Nepal Agriculture Research Journal
Vol. 15, No. 1, pp. 98-105, 2023
DOI: https://doi.org/10.3126/narj.v15i1.51505

Effect of varieties and pinching days on growth and yield attributes of African marigold (*Tagetes erecta* L.)

Karishma Bhusal[1*], Pooja Bhusal[1], Nirajan Acharya[1], Dharma Prasad Chapai[1] and Jiban Shrestha[2]

[1]Faculty of Agriculture, Agriculture and Forestry University, College of Natural Resource Management, Puranchaur, Kaski, Nepal
[2]Nepal Agricultural Research Council, National Plant Breeding and Genetics Research Centre, Khumaltar, Lalitpur, Nepal
*Corresponding author's email: karishmabhusal09@gmail.com
*ORCID: https://orcid.org/0000-0002-4010-7393

ARTICLE INFO

Research Paper

Received: September 10, 2022
Revised: November 26, 2022
Accepted: January 15, 2023
Published: February 01, 2023

Contents available at http://www/sasnepal.org.np

ABSTRACT

From June to August 2021, a field experiment was carried out at the College of Natural Resource Management, Puranchaur-19, Kaski to examine the effects of pinching on the vegetative growth and yield characteristics of African marigold (*Tagetes erecta* L.). Two major varieties, Karma-666 and Karma-555, were evaluated in the experiment with three different dates of pinching (Control, 20 DAT, and 40 DAT), which were set up in a Randomized Complete Block Design (RCBD) with four replications. According to the findings, at 5% level of significance, no significant difference was found in the interaction effect between growth and floral characters. Karma-555 showed greater plant spread (34.77 cm) and more branches per plant (13.73) than Karma-666. Additionally, Karma-555 was found to have a higher number of flowers plant^{-1} (39.10) and flower yield plant^{-1} (335.77 g). However, Karma-666 had significantly ($P < 0.001$) high fresh flower weight (10.51 g) and flower diameter (7.18 cm). Plants pinched at 20 DAT were found to be the most effective for enhancing vegetative growth parameters and flower yield.

Keywords: Flower yield, Marigold, Pinching

Cited as: Bhusal K, P Bhusal, N Acharya, DP Chapai and J Shrestha. 2023. Effect of varieties and pinching on growth and yield attributes of African marigold (*Tagetes erecta* L.). Nepal Agriculture Research Journal **15**(1): 98-105.
DOI: https://doi.org/10.3126/narj.v15i1.51505

INTRODUCTION

The marigold (*Tagetes erecta* L., 2n=24) is one of the important and in-demand flower crops grown today. It is native to Central and South America, specifically Mexico, and has spread to other countries (Patade et al 2020). It has been used commercially as cut and loose flowers for garlands, home decor, and landscaping. Due to its abundant flowering, bright colors, wide adaptability, easy farming, and quick harvest, marigold cultivation has captured the attention of many flower growers (Arora 1998). The cultivation of marigold prevails in 32 districts covering about 157 ha in Nepal (Sureis 2020). The summer and autumn months are peak production period of marigold in the districts of Chitwan, Makwanpur, Sindhuli, Dhading, and Kavre (Dhakal 2016).

The demand for marigolds was predicted to increase by 10% in 2022, and Nepal was expected to import 300,000 marigold garlands from India to satisfy the festive demand (Republica 2022). It was mentioned that about 1.81 million marigold garlands were sold in Nepal costing NRs.127 million during Tihar the year 2022, however, producer shared low market price for their marigold due to the imported flowers during the holiday season (Republica 2022). Nepal has limited production technology and knowledge on varietal diversity especially suitable germplasm which can perform well during the winter and spring seasons. Thus, marigold are imported primarily during the winter and spring (Dhakal and Bhattarai 2017).

To get a desired economic yield from marigold flowers, improved cultural practices like pinching in location-appropriate varieties are applied. Many flower growers use varieties like Karma-555, Karma- 666, Karma- 777, etc. in hills of Nepal (Dahal et al 2021). A few of the growers perform pinching of marigold at various day intervals by stopping apical dominance and redistributing nutrients to the lateral branches. Pinching encourages the growth of side shoots, which increases flower yield by allowing for more flower production (Jyothi et al 2018). Therefore, our aim in present study was to compare the effective days of pinching for enhancing growth parameters of examined varieties and yield of African marigold at field condition of Puranchaur-19, Kaski, Nepal.

Therefore, the research was conducted to evaluate the effects of varieties and pinching on plant growth and flower yield.

MATERIALS AND METHODS

The experiment was conducted in at the College of Natural Resource Management in Puranchaur from June to August 2021. Geographically, the site was located at Nepal's hilly region with subtropical climate at 28º 17' N Latitude and 83º 56' E Longitude at an altitude of 1190 masl. The area generally faces warm to hot summer and a cool winter with intermediate frost. The average maximum and minimum temperatures were 33.5 ºC and 6 ºC respectively and the average temperature was 19.4 ºC during the research period. Similarly, average annual precipitation and relative humidity observed in the site were 241.23 mm and 76.78% respectively. The soil at the location had an acidic pH that ranged from (3.8-4.0). Karma-555 and Karma-666 of African marigold (*Tagetes erecta* L.), the most popular and advised marigold varieties for mid-hill, were chosen for experiments. Four replications of a two-factorial Randomized Complete Block Design (RCBD) design were used to set up the experiment. The field was split into 24 plots, each containing 16 plants.Two varieties and three levels of pinching were used as the treatment respectively. The treatment detail is given in Table 1a and 1b.

Table 1a. Factors details used in the study

S.N	Factors	Symbol
	Variety	
1.	Karma-666	V1
2.	Karma-555	V2
	Level of pinching	
1.	Pinching at 20DAT	P1
2.	Pinching at 40DAT	P2
3.	Control	P0

Table 1b. Treatment details used in the study

S.N	Factors' combination	Symbol
1	Karma-666 (V1) × Pinching at 20 DAT (P1)	T1 = V1 × P1
2	Karma-666 (V1) × Pinching at 40 DAT (P2)	T2 = V1 × P2
3	Karma-666 (V1) × Control (P0)	T3 = V1 × P0
4	Karma-555(V2) × Pinching at 20 DAT (P1)	T4 = V2 × P1
5	Karma-555(V2) × Pinching at 40 DAT (P2)	T5 = V2 × P2
6	Karma-555(V2) × Control (P0)	T6 = V2 × P0

The field was plowed twice before the plantation at a depth of around 40 cm. Seed rate was 1.5 kg ha^{-1}. The spacing were 40 cm × 30 cm (row to row × plant to plant). Seedlings that were 26 days old and had two true leaf stages were uniformly planted according to the treatment combinations, and after transplanting, they were watered. N: P_2O_5: K_2O was added in the following proportions: 120: 80: 40 kg ha^{-1} and FYM at 20 t ha^{-1}, respectively (Singh et al 2015). A periodic supply of irrigation was made in accordance with the crop's need. Hand weeding was done at intervals of 10 days during the early plant stage and 15 days during the crop's later stages. At 25 days after transplanting, Dithane M-45 was applied topically to all plants at a rate of 20 g per 10 liters of water. Using clean scissors and routine disinfection of the scissors with detergent water, the first pinching was performed at 20 days after transplanting, and the second at 40 days.

In each treatment, the four plants chosen for the sample were tagged for recording data. The information was gathered from the mature plants that were sampled and evaluated for analysis. The data were taken on plant height (cm), spread (cm), number of branches, number of flowers per plant, fresh weight (g), diameter (cm), number of flowers per plant, yield per plant (g), and total yield (mt ha^{-1}). Using a long scale, the height of the tagged plants was calculated from the base to the top portion of the plant. The average height was then determined, and the plant spread was calculated by averaging the measurements along the diagonal width of the plant's covered area. The number of branches on the plants that were sampled was also noted. The average and total number of flowers picked from the tagged plants were kept. The fresh weight per flower was also determined by randomly choosing five flowers from the harvest, weighing each one separately, averaging the results, and expressing the results in grams. Additionally, a vernier caliper was used to measure the flower's diameter, which was then averaged and expressed in centimeters. Using a weighing scale, the yield of the sampled plants was determined. The average weight was then calculated as the yield per plant and expressed in grams (g).

Statistical analysis

Microsoft Excel 2016 was used to input and process the gathered data. Rstudio was used to analyze the data after that. Duncan's multiple range test (DMRT) was used to separate and compare the means at 5% level of significance (Gomez and Gomez 1984).

RESULTS

Plant height

The result in Table 2 revealed plant height by variety and pinching factor was significantly different at 5% level. The variety Karma-555 had the tallest plants, measuring 62.11 cm, while Karma-666 had the shortest plants, measuring 51.27 cm. In control, the plant height was reaching to 61.56 cm which was statistically similar to plants pinched at 40 DAT (59.04 cm), and for pinching at 20 DAT, lower plant height was noted (49.46 cm).

Plant spread

According to the data on plant spread shown in Table 2, there was significant ($P<0.01$) difference between varieties and also ($P<0.001$) between pinching treatments, but their interaction had no significant impact at the 5% level of significance. Karma-555 had the widest plant spread among the varieties (34.77 cm), while Karma-666 had the narrowest plant spread (28.97 cm). Additionally, the mean data demonstrated that plants pinched at 20 DAT (35.65 cm) had the greatest plant spread, followed by those pinched at 40 DAT (31.71 cm), and a non-pinched plant had the lowest plant spread (27.24 cm).

Number of branches per plant

According to the experimental data shown in Table 2, pinching and variety both significantly affected the number of branches per plant at the 5% level of significance. Variety Karma-555 demonstrated significantly more branching (13.73) than Karma-666 (10.83). Regarding the impact of pinching, plants that were pinched at 20 DAT showed the highest number (14.36) of branches, followed by those that were pinched at 40 DAT (12.03). And the control group showed the lowest number (10.5) of branches.

Number of flowers per plant

According to the data in Table 3, pinching and variety both significantly affected the number of flowers produced per plant at the 5% level of significance. Karma-555 produced more flowers (39) than Karma-666 (22.59). The number of flowers per plant also was changed as a result of pinching, with more appearing at 20 DAT (36.34) than at 40 DAT (29.5). At 40 DAT, it was discovered that non-pinched plants shared statistical similarities in flowers number with pinching plants (26.7).

Flower diameter

As shown in Table 3 at 5% level of significance, the variety had significant impact on the size or diameter of the flower, whereas pinching had no significant impact. Flowers from the Karma-666 variety had a larger diameter (7.18 cm) than those from the Karma-555 variety (5.21 cm).

Fresh weight of flower

At a 5% level of significance, the variety as shown in Table 3 had significant impact on the flower's weight. Karma-666 flowers had the highest fresh weight (10.51 g), followed by Karma-555 (7.56 g). The difference in weight as a result of days of pinching, however, was found to be non-significant.

Flower yield per plant

At a 5% level of significance, the experimental results from Table 3 showed that marigold variety had significant impact on plant yield of flowers. Karma-555 produced high yield per plant (335.77 g), whereas Karma-666 recorded low yield (214.29 g). Similar to this, pinching also revealed a notable variation in terms of flower yield per plant. Higher (327.10 g) was produced by plants that were pinched at 20 DAT, followed by 40 DAT (271.21 g). In contrast, the control treatment had a lower yield (226.77 g).

Total yield of flower

At 5% level of significance, experimental data from Table 3 showed that the varietal factor substantially affected total yield (mt ha^{-1}). The varieties with the highest and the lowest yields were Karma-555 (27.98 mt ha^{-1}) and Karma-666 (17.86 mt ha^{-1}) respectively. Similarly, pinching revealed significant difference in terms of overall yield (mt ha^{-1}). The highest yield

(27.26 mt ha^{-1}) was produced by plants pinched at 20 DAT, which was followed by 40DAT (22.60 mt ha^{-1}). In contrast, the control treatment produced lower yield (18.90 mt ha^{-1}).

Table 2. Effect of different varieties and pinching practices on growth parameters of African marigold

Treatment	Plant height (cm)	Plant spread (cm)	Branches $plant^{-1}$ (no.)
Variety			
Karma-666	51.27^{b}	28.97^{b}	10.83^{b}
Karma-555	62.11^{a}	34.77^{a}	13.73^{a}
LSD(0.05)	4.79	3.25	1.23
SEM (±)	1.58	1.08	0.41
P value	<0.001	<0.01	<0.001
Pinching			
Pinching at 20DAT	49.46^{b}	35.65^{a}	14.36^{a}
Pinching at 40DAT	59.04^{a}	31.71^{b}	12.03^{b}
Control	61.56^{a}	27.24^{c}	10.50^{c}
LSD(0.05)	5.868	3.98	1.52
SEM (±)	1.94	1.32	0.5
P value	<0.01	<0.001	<0.001
CV%	9.71	11.72	11.58
Grand mean	56.69	31.87	12.28

†Means of 4 replication. Means in column with same superscript is not significantly different by DMRT at 0.05 level, LSD : Least Significant Difference, CV: Coefficient of variation, SEM (±): Standard error of mean

.

Table 3. Effect of different varieties and pinching practices on flower parameters and yield of African marigold

Treatment	No. of flowers $plant^{-1}$	Flower diameter (cm)	Fresh wt. of flower (g)	Flower yield $plant^{-1}$ (g)	Flower yield (mt ha^{-1})
Variety					
Karma-666	22.59^{b}	7.18^{a}	10.51^{a}	214.29^{b}	17.86^{b}
Karma-555	39.10^{a}	5.21^{b}	7.36^{b}	335.77^{a}	27.98^{a}
LSD(0.05)	3.44	0.38	0.952	32.99	27.49
SEM (±)	1.14	0.13	0.32	10.95	0.91
P value	<0.001	<0.001	<0.001	<0.001	<0.001
Pinching					
Pinching at 20DAT	36.34^{a}	6.39^{a}	9.05^{a}	327.10^{a}	27.26^{a}
Pinching at 40DAT	29.5^{b}	6.10^{a}	8.91^{a}	271.21^{b}	22.60^{b}
Control	26.7^{b}	6.08^{a}	8.85^{a}	226.77^{c}	18.90^{c}
LSD(0.05)	4.21	0.47	1.17	40.41	3.37
SEM (±)	1.4	0.16	0.39	13.41	1.12
P value	<0.001	ns	ns	<0.001	<0.001
CV%	12.82	7.2	12.24	13.79	13.78
Grand mean	30.84	6.19	8.93	275.04	22.92

†Means of 4 replication. Means in column with same superscript is not significantly different by DMRT at 0.05 level, LSD : Least Significant Difference, ns : non significant, CV: Coefficient of variation, SEM (±): Standard error of mean

DISCUSSION

The results of our experiment showed that plant height, plant spread, branches per plant, number of flowers per plant, flower yield per plant and flower yield per hectare were significantly affected by varieties and pinching at different days after transplanting at 5% level of significance (Table 2 and 3). Plant height was observed higher in Karma-555 which were not practiced with pinching technique (Table 2).The present study's findings indicated

that Karma-666 achieved the highest fresh weight per flower among the two varieties, while Karma-555 plants recorded the lowest (Table 3). However, the maximum number of flowers per plant and the minimum yield per plant (g) were found in Karma-555 and Karma-666, respectively (Table 3). Similarly, pinching did not reveal any appreciable variation in fresh weight per flower. While the maximum value for pinching at 20 DAT and the minimum for control were reported in terms of the number of flowers per plant and yield per plant, respectively (Table 3).

Salve et al (2016), Singh and Singh (2006) and Khanvilkar et al (2003) explained the the variation in plant height results out of genetic differences among the genotypes. In accordance with pinching, the non-pinched plant marigold grows to its greatest height at maturity due to apical dominance (Rajyalakshmi and Rajasekhar 2014). The unpinched plants were 25% taller than the pinched ones in height (Awasthi et al 2022). The difference in maximum height between pinched and unpinched plants was primarily caused by the unpinched plant's ability to grow unhindered and reach its full potential height (Pandey et al 2021). The plant spread and number of branches per plant largely depend on genotypic effect as observed by (Rao et al 2005). At 20 DAT, the pinched plants of China aster and African marigold showed the greatest plant spread (Gaidhani et al 2020, Awasthi et al 2022). By 20DAT, maximum branching had been completed (Gaidhani et al 2020). Similar findings in marigold were explained by (Dahal et al 2021). The number of flowers per plant, fresh weight of flower, flower yield per plant and flower yield per hectare are affected by genetic makeup of African marigold. The results presented above could be attributed to marigold genetic factors (Deepa et al 2016). These findings are in line with those of (Gupta et al 2016). Perhaps genetic differences between the varieties and the superiority of one over the other are to blame for the variation in flower diameter (Deepa et al 2016, Gobade et al 2017). Likwise, pinching was attributed to an increase in the number of flowers in zinnia (Ullah et al 2019). More flowers per plant (92.04) were observed in pinched than in control (Indu Rathore et al 2011, Salve et al 2016). African marigold plants that were pinched at 20 DAT had a higher flower yield (167.80 q ha^{-1}) than control plants (Khandelwal et al 2003). The findings of (Thakare et al 2020) in chrysanthemum are similar to the results presented above. In marigold, pinching is a process that increases flower production by diverting energy and reducing apical dominance in plants.

CONCLUSION

The pinching techniques significantly increase the marigold yield. By adopting traditional pinching technology marigold yield has been substantially increased in Puranchaur area of Kaski district.

Acknowledgements

The author expresses words of gratitude to the College of Natural Resource Management, Puranchaur, and Kaski for providing a platform and support during the research.

Authors' Contributions

KB, PB, NA and DPC was involved in conducting the experiments, data analysis and interpretation, and drafting of the manuscript. JS was involved in critical revision and final shape of the manuscript. All authors listed have made a substantial, direct and intellectual contribution to the study, and approved it for publication.

Conflicts of Interest

The authors have no relevant financial or non-financial interests to disclose.

Publisher's Note

All claims made in this article are those of the authors alone; they do not necessarily reflect the views of any affiliated organizations, the publisher, the editors, or the reviewers.

REFERENCES

Arora JS. 1998. Marigold. TK Bose and LP Yadav (Eds) Commercial flowers. Naya Prakash, India; **pp.** 713- 731

Awasthi P, D Joshi and G Rizal. 2022. Impact of pinching on growth and yield of marigold (*Tagetes erecta* L.). Environment and Ecosystem Science **6**: 34–38. **DOI**: https://doi.org/10.26480/ees.01.2022.34.38

Dahal J, S Tiwari, U Bhandari and S Shrestha. 2021. Evaluation of marigold (*Tagetes erecta*) varieties for growth, flowering, and floral attributes at three localities of Nepal. Journal of Ornamental Plants **11**(3): 209–219.

Deepa VP, VS Patil, CK Venugopal, MS Biradar and K Sridhar. 2016. Study on the growth and yield attributes of marigold (*Tagetes spp*.) hybrids under Dharwad condition. HortFlora Research Spectrum **5**(1): 43–47.

Dhakal M and S Bhattarai. 2017. Marigold (Tagetes species) winter-spring production at Kavre District of Nepal IJHSOP Marigold (*Tagetes species*) winter-spring production at Kavre District of Nepal.

Gaidhani A, SR Dalal and PK Nagre. 2020. Effect of different planting dates and pinching on growth and flowering of China aster. International Journal of Chemical Studies **8**(2): 1120–1124. **DOI:** https://doi.org/10.22271/chemi.2020.v8.i2q.8918

Gobade N, RP Gajbhiye, VS Reshma, G Ghormade and A Ganorkar 2017. Yield and quality of marigold as influenced by different genotypes under Vidarbha conditions. Journal of Soils and Crops **27**(2): 72–76.

Gomez AK and AA Gomez. 1984. Statistical procedures for agricultural research. John wiley & sons.

Gupta YC, SR Dhiman, P Sharma, B Sharma, P Sharma and S Bhatia. 2016. Evaluation of genotypes of French marigold (*Tagetes patula* L.) under mid hill conditions of Himachal Pradesh. Journal of Ornamental Horticulture **19**(1&2): 13-18.

Jyothi K , CR Goud, A Girwani and TS Kumar. 2018. Studies on the effect of planting dates and levels of pinching on growth, flowering and yield in marigold (*Tagetes erecta*) cv. Arka Agni. International Journal of Current Microbiology and Applied Sciences **7**(11): 2705–2713.

Khanvilkar MH.2003. Performance of African marigold (*Tagetes erecta*) in north Konkan coastal zone of Maharashtra. Journal of Maharashtra Agriculture University **28**(3): 333-334.

Pandey M., S Subedi, P Khanal, P Chaudhary, A Adhikari, TP Sharma and J Shrestha. 2021. Effects of different rates of nitrogen and pinching on yield and yield attributes of African marigold (*Tagetes erecta* L.). Journal of Agriculture and Natural Resources **4**(2): 21-28.

Patade A, KV Malshe, K, BR Salvi, VV Sagvekar and UB Pethe. 2020. Effect of pinching on yield and economics in different varieties of marigold (*Tagetes spp*). Journal of Pharmacognosy and Phytochemistry **9**(4): 212–214.

Rajyalakshmi, R and M Rajasekhar. 2014. Effect of different growth regulators (NAA, GA, Cycocel and Ethrel) and pinching on growth and flowering of African marigold (*Tagetes erecta* L.) Cv Pusa Narangi Gainda in different dates of planting. Journal of Research ANGRAU **42**(1): 52–54.

Rathore I, A Mishra, SK Moond and P Bhatnagar. 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.

Republica. 2022. Around 2 million marigold garlands to be sold in the upcoming Tihar, 15 percent to be imported from India. My Republica. Retrieved December 1, 2022, from http://myrepublica.nagariknetwork.com/news/132401/

Republica. 2022. Rampant import of Marigold results in heavy wastage of local flowers this festival. My Republica. Retrieved December1, 2022, from http://myrepublica.nagariknetwork.com/news/120428/

Salve DM, DM Panchbhai, S Badge and V Satar. 2016. Growth and flower yield of chrysanthemum as influenced by varieties and pinching. Plant Archives **16**(2): 826-828.

Singh D and AK Singh. 2006. Characterization of African marigold (*Tagetes erecta* Linn.). Journal of Ornamental Horticulture **9**(1): 40-42.

Singh L, PKS Gurjar, AK Barholia, A Haldar and A Shrivastava. 2015. Effect of organic manures and inorganic fertilizers on growth and flower yield of marigold (*Tagetes erecta* L.) var. Pusa Narangi Gainda. Plant Archives **15**(2): 779–783.

Sunitha HM, R Hunje, BS Vyakaranahal and HB Bablad. 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.

Sureis .2020. Domestic production to meet flower demand. The Himalayan Times. https://thehimalayantimes.com/business/domestic-production-to-meet-flower-demand

Thakare AA, MH Dahale, AS Deogade, AR Ingole and EP Ningot. 2020. Effect of pinching and nitrogen on growth and flower yield of annual chrysanthemum. Journal of Pharmacognosy and Phytochemistry **9**(6): 945–949.

Ullah L, N Amin, A Wali, A Ali, S Khan, M Ali and R Kabir. 2019. Improvement of Zinnia flower (*Zinnia elegans*) through evaluating of various pinching methods. Global Advanced Research Journal of Agricultural Science **8**(5): 179–184.