into lateral buds, and branching occurs if the growing tips are pinched out. (Dorajeerao *et al.*, 2012) [4]. It gives the plant additional flowers and makes it bushy and compact. For effective marketing, flower yield and blooming time management are directly related. As one of the most popular crops for the domestic market, efforts must be made to boost flower quality and quantity by optimizing cultural procedures, such as pinching and plant spacing, in order to fully utilize one's best resources and earn a profit.

Materials and Methods
The experiment was carried out during Rabi season in the year 2022-23 at Pt. Kishori Lal Shukla College of Horticulture and Research Station, Pendri, Rajnandgaon. The treatments comprised of three level of spacing's *viz.*, S1 (60 cm x 60 cm), S2 (60 cm x 45 cm) and S3 (60 cm x 30 cm) and three level of pinching P1 (No pinching), P2 (20 Day After Transplanting) and P3 (40 Day After Ttransplanting). The treatments were replicated thrice in a Randomized Block Design with Factorial concept.

Results and Discussion

The data regarding performance of effect of pinching on growth and flowering has been presented in Table 1 and 2.

Effect of pinching on growth parameter

The maximum plant height (49.40 cm) at 90 DAT, was observed with treatment no pinching. The reduction in the plant height in double pinched plant was mainly due to the removal of apical meristematic tissue, which prevented apical dominance and redirected plant metabolites from vertical development to horizontal growth, Similar results are also found by Baskaran *et al.* (2017) [1] in African marigold.

Stem diameter the double pinching (40 DAT) produced maximum stem diameter (0.97 cm) at 90 DAT. The promotion of cell division, expansion, and ultimately increased cell size of the stem could be the cause of the pinching-induced increase in stem diameter. These observations are in agreement with the findings of Rathore (2007) [14].

The maximum number of primary branches (10.46) were recorded under double pinching (40 DAT) at 90 DAT. It might be due to when the apical buds are pinched, the lowering in concentration of IAA encourages the lateral buds to grow and produces new shoots and branches which can be relate to the fact that decrease in IAA overcome apical dominance (Singh *et al.* 2017) [16]. Similar results were also found by Baskaran *et al.* (2017) [1], Singh *et al.* (2017) [16] and Jyothi *et al.* (2018) [7] in marigold.

The higher number of secondary branches per plant (46.19) was recorded under double pinching (40 DAT) at 90 DAT. There was a significant increase in the number of secondary branches per plant with each pinching treatment due to supply of more plant assimilates towards the side branching after the pinching process. These observations are in agreement with the findings of Rathore (2007) [14] and Meena *et al.* (2015) [10].

The maximum plant spread (34.77 cm) was observed in case of double pinching (40 DAT) at 90 DAT. The possible reason for more plant spread under different pinching treatments may be due to cell elongation and pinching reduced the apical growth of stem, which finally results in more number of secondary branches per plant. Similar views have also been expressed by Maharnor *et al.* (2011) [9], Mohanty *et al.* (2015) [11] and Jyothi *et al.* (2018) [7] in African marigold.

The maximum number of leaves per plant (169.03) was observed under double pinching (40 DAT) at 90 DAT. The possible reason for higher number of leaves per plant in different interval of pinching may be the result of increased cell division, photosynthetic activity, and metabolic activity. Similar views have also been expressed by Mohanty *et al.* (2015) [11].

Effect of pinching on flowering parameters

The minimum days of first bud appearance (58.09 days) was noted under no pinching. This might be due to the fact that pinching of apical bud suppresses the bud initiation process by inhibiting cell division in the lateral meristem resulting in prevention of flower primordial development in the meantime which would have ultimately resulted in delayed initiation of bud and shortest duration of flowering. These results are in line with the findings of Singh *et al.* 2017 [16] and Kumar *et al.* 2002 [8].

The minimum days taken to first flowering (66.40 days) were recorded with no pinching. This may be due to the fact that after removal of apical portion of the plant, the plant enters into the vegetative phase and the new shoots took maximum time to get physiological maturity. Similar views have also been expressed by Srivastava *et al.* (2005) [17] and Halagi *et al.* (2023) [5] in African marigold.

The maximum number of flowers per plant which was found (56.90) in double pinching (40 DAT). The fact that a pinched plant produces a lot of axillary branches, which results in bushy, well-shaped plants with a greater number of flowers, could be the cause of the increase in flower number. Similar result was obtained by Bhat *et al.* (2007) [3] in marigold.

The maximum flower diameter (4.92 cm) of flower was recorded under no pinching. This decrease in flower diameter might be attributed to the fact that in pinched plant energy is shared by the developing side branches, while in case of un pinched plants the energy sharing is limited to the flower developing on main branch only. These results are in conformity with findings of Nain *et al.* (2017) [12] and Poudel *et al.* (2017) [13] in marigold.

The maximum flower weight (9.63 gm) was recorded under no pinching. This might be due to the accumulation of more assimilates in no pinching treatment. These results are in similar with the findings of Baskaran *et al.* (2017) [1].

The minimum number of days taken for 50 per cent flowering (62.22 days) was found under no pinching. The possible reason for maximum days taken for 50 per cent flowering under different pinching treatments may be due to fact that new shoots which emerged after pinching took more time to become physiologically mature to bear flowers. The present findings are in accordance with the report of Sehrawat *et al.* (2003) [15], Halagi *et al.* (2023) [5] and Rathore (2007) [14] in African marigold.

Table 1: Growth parameter in African marigold cv. pusa Narangi Gainda as influenced by pinching.

Treatment	Plant height(cm)	Stem diameter (cm)	Number of primary branches per plant	Number of secondary branches per plant	Plant spread (cm)	Number of leaves per plant
Pinching No pinching (P1)	49.40	0.91	8.80	43.18	32.44	161.83
Single pinching (20 DAT)	48.12	0.95	9.59	44.49	33.51	164.53
Double pinching (40 DAT)	46.23	0.97	10.46	46.19	34.77	169.03
CD at 5%	1.05	0.014	0.23	0.37	0.28	0.73
S.E(m)	0.35	0.005	0.08	0.12	0.16	0.24

Table 2: Flowering parameter in African marigold cv. pusa Narangi Gainda as influenced by pinching.

Treatment	Days of first bud appearance	Days to first flowering	Number of flowers per plant	Flower diameter (cm)	Flower to taken 50% flowering	Individual flower weight (gm)
Pinching No pinching (P1)	58.09	66.40	53.12	4.92	62.22	9.63
Single pinching (20 DAT)	59.66	68.09	54.49	4.60	64.14	9.47
Double pinching (40 DAT)	61.50	69.87	56.90	4.41	66.17	9.23
CD at 5%	0.25	0.23	0.30	0.05	0.24	0.15
S.E(m)	0.08	0.08	0.10	0.02	0.08	0.05

Conclusion

The following conclusion may be drawn from the result of this study. In case of pinching double pinching (40 DAT) gives significantly better performance at vegetative parameters like stem diameter, number of primary branches per plant, number of secondary branches per plant, plant spread and number of leaves per plant and as well as flowering parameters like number of flowers per plant, maximum flower diameter, individual flower weight, while no pinching gives minimum days of first bud emergence, minimum days to first flowering and days to taken 50% flowering and maximum plant height.

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