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Research Article

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A Review on Effect of Pinching on Growth, Flowering and Flower Yield of Marigold

Rajmani Singh[1*], M.L. Meena[1], Sudhansu Verma[2], Sandeep K. Mauriya[3], Shatrunjay Yadav[1], Viplaw Kumar[1], Vipnesh Singh[1], Lalit Kumar[1] and Shree Kant Maurya[1]

[1]Department of Horticulture, Babasaheb Bhimrao Ambedkar University, Vidya-vihar, Rae Bareli Road, Lucknow- 226 025 (U.P.),

[2]Institute of Agriculture Science, B.H.U. Varanasi

[3]Narayan Institute of Agriculture Science, Gopal Narayan Singh University, Jamuhar, Rohtas, Bihar

*Corresponding Author E-mail: rajmani813926@gmail.com

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ABSTRACT

A study was carried out to review on effect of pinching on flower yield of marigold. The number of experiments reviewed that consist of treatments like o pinching, Single pinching, Double pinching. The results showed by different experiment that have maximum plant spread, number of branches, duration of flowering, number of flowers per plant, size of flower, weight of single flower, flower yield per plant and seed yield per plant were observed in the double pinching treatment. The flower yield was maximum in double pinching with three times more yield than the control.

Keywords: *Marigold, Pinching, Flowering, Growth and Yield.*

INTRODUCTION

Marigold (*Tagetes erecta* L.*)* belongs to the family: Asteraceae and it is native to South and Central America especially Mexico. It is also known as 'Gainda' in Hindi. The genus Tagetes comprises about 33 species reported by Rayberg, (1915). Amongst these, *Tagetes erecta L.* and *Tagetes patula* L. are more commonly grown for their ornamental values while *Tagetes minuta* L. is grown for its high content of essential oil. Out of these, mainly two types are commercially grown in India *viz*., African marigold (*Tagetes erecta* L., 2n = 24) and French marigold (*Tagetes patula* L., 2n = 48). It is one of the oldest cultivated flowering plants, comes under the ornamental being very popular in tropical and sub-tropical countries as a garden plant for beautification. *Tagetes erecta* L. is commonly known as African marigold. The plant of *Tagetes erecta* L. is hardy annual, tall in nature 90 to 95 cm height, erect and more branching. Leaf is pinnate, divided and leaflets are lanceolate and serrated. It has large sized flower. Flower colours are yellow and orange in various shades *i.e.* light yellow, golden yellow, bright yellow, deep orange, golden yellow and bright orange. The florets are quilled or two lipped.

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In India, major flower growing states are West Bengal, Tamil Nadu, Karnataka, Uttar Pradesh, Kerala, Andhra Pradesh and Maharashtra, etc. In India about 307.87 thousand hectare area under floriculture with production estimated to 1805.92 thousand MT of loose flower and 704.23 thousand MT of cut flower. In India maximum area of flower covered by Karnataka state (52.37 thousands hectare), maximum production of loose flower is covered by Tamil Nadu state (426.66 thousands MT) and maximum production of cut flower is covered by West Bengal (203.42 thousands MT), (Anonymous, 2017).

Pinching is the process of removal of apical bud along with few leaves. Pinching delays the flowering but increases the number of flowers. Work on pinching has been done on marigold and it responded well for flower production but limited information is available on effect of double pinching in marigold. The main purpose of this operation is to encourage branching to produce a bushy growth and/or the production of more flowers, and enhance flower and seed yield.

EFFECT OF PINCHING ON GROWTH

A field experiment conducted on African marigold cv. "Crackerjack" comprised with three levels of pinching i.e. no pinching, early pinching at 20 days after transplanting (DAT) and late pinching at 30 DAT, among these treatments no pinching treatment significantly increased fresh and dry weight (Joshi et al., 2002). Pinching at 20 days after transplanting significantly reduced the plant height (49.39 cm) but produced more number of secondary branches per plant (35.29) compared to no pinching (63.46 cm and 24.91, respectively) in marigold (Srivastava et al., 2002). An experiment that the pinching at 25 days after transplanting under the spacing of 20 x 30cm produced maximum plant spread and fresh weight of plant in chrysanthemum (Beniwal et al., 2003). pinching at 20 days after planting resulted in reduction in plant height (72.82 cm) and produced more number of branches per plant(58.03) compared to control (109.90 cm and 38.62, respectively) in African marigold (Khandelwal et al., 2003). Sehrawat et al. (2003) noticed that pinching at 30 days after transplanting significantly decreased the plant height (63.52 cm) as compared to control (80.20 cm) in marigold. Chauhan et al. (2005) observed that pinching in African marigold cv. Pusa Narangi Gainda resulted reduction in plant height (17.60 cm) and more number of branches (11.22) per plant when the plants were pinched at 30 DAT (days after transplanting) compared to no pinching (27.66 cm and 9.64, respectively). Pinching in marigold at 40 days after transplanting produced maximum number of primary branches per plant and number of leaves per plant, while plant spread and number of secondary branches per plant was recorded maximum in pinching at 20 days after transplanting (Sharma et al., 2006). Sunitha et al. (2007) carried out an experiment in African marigold cv. Orange Double resulted maximum plant height with no pinching (98.8 cm) as compared to pinching (87.3cm), while the number of primary branches per plant maximum in pinched one(12.0) as compared to no pinching (9.9). Bhat & Shephered (2007) noticed that the effect of pinching on the growth of African marigold cv. Pusa Narangi Gainda and found that maximum number of branches per plant, plant height, spread of plant were with single pinching at 35 days after transplanting as compared to no pinching and double pinching at 39 days after transplanting. A field experiment with marigold cv. Pusa Basanti Gainda and observed that maximum number of secondary branches when pinching was done at 30 days after transplanting as compared to 40 days after transplanting (Rajbeer et al. 2009).

Rathore et al. (2011) carried out a field experiment on effect of pinching in African marigold cv. Pusa Basanti Gainda was conducted and the results revealed that pinching treatment significantly decreased the plant height (64.40 cm), increased number of primary branches (37.67) as compare to control. Maharnor et al. (2011) reported maximum plant height in African marigold with no pinching, whereas number of primary branches per plant, spread of plant and stem

diameter were maximum with pinching at 30 DAT. Kour et al. (2012) observed that pinching in marigold at 40 days after transplanting produced more number of secondary branches per plant. A research carried out in African marigold with three level of pinching (30, 40, and 50 days after transplanting) during rainy season and observed that the plant height maximum in pinching at 30 days after transplanting (71.38cm) as compared to pinching at 40 days after transplanting(70.25cm) and 50 days after transplanting (68.72 cm). However, spread of plant and number of primary branches per plant maximum in pinching at 40 days after transplanting as compared pinching at 30 and 50 days after transplanting (Kumar et al. 2012). Rajyalakshmi & Rajashekhar (2014) conducted a research on effect of pinching on growth and flowering of African marigold cv. Pusa Narangi Gainda and observed that maximum plant height without pinching (65.38cm) as compared to pinching (61.02cm).A field experiment during 2010-12 in African marigold comprised four levels of pinching i.e.0,15, 22 and 30 DAT and recorded that plant height (89.15 and 95.10 cm, respectively) and number of branches (18.60 and 18.70 respectively) increased significantly with pinching at 15 DAT and minimum in without pinching (Badge et al. 2014). Gnyan dev et al. (2014) carried out research on effect of pinching on the growth of China aster cv. Phule Ganesh resulted that maximum number of branches (11.60) and leaves (42.29) per plant when pinching at 15 days after transplanting as compared to no pinching (9.71 and 37.16, respectively) while, plant height was maximum in no pinching (48.38cm) as compared to pinching at 15 DAT (44.54cm). Singh et al. (2015) to find out the effect of pinching and nitrogen on African marigold cv. Pusa Narangi Gainda, resulted that double pinching with 2% nitrogen significantly increased number of secondary branches, number of leaves per plant, plant spread, plant height as compared to single pinching, whereas single pinching at 3% nitrogen significantly increased number of primary branches per plant. Sasikumar et al. (2015) carried out research on effect of pinching on growth and flowering in African marigold cv. Pusa Narangi Gainda found that maximum plant height (67.0cm) with no pinching as compared to pinching (52.33cm) while spread of plant (34.0 cm^2) and number of primary branches per plant (9.33) maximum in pinching as compared to no pinching (29.0 cm^2 and 5.33, respectively). African marigold with no pinching have maximum plant height as compared to pinching at 30 and 60 DAT but the number of branches per plant maximum in pinching at 60 DAT (21.91) as compared to no pinching (11.92) and pinching at 30 DAT (18.53). Stem diameter of plant were minimum in case of pinching at 60 DAT (1.35 cm) and no pinching (1.35 cm) and maximum in pinching at 30 DAT (1.36 cm) (Meena et al., 2015). Mohanty et al. (2015) observed that four planting dates and three levels of pinching. November planting resulted in more plant spread (north-south, east-west direction), number of leaves, primary and secondary branches per plant. November planting was found beneficial in improving several floral characters like diameter (5.00 cm), number as well as weight of flowers per plot (843.55, 5422.66 g, respectively) and yield of flower per hectare (20083.92 kg). Shoot pinching at 30 days after planting improved plant spread, number of leaves, as well as weight of flowers per plot (3745.95 g) and yield of flowers per hectare (13873.0 kg). Interaction effect of November planting with single pinching was found beneficial in improving flower yield per hectare (21382.96 kg) weight of the plant as compared to no pinching. Parhi et al. (2016) investigated that maximum plant height was found with no pinching (50.89cm) as compared to single pinching (47.52 cm) whereas leaf area (23.31cm^2) and stem diameter (1.30 cm) was highest in pinched one as compared to no pinching (22.61cm^2 and 1.24cm, respectively) in African marigold cv. Sirakole. Chauhan et al. (2016) result revealed that pinching was significantly increased the plant spread (52.14cm), number of leaves per plant

(363.24), leaves area per plant (90.45cm^2) as compared to no pinching (47.17 cm, 327.17, 82.85 cm^2,respectively). Prakash et al. (2016) recorded maximum plant height in no pinching (55.24 cm and 115.80 cm, respectively) as compared to pinched one (38.28 cm and 107.90 cm, respectively) whereas number of primary branches per plant (14.08 and 16.40, respectively) and number of secondary branches per plant (62.20 and 59.48, respectively) were maximum in pinching treatment as compared to lowest in no pinching. Sarkar et al. (2018) reported that among the pinching treatments, pinching at 40 DAT recorded significantly maximum number of branches (40.55 branches/plant), total leaf number (180.54), number of flowers (62.78) as compare to other treatments. Plant height (86.61 cm) was found under no pinching. Plant pinched at 15 days after transplanting recorded maximum flower yield, gross, net monetary returns with higher B:C ratio African marigold (Badge & Panchbhai 2018). Palekar et al. (2018) revealed that, significantly maximum stem diameter, primary and secondary branches plant^{-1} and flower yield plant-1were noted with the plants treated with double pinching + 125 kg N ha^{-1} Wani et al. (2018) reported pinching at visible bud stage, significantly improves plant spread (37.73 cm), leaf area (5883.25 cm2), Leaf Area Index (LAI) (21.15), chlorophyll content (60.63), number of primary (16.64) and secondary branches (23.19), Increasing planting density increased plant height (81.26 cm), LAI (23.63) as compare to other treatments.

EFFECT OF PINCHING ON FLOWERING AND FLOWER YIELD

Effect of pinching on chrysanthemum cv. MDU-1. The maximum number of flowers and the maximum flower yield per plant (252.82 g) was obtained when plants were pinched on the 60 days after transplanting as compared to the plants where pinching was done at 30 days after transplanting (Yassin & Pappiah, 1990). Pinching did not increase flower production but delayed it by 10-20 days in Ludhiana condition. They suggested that the delay could be useful for regulating flower production and avoiding a glut in the market (Arora & Khanna 1986). Phetpradap et al. (1994) observed effect of pinching in hybrid dahlia cv. "UnwinsMixed". Pinching increases days to first flowering (81 days), as compare to without pinching (67 days) and no differences in number of flowers per plant (34.7) were recorded. The double pinching produced maximum number of cut blooms/ m^2 (177.77) and delayed flowering, but the stems were weak and short (21.10 cm) and the unpinched plants were early to flower (100.53 days), had longest stems (48.77 cm) and maximum flower size (6.98 cm), but the flower yield/ m^2 was very low (11.11) (Pathania et al., 2000). Sajjan et al. (2002) noticed that pinching at 20 days after sowing in okra produce more number of fruits (9.01 / plant), processed seed yield (951.90 Kg/ha) and seed recovery (81.15%) compared to no – pinching (6.57, 718.80 Kg / ha and 73.12%, respectively). Srivastava et al. (2002) recorded maximum number of flowers per plant (58.18) and flower yield (30.99 tonnes/ha) due to pinching at 40 days after transplanting compared to no pinching (42.80 and 22.40 tonnes/ha, respectively) in African marigold cv. Pusa Narangi Gainda. Kumar et al. (2002) carried out a field experiment on carnation to find out the effect of pinching and observed that pinching (once at 4 weeks after transplanting and twice at 4 and 8 weeks after transplanting) resulted into delayed in bud initiation (99.74 days),flower opening (129.93 days) and peak flowering(154.53 days) in comparison of control. Khandelwal et al. (2003) conducted a field experiment on effect of pinching on African marigold revealed that plants pinched 20 days after planting resulted in reduction of plant height (72.82 cm) and produced more number of branches (58.03) and flowers per plant (63.15) and highest flower yield (167.80 q/ha) as compared to no pinching. Pinching in marigold at 30 days after transplanting increased the number of days to flower bud initiation, delayed flowering and flowering duration as compared to without pinching (Sehrawat et al., 2003). Pinching at 35 days after transplanting gave more yield (104.38 g)

per plant compared to control (98.88 g/ plant) in chrysanthemum (Rakesh et al., 2003). Pinching in chrysanthemum at 30 days after transplanting produced more number of flowers (53.90) per plant compared to control (36.80) (Singh & Baboo, 2003).

The yield of flowers per plant significantly increased over control when plants were pinched at 35 days after transplanting in chrysanthemum cv. Flirt (Singh et al. 2003). Tomar et al. (2004) revealed that maximum number of flowers per plant (48.34) was obtained due to double pinching, followed by single pinching (32.86) as compared to control (17.63) in African marigold. Naik et al. (2004) observed that pinching at 40 days after transplanting recorded maximum flower yield (16.44 t/ha) as compared to unpinched plants in marigold. Grawal et al. (2004) reported that pinched plants took more number of days (138.35 days) to bud break and produced more number of flowers per plant (10.53) than unpinched plants (129.74 days and 7.81 flower per plant, respectively) in chrysanthemum. Beniwal et al. (2003) noticed in an experiment on chrysanthemum that plant pinched at 25 DAT exhibited flowers with maximum size, weight and yield of flower as compared to other pinching treatments i.e., pinching at 35 and 45 DAT. Chauhan et al. (2005) reported that pinching at 30 days after transplanting recorded more number of flowers per plant (19.76) and flower yield (1700.78 g/m^2) as compared to control (17.60 and 1120.53 g/m^2) in African marigold cv. Pusa Narangi Gainda. Effect of pinching (no pinching, pinching at 20, 30 and 40 days after transplanting) on flowering of African marigold cv. Pusa Basanti Gainda, resulted that pinching at 40 days after transplanting delay in flowering, increased flowers per plant and improved flower quality as compared to no pinching and pinching at 20 and 30 DAT (Shrivastava et al., 2005). Singh et al. (2005) recorded maximum flower size (5.7 cm) with single pinching while plant spread (25.0 cm) and the number of branches per plant (8.5) was recorded maximum with double pinching in carnation. Dalal et al. (2006) reported maximum nodes per flower stalk, flower bud appearance, diameter of flower, cumulative uptake of water and vase life were observed in no pinching, while shoots per plant, flower yield per plant and flower yield/m^2 were observed maximum with double-pinching in carnation cv. Yellow Solar. Sunitha et al. (2007) reported that pinching of marigold cv. Orange Double significantly increased the number of flowers (61.9) as compared to no pinching (50.6). Bhat & Shephered (2007) reported that double pinching significantly increased number of flowers per plant (63.81) and size of flower (5.05cm) as compared to single pinching in African marigold cv. Pusa Narangi Gainda. Rajbeer et al. (2009) carried out a field experiment on marigold cv. Pusa Basanti Gainda with two levels of pinching i.e. one at 30 days and another at 40 days after transplanting, resulted that maximum number of flowers per plant (18.64) was obtained when pinching was done at 40 days after transplanting.

Pinching increased the number of flowers per plant (82.14) and flower yield (96.78 q/ha) as compare to no pinching (68.78 and 86.35 q/ha) whereas, fresh weight (7.64 g) and dry weight (5.16 g) of flower was maximum in no pinching as compare to pinched one (7.12 g and 4.31 g) (Rathore et al. 2011). Khobragade et al. 2012) resulted that number of flowers per plant (55.52) and flower yield per plant (334.70 g) was maximum in pinched plant as compare to unpinched (39.47and 266.91 g, respectively) whereas, the flower diameter (5.72 cm) and fresh weight of flower (6.59g) was maximum in case of no pinching as compare to pinched one (5.58 cm and 6.02g). Pushkar & Singh (2012) observed that the bud initiation and first flower visibility, maximum duration of flowering was recorded at pinching 30 days after transplanting whereas, stalk length, number of flowers per plant were recorded with pinching 20 days after transplanting. The highest flower yield (203.00 q/ha) was obtained with pinching of terminal shoots at 30 days after transplanting in African marigold as compared

to no pinching (Sharma et al. 2012). No pinching significantly increased the flower diameter (5.61 cm) and fresh weight of flower (2.0g) as compare to single pinching (5.21cm and 1.96g, respectively) and double pinching (4.38 cm and 1.71g, respectively) in China aster (Sailaja et al., 2013). Badge et al. (2014) was recorded that maximum number of flowers per plant (31.10 and 34.10, respectively), with pinching at 15 days after transplanting as compared to no pinching (24.35 and 25.01, respectively), pinching at 22 days after transplanting(27.98 and 32.21, respectively) and pinching at 30 days after transplanting (29.69 and 32.62, respectively). Rajyalakshmi & Rajashekhar (2014) observed that number of flowers maximum in pinched plant (28.25) as compared to no pinching (23.55). Badge et al. (2015) resulted that earliest days to bud initiation and days to first harvesting, maximum diameter of flower and pedicel length recorded in no pinching whereas, number of flowers and flower yield per plant was maximum in pinching at 15 days after transplanting. Singh et al. (2015) resulted that increased number of flowers per plant (53.33) and early to flowering (34.33 days) due to single pinching as compared to double pinching (46.33 and 37.67 days respectively). Meena et al. (2015) carried out a field experiment on African marigold cv. Pusa Narangi Gainda with three level of pinching (i.e. no pinching, single pinching at 30 days after transplanting and double pinching at 30 and 60 days after transplanting) and were found that double pinching delayed the flowering (94.85 days) but maximum number of flowers per plant (34.91) followed by single pinching (77.12 days, 31.97) and no pinching (71.35 days, 28.90). Parhi et al. (2016) carried research on African marigold cv. Sirakole with three levels of pinching (i.e. no pinching, single pinching at 30 days after transplanting and double pinching at 30 and 45 days after transplanting) were observed that double pinching significantly delayed in appearance of flower bud (59.50 days) followed by single pinching (52.50 days) while it was earliest in unpinched plant (48.33 day), Whereas maximum number of flowers produced in plant with single pinching (39.34) followed by double pinching (38.16) and no pinching (34.50). Prakash et al. (2016) reported that effect of pinching on two varieties (Pusa Narangi Gainda and Pusa Basanti Gainda) of African marigold resulted that earliest days to first flowering and maximum duration of flowering in no pinching whereas number of flowers per plant and flower yield per plant was maximum in pinched one. Singh et al. (2018) reported that pinching at 30 DAT recorded significantly maximum flowers yield (224.10 q/ha) as compare to other treatments. Palekar et al. (2018) revealed that, maximum weight of flower, number of petals flower-1 and longevity of flower were recorded with the plants treated with no pinching + 125 kg N ha. Sarkar et al. (2018) observed that among the pinching treatments, pinching at 40 DAT recorded significantly maximum flower yield per hectare (10.20 t) as compare to other treatments.

CONCLUSION

Pinching might be due to the fact that by removal of apical portion move energy might have been to promote the number of side branches. Number of side branches directly positive correlated the yield of flowers in African marigold. From above study plants pinched between 20 to 40 DAT were found best for better growth, flowering and yield of marigold.

REFERENCES

Arora, J.S., & Khanna, K. (1986). Effect of nitrogen and pinching on growth and flower production of marigold (*Tagetes erecta*). *Indian Journal of Horticulture, 43,* 291-293.

Badge, S., Panchbhai, D.M., & Dod, V.N. (2014). Response of pinching and foliar application of gibberellic acid on growth and flower yield in summer African marigold. *Research on Crops*. *15*(2), 394-397.

Badge, S., Panchbhai, D.M., & Patil, S. (2015). Regulation of flowering by

pinching and foliar application of gibberellic acid in African marigold (*Tagetes erecta* L.). *Indian Horticulture Journal*. *5*(1/2), 41-46.

Beniwal, B.S., & Ahlawat, V.P. (2003). Studies on the effect of spacing and pinching on growth and flower production of chrysanthemum cv. Flirt. *Haryana Journal of Horticultural Sciences*. *32*, 228-229.

Bhat, Z.A., & Shephered, H. (2007). Effect of pinching on growth, flowering, seed yield and quality traits in African marigold (*Tagets erecta* Linn.). *Journal of Ornamental Horticulture*. *10*(3), 197-198.

Bose, T.K., & Yadav, L.P. (1993). Nutrient management in flower crops. Commercial Flowers, pp. 713.

Chauhan, S., Rao, V.K., Kumar, A., & Ghosh, S. (2016). Response of pinching on African marigold cv. Pusa Basanti Gainda under hill condition of Uttarakhand. *Jouranal of Hill Agriculture*. *7*(1), 46-51.

Chauhan, S., Singh, C.N., & Singh, A.K. (2005). Effect of vermicompost and pinching on growth and flowering in marigold cv. Pusa Narangi Gainda. *Progressive Horticulture*. *37*(2), 419-422.

Dalal, S.R., Nandre, D.R., Bharad, S.G., Utgikar, S., & Shinde, R.D. (2006). Effect of pinching on carnation cv. Yellow Solar under polyhouse condition. *International Journal of Agriculture Sciences*. *2*(2), 356-357.

Gnyandev, B., Kurdikeri, M.B., Patil, A.A., & Channappagoudar, B.B. (2014). Influence of pinching, nitrogen level and growth retardants spray on seed yield and quality of China aster cv. Phule Ganesh. *International Journal of Tropical Agriculture*. *32*(3-4), 377-380.

Grawal, H.S., Kumar, R., & Singh, H. (2004). Effect of nitrogen, planting time and pinching on flower production in chrysanthemum cv. Flirt. *Journal of Ornamental Horticulture*. *7*(2), 196-199.

Joshi, A.S., Barad, A.V., Misra, R.L., & Misra, S. (2002). Effect of N, P and pinching on the nutrient composition and uptake by African marigold. In National Symposium on Indian Floriculture in the New Millenium, 334-335.

Khandelwal, S.K., Jain, N.K., & Singh, P. (2003). Effect of growth retardants and pinching on growth and yield of African marigold (*Tagetes erecta* L.). *Journal of Ornamental Horticulture*. *6*(3), 271-273.

Khobragade, R.K., Bisen, S., & Thakur, R.S. (2012). Effect of planting distance and pinching on growth, flowering and yield of China aster cv. Poornima. *Indian Journal of Agricultural Sciences*. *82*(4), 334-339.

Kumar, A., Kumar J., Braj, M., Singh, J.P., Rajbeer & Nathi, R. (2012). Studies on the effect of plant growth regulators on growth, flowering and yield of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *Annals of Horticulture*. *5*(1), 47-52.

Kumar, R., Singh, K., & Reddy, B.S. (2002). Effect of planting time, photoperiod, GA_3 and pinching in carnation. *Journal of Ornamental Horticulture*. *5*(2), 20-23.

Maharnor, S.I., Neha, C., Seema, T., & Raut, P.D. (2011). Effect of nitrogen and pinching on growth and yield of African marigold. *Asian Journal of Horticulture*. *6*(1), 43-45.

Meena, Y., Sirohi, H.S., Tomar, S.B., & Kumar, S. (2015). Effect of planting time, spacing and pinching on growth and seed yield of African marigold cv. Pusa Narangi Gainda. *Indian Journal of Agricultural Sciences*. *85*(6), 797-801.

Naik, H.B., Patil, A.A., Patil, V.S., Basavaraj, N., & Heremath, S.M. (2004). Effect of pinching and chemicals on xanthophyll yield in African marigold

(*Tagetes erecta* L.). *Journal Ornamental Horticulture*. *7*(3&4),182-190.

Palekar, A.R., Chopde, N., Kuchanwar, O., & Raut, V.U. (2018). Response of marigold to pinching and nitrogen. *Journal of Pharmacognosy and Phytochemistry*. *7*(2), 157-159.

Parhi, R., Mohanty, A., & Harichandan, S. (2016). Performance of various characters in African marigold due to different in pinching levels and planting dates. *Annals of Agri-Bio Research*. *21*(1), 44-48.

Pathania, N.S., Sehgal, O.P., & Gupta, Y.C. (2000). Pinching for flower regulation in Sim carnation. *Journal of Ornamental Horticulture*. *3*(2), 114-117.

Phetpradap, S., Hampton, J.G., & Hill, M.J. (1994). Studies on the effect of hand pinching and plant growth regulators on seed production of field grown hybrid dahlia. *New Zealand Journal of Crop and Horticulture Sciences*. *22*, 313-320.

Prakash, S., Anitha, P., Giridharan, M.P., Rajgopalan, A., & Rao, S.V.G. (2016). Impact of seasons and pinching on growth and flowering in African marigold. *Journal of Tropical Agriculture*. *54*(1), 50-54.

Pushkar, N.C., & Singh, A.K. (2012). Effect of pinching and growth retardants on flowering and yield of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *International Journal of Horticulture. 2*(1), 1-4.

Rajbeer, Singh, J., & Kumar, J. (2009). Effect of nitrogen and pinching on growth and flowering in African cv. Pusa Narangi Gainda. *Annals of Horticulture*. *2*(2), 226-227.

Rajyalaksmi, R., & Rajshekhar, M. (2014). Effect of different growth regulators and pinching on growth and flowering of African marigold cv. Pusa Narangi Gainda in different planting dates. *The Journal Research Angrau*. *42*(1), 52-54.

Rathore, I., Mishra, A., Moond, S.K., & Bhatnagar, P. (2011). Studies on effect of pinching and plant bioregulators on growth and flowering of marigold (*Tagetes erecta* L.) cv. Pusa Basanti Gainda. *Progressive Horticulture*. *43*(1), 52-55.

Sailaja, S.M., Panchbhai, D.M., & Suneetha, K. (2013). Response of China aster varieties to pinching for growth, yield and quality. *Hort Flora Research Spectrum*. *2(*4), 366-368.

Sarkar, D., Saud, B. K., Mahanta, P., Kalita, P., Neog, B., & Talukdar, M. C. (2018). Response of Pinching and Gibberellic Acid on Growth and Physiological Characteristics of African Marigold. *Int. J. Curr. Microbioly and App. Sci*. *7*(3), 1666-1672.

Sasikumar, K., Baskaran, V., & Abirami, K. (2015). Effect of pinching and growth retardants on growth and flowering in African marigold cv. Pusa Narangi Gainda. *Journal of Horticultural Sciences*. *10*(1), 109-111.

Sehrawat, S.K., Dahiya, D.S., Singh, S., & Rana, G.S. (2003). Effect of nitrogen and pinching on growth, flowering and yield of marigold (*Tagetes erecta* L.) cv. African Giant Double Orange. *Haryana Journal of Horticultural Sciences*. *32*, 59-60.

Sharma, D.P., Patel, M., & Gupta, N. (2006). Influence of nitrogen, phosphorus and pinching on vegetative growth and floral attributes in African marigold (*Tagetes erecta* Linn.). *Journal of Ornamental Horticulture*. *9*(1), 25-28.

Sharma, P., & Singh, A.K. (2012). Post harvest life of tuberose as influenced by GA_3 and varieties. *J. Plant Development Sciences*. *4*(1), 133-134.

Singh, A.K., Singh, S.V., Sisodia, A., & Hembrom, R. (2015). Effect of pinching and nitrogen on growth flowering and seed yield of African marigold cv. Pusa Narangi Gainda.

Environment and Ecology. *33*(4B), 1876-1879.

Singh, M.K., & Baboo, R. (2003). Response of nitrogen, potassium and pinching levels on growth and flowering in chrysanthemum. *Journal of Ornamental Horticulture*, *6*(4), 390-393.

Singh,H., Singh, J., & Ahirwar, G.K. (2018). Effect of spacing and pinching on growth and flowering in African Marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. *Journal of Pharmacognosy and Phytochemistry*, *7*(2), 1764-1766.

Singhrot, R.S., & Beniwal, B.S. (2003). Effect of GA_3 and pinching on growth and yield in chrysanthemum. *Haryana Journal of Horticultural Sciences*, *32*, 61-63.

Srivastava, S.K., Singh, H.K., & Srivastava, A.K. (2002). Effect of spacing and pinching on growth and flowering of Pusa Narangi Gainda marigold (*Tagetes erecta* L.). *Indian Journal of Agricultural Sciences*, *72*(10), 611-612.

Srivastava, S.K., Singh, H.K., & Srivastava, A.K. (2005). Effect of spacing and pinching as factors for regulating flowering in marigold cv. Pusa Basanti Gainda. *Haryana Journal of Horticultural Sciences*, *34*(1-2), 75-77.

Sunitha, H.M., Hunje, R., Vyakaranahal, B.S., & Bablad, H.B. (2007). Effect of pinching and growth regulators on plant growth, flowering and seed yield in African marigold (*Tagetes erecta* L.). *Journal of Ornamental Horticulture*, *10*(2), 91-95.

Wani, Muneeb Ahmad., Khan, F.U., Nazkil, Imtiyaz Tahir., Khan, F.A., Khan, Shabir Hussain., Ali, Tahir & Neelofar (2018). Phytomorphology of Callistephus chinensis as influenced by differential planting geometry, pinching and compound nutrient sprays. *Current Journal of Applied Science and Technology*, *26*(4), 1-11.

Yassin, G.M., & Pappiah, C.M. (1990). Effect of pinching and manuring on growth and flowering of chrysanthemum cv. MDU-1, *South Indian Horticulture*. *38*(4), 232-233.