Effect of Different Planting Time and Varieties on Growth and Yield of African Marigold (*Tagetes erecta*) in the Kavre District, Nepal

Mira Dhakal[1]*, Amar Bahadur Pun[2] and Shandesh Bhattarai[3]

[1]National Horticulture Research Center, NARC, Khumaltar, Nepal
[2]Regional Agriculture Research Station, NARC, Khajura, Banke, Nepal
[3]Faculty of Science, Nepal Academy of Science and Technology, Khumaltar, Lalitpur, Nepal

***CORRESPONDING AUTHOR:**

Mira Dhakal
Email:dhakalmira13@gmail.com

ISSN : 2382-5359(Online), 1994-1412(Print)

DOI:

https://doi.org/10.3126/njst.v20i1.43349

ACCESS THE ARTICLE ONLINE

CONFLICT OF INTEREST: None

ABSTRACT

A field experiment was conducted to study the effect of different planting time on growth and flowering attributes of different varieties of African marigold at Kavre district of Nepal during the year of 2014 to 2017. The experiment consisted of four replications and was laid out in a two factorial RCB design. Six treatment combinations consisting of two open pollinated varieties of marigold viz. Calcattia Orange and Calcattia Yellow and three planting time viz. 1st January 2015, 15th February 2015 and 30th March 2015 were evaluated. The pooled analysis of two years' data showed a significant influence of varieties and planting dates on vegetative growth and flower yield and yield attributing characters Flowering duration differed significantly with variety and its interaction with date of planting. Longer duration of flowering was observed by Calcattia Orange (57.58 days) followed by Calcattia Yellow (53.50 days). 1st January planting of Calcattia Orange exhibited significantly the longest flowering duration (62.00 Days). The flower yield per plant was the highest in Calcattia Orange (894.3 gm/plant) than Calcattia Yellow (815.3 gm/plant). Similarly, 1st January planting had the highest flower yield/plant (1033.1 g/plant) followed by 15th February planting (854.9 gm/plant) and 30th March planting (676.4 g/plant). Although not significant, Calcattia Orange planted on 1st January showed better results in terms of Flower yield /plant (1081 g), Number of flowers per plant and flower size as compared to other treatment combinations and significantly the highest duration of flowering (62.00 days) along with attractive orange color under Kavre condition.

Keywords: Calcattia orange, Calcattia yellow, Planting time, Yield

1. INTRODUCTION

African marigold (*Tagetes erecta*) belonging to the composite family is one of the important flower crops in Nepal. Marigold is a potential commercial flower with growing demand in the context of Nepal due to its cultural and religious importance (Adhikari *et al.* 2020). A wide range of colors, shape, size and good keeping quality, makes the flower more popular (Kumar *et al.* 2010). Marigold cultivation is attracting flower growers on account of its easy culture, wide adaptability and short duration to produce marketable flowers and gaining popularity amongst flower dealers due to its wide spectrum of attractive color, shape, size and good keeping quality (Arora 1998). In the South Asian marigold is used as a loose flower for decorations, preparation of garlands, for landscaping, as well as religious and social purposes (Kumar *et al.* 2010). Extract of marigold can be used as a nematicide. Carotenoids extracted from dry petals are used for poultry feeds to improve egg yolk color and they are also used as a trap crop for controlling different insects like tomato fruit borers. Oil extracted from marigold is used in manufacturing perfumes and insect repellents (Ravindra *et al.* 2017).

The production of flowers in Nepal alone cannot meet the ever-increasing demand. Hence, flowers need to be procured from neighboring countries. The demand for Marigold flowers during Dashain and Tihar including wedding seasons is very high, while the production in Nepal is limited to the period of June to October due to limited knowledge and technology for winter-spring season production in terms of varieties and environmental factors (Dhakal & Bhattarai 2017) So, the demand of the winter and spring season is currently met by import from Calcutta and Silguri (West Bengal state of India). Nepal imports Marigold worth NRs 8100,000 during winter-spring season, while 150,000 garlands of marigold were imported to fulfill flower demand in the domestic market in Tihar (FAN 2013).

Marigold production in Nepal is limited to summer and autumn seasons in nearby Kathmandu valley and some other districts such as Chitwan, Janakpur, Dhading and Kavre (FAN 2013; Dhakal M. 2016). The production beyond this period i.e., during winter and spring seasons could not be succeed yet, this is only because of low temperature in winter, poor light intensity and inadequate appropriate varieties in the existing growing practice. Besides, the flower produced during winter season is very poor quality in comparison to Indian flowers. The requirement of this flower for whole six months beyond November is being met by import from India. Therefore, there is a challenge to substitute import for the economic benefits to Nepalese growers. This flower has been grown during winter-spring season in Calcutta that has similar climate to Kavre (Dhakal M. 2016). However, there are lots of pocket areas having diverse and fog-free micro-climates that could capitalize on its special advantage for winter-spring production.

In Nepalese context, appropriate variety, best planting time with favorable condition for production in winter- spring season were felt necessary. Hence, in this study, two varieties were evaluated for its planting time and production. Keeping in view the importance of the crop and the present demand, the research was undertaken to standardize agro-technique in terms of varieties and planting time for the production of marigold in winter-spring season in mid-hills condition of Nepal.

2. MATERIALS AND METHODS

The research was conducted in the farmer's field at Katunjebeshi Village Development Committee in Kavre district of Nepal at an altitude of 890 masl. A field experiment was laid out on silty loam soil having pH 7.5. A factorial randomized trial was carried out from November 2014 to October 2017. The treatment consisted of two cultivars (Calcuttia Orange & Calcuttia Yellow) with three different planting time's viz. 1st January 2015, 15th February 2015 and 30th March 2015. There were six treatment combinations with four

replications. In total, 24 treatment combinations were evaluated. The treatments were randomly allocated by using random table (Gomez & Gomez 1984). Twenty-eight days old seedlings at two true leaf stages were planted as per the treatment combinations uniformly throughout the experimentation and irrigated immediately after planting and fertilization. The individual plot size was 7.2 m^2 with 60 X 60 cm^2 row to row and plant to plant distance. The space between replications and plots was 1 m and 0.5 m respectively. There were four rows in each plot and five plants in each row consisting 20 plants in each plot and from these plants inner six plants were selected for observation. The field was depth ploughed to around 40-50 cm. The seeds were sown in 7 cm a part lines covering with straw. Manure and fertilizer were applied at the rate of 20-ton FYM and 200:100:100 kg NPK/ha. Full dose of compost, P and K and 1/3 dose of N were applied as basal dose while the other 1/3 dose of N was applied as top-dressing one and two months after planting. The crop was irrigated on regular basis as per the requirement of the crop. The plot was kept weed free by regular hand weeding. Pinching was done after one month of transplanting with the help of clean scissors. It was performed manually by plucking the flower in the morning after dew had been dried up. Harvesting was done when the central whorls of petals were fully open.

2.1 Obervations

Six represented plants from the inner rows of each plot were selected and tagged in each replication for recording data. Data on different parameters like plant height, plant spread, Number of secondary branches at 30 and 60 days after transplanting, days to first flower initiation, days to 50% flowering, weight of single flower, size of single flower and number of flowers per plant and yield per plant were recorded. The height of tagged plants was measured from the base of the plant to the tip of the main stem using a long scale until harvesting. The average height was calculated and expressed in centimeter (cm). The Number of days taken for 50% flowering in each plot was recorded by counting the days from the date of transplanting and expressed as days to 50% flowering. Similarly, the number of flowers harvested from the tagged plants was averaged and recorded as the number of flowers per plant. After recording the number of flowers harvested, ten flowers were randomly selected and their total weight was calculated in gram and the average fresh weight per flower was obtained. Further, ten fully opened flowers were selected randomly from the tagged plants and the diameter of the flower was measured using Vernier calliper and expressed in cm. The flower yield of sampled plants was recorded and the average was calculated as yield per plant and expressed in gram (g).

2.2 Statistical Analysis

The collected data were entered, tabulated and processed in Microsoft Excel 2016. Data were analyzed through GenStat 18th edition statistical package. Means were separated by least significant difference (LSD) test at 1% or 5% level of significance by using DMRT (Gomez & Gomez 1984)

3. RESULTS AND DISCUSSION

3.1 Plant Height

The two years data of marigold variety study showed significant effect while date of planting and its interaction showed non-significant on plant height. The tallest plant was recorded in Calcattia Orange (96.58 cm) than Calcattia Yellow (54.56 cm). Though the interaction data showed non-significant effect, plant height was maximum (77.38 cm) in 1st January planting followed by 15th February planting (76.16 cm) and shortest was observed in 30th March planting (73.17 cm). The increased height in 1st January planting may be due to favorable warm humid condition for luxuriant plant growth. Similar result was found by Bhati and Chitkara 1989 and Sanantaray *et al.* 1999. The variation in plant height might be due to difference in time of planting and thus variation in ambient temperature. This is in conformity with finding of Nair *et al.* 1985 (Table 1).

Table 1. Effect of different planting dates and varieties on vegetative and flowering parts of African marigold during 2014-2017 in the Kavre district of Nepal

	Vegetative characters				
Treatment	**Plant height (cm)**	**Plant spread (cm)**	**Number of branches at 30 and 60 DAT**	**Days of 1st flower initiation DAT**	**Days to 50% flowering**
Variety					
Calcattia Orange	96.58a	91.09	11.67	43.17a	52
Calcattia Yellow	54.56b	70	6.67	38.75b	44.33
F-test	***	***	NS	***	NS
LSD (0.05)	3.57	1.32	-	1.64	-
Date of planting					
1st January planting	77.38	85.95	10	40	47
15th February planting	76.16	84.67	9	41.25	49
30th March planting	73.17	71.03	8.5	41.62	48.5
F-test	NS	***	NS	NS	NS
Variety x Date of planting					
Calcattia OrangeX 1st January planting	98.27	90.22b	12	42	50
Calcattia OrangeX 15th February planting	96.11	90.00b	11	43.5	52
Calcattia OrangeX 30th March planting	95.35	93.05a	12	44	54
Calcattia YellowX 1st January planting	56.48	81.67c	8	38	44
Calcattia Yellow X 15th February planting	56.2	79.32d	7	39	46
Calcattia Yellow.X 30th March planting	51	49.00e	5	39.25	43
Mean	75.57	80.54	9.17	40.96	48.17
F-test	NS	***	NS	NS	NS
LSD (0.05)	6.19	2.3	-	2.84	-
CV%	5.4	1.9	-	4.6	1.7

Note: CV= Coefficient of variation, LSD= least significant Difference, *= Significant at P≤0.05, **= Significant at P≤0.01, ***= Significant at P≤0.001 and NS= Non significant at 5% level of significance.

3.2 Plant Spread

The variety, date of planting and its interaction showed highly significant effect on plant spread. Calcattia Orange showed 91.09 cm plant spread while Calcattia Yellow showed only 70.00 cm. Similarly, 1st January planting showed higher spread (85.95 cm) followed by 15th February planting (84.67 cm) and the least was observed in 30th March planting (71.03 cm). The variation in plant spread may be due to extension in Plant height and increased in main axis count caused by hyper elongation of intermodal length. This fluctuation in value may be due to external factors such as climactic fluctuation and genetic composition (Table 1).

3.3 Number of Branches per plant at 30 and 60 DAT

The two years experimental data showed that the effect of variety, date of planting and their interaction effect were non-significant, but the variation in the number of branches according to the dates of planting were higher in the beginning of plant life, decreased with the progress of plant age and remained almost the same at the end of plant life. It is interesting to mention that the number of branches tended to be stable in the last 60 days after transplanting.

3.4 Days to 1st Flower Initiation (DAT)

The two years research experiment showed that the variety showed highly significant effect on Day's to 1st flowering. Days to the first flower initiation i.e. early flowering was shown by Calcattia Yellow (38.75 DAT) than Calcattia Orange (43.17 DAT). Though time of planting and its interaction with variety showed non-significant effect, 1st January planting produced early flowering (40.00 DAT) followed by 15th February planting (41.25 DAT) and 30th March planting (41.62 DAT) respectively (Fig. 1). All marigold flowers are quantitative short-day plants. It has been found that African marigold flowers under long day but medium temperatures ranging from 12-24°C, while the plants failed to grow under short days at higher temperatures. During the long day condition plant produces more vegetative growth and delay flowering. The weakest requirement for short photoperiod was exhibited by *T. erecta* whereas *T. fatula* was intermediate and *T. tenuifolia* had the strong requirement. Marigold requires high light intensities that it requires light between 35000-45000 lux to hasten flower induction with root and shoot growth (www.ballseed.com) (Table 1 and Fig.1).

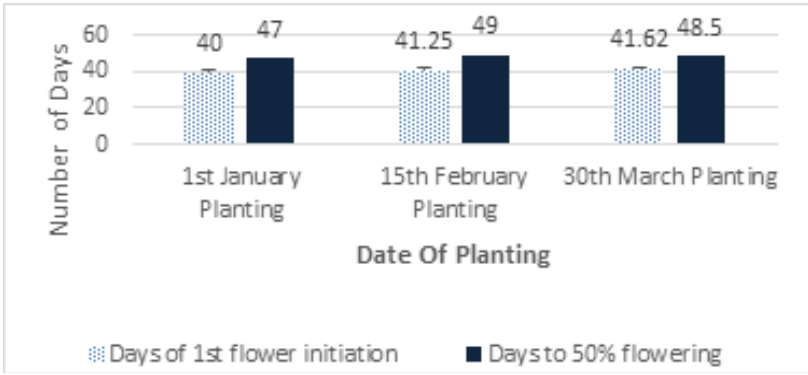

Fig. 1: Effect of different time of planting on flowering characteristics of Marigold in Kavre district of Nepal

3.4 Days to 50% Flower Initiation (DAT)

This parameter showed non-significant effect due to varieties, date of planting and its interaction. Though they showed non-significant effect, early flowering was shown by Calcattia Yellow (44.33 DAT) than Calcattia Orange (52.00 DAT) (Fig. 2). Similar results were found by Singh and Arora, 1980. Marigold takes about 55-60 days to complete vegetative growth and enter into reproductive stage. This variation in flowering

characteristics might be due to the varietal traits and variation in ambient temperature. Similar result was found by Mohanty *et al.* 1997. (Table 1 and fig.2).

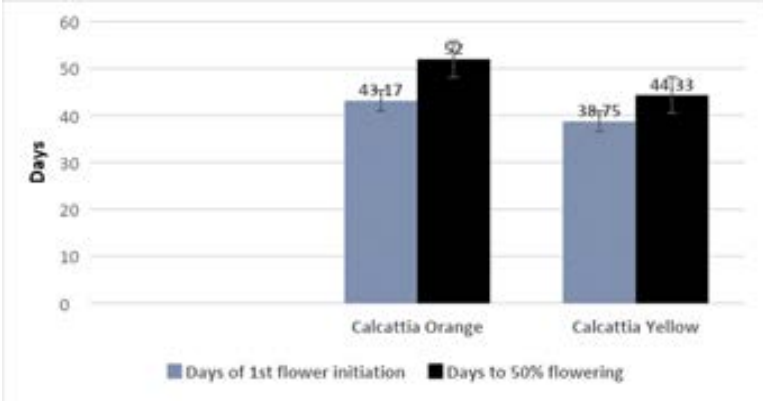

Fig. 2: Effect of different varieties on flowering characteristics of marigold in Kavre district of Nepal

3.6 Weight and Size of Flower

These two parameters were also found non-significant due to treatments. The non-significant effect may be due to the ideal temperature for marigold which ranges between 18° and 23°C as the night temperature being 15.5-18°C and the day time temperature 18-22°C for quality flower production. In very high temperature, plants cease to grow and flower production is adversely affected while flower size is reduced to a great extent (Table 2).

3.7 Number of Flowers per Plant

The variety and time of planting both showed significant effect on number of flowers/ plant while its interaction showed non-significant effect. The maximum number of flowers was found in Calcattia Orange (203.30) than Calcattia Yellow (170.00). Similarly, 1st January planting has the highest number of flower (205.00) followed by 15th February planting (185.00) and 30th March planting (170.00) respectively (Table 2). Though interaction showed non-significant effect, higher number of flower were obtained by 1st January planting of Calcattia Orange (220.00) followed by 15th February planting (200.00) and 30th March planting time (190) which was at par with 1st January planting of Calcattia Yellow (190.00) (Table 2) .

3.8 Duration of Flowering (Days)

Variety and its interaction with dates of planting showed significant effect while simply date of planting showed non-significant effect. Longer duration of flowering was shown by Calcattia Orange (57.58 Days) than Calcattia Yellow (53.50 Days). Calcattia Orange with 1st January planting had longer duration of planting (62 Days) followed by Calcattia Orange with 15th February planting (56.25 days) followed by Calcattia Orange with 30th March planting (54.50 days) which is at par with Calcattia Yellow with 30th March planting (Table 2).

3.9 Flower Yield/Plant

The variety and date of planting showed significant effect on flower yield/ plant while their interaction showed non-significant effect. The maximum yield of flower per plant in Calcattia Orange was 894.3 g followed by Calcattia Yellow (815.3 g). Similarly, 1st January planting showed the highest yield (1033.1 g/plant) followed by 15th February planting (854.9 g) and 30th March planting (676.4 g) (Table 2). Similarly, though the interaction showed non-significant effect, the highest Flower yield/plant was obtained from 1st January planting (1081.2g/plant) of Calcattia Orange followed by 1st January planting of Calcattia Yellow (985 g/plant) and 15th February

planting of Calcattia Orange (860.5 g/plant). The highest yield could be attributed to greater diameter of flowers which in turn induced higher number of florets as a result of better nutrition during reproductive phase. This may be due to January planting time, in which the plants obtained ample light along with higher temperature. So, with the higher temperature and better light exposure the photosynthetic activities might have increased resulting into production of food materials in ample amount. This might have resulted into better growth of plant and obviously increased flower yield (Table 2).

Table 2: Effect of different planting dates and varieties on flowering parts of African marigold during 2014-2017 in Kavre district of Nepal

Treatment	Flowering characters				
	Average flower weight (g)	Average size of flower (cm)	Number of flowers/ Plant	Duration of Flowering(days)	Flower yield/ plant(g/plant)
Variety					
Calcattia Orange	4.37	4.63	203.3a	57.58a	894.3
Calcattia Yellow	4.77	3.97	170.0b	53.50b	815.3
F-test	NS	NS	***	***	***
LSD (0.05)			7.17	3.13	41.28
Date of planting					
1st January Planting	5.05	5.05	205a	57.25	1033.1a
15th February Planting	4.65	4.35	185b	54.88	854.9b
30th March Planting	4	3.5	170c	54.5	676.4c
F-test	NS	NS	***	NS	***
LSD (0.05)			8.78		50.55
Variety x Date of planting					
Calcattia Orange.X 1st January Planting	4.9	5.2	220	62.00a	1081.2
Calcattia Orange.X 15th February Planting	4.3	4.9	200	56.25b	860.5
C.O.X 30th March Planting	3.9	3.8	190	54.50b	741.2
Calcattia Yellow.X1st January	5.2	4.9	190	52.50b	985
CalcattiaYellowX 15th February	5	3.8	170	53.50b	849.4
Calcattia Yellow.X 30th March Planting	4.1	3.2	150	54.50b	611.5
Mean	4.57	4.3	186.7	55.54	854.8
F-test	NS	NS	NS	**	NS

LSD (0.05)	_	_	12.41	5.43	71.49
---			4.4	6.6	5.5
CV%	--				

Note: CV= Coefficient of variation, LSD= least significant Difference, *= Significant at P≤0.05, **= Significant at P≤0.01, ***= Significant at P≤0.001 and NS= Non significant at 5% level of significance.

4. CONCLUSION

The two years experimental results showed that Calcattia Orange planted on 1st January performed better followed by other two dates of planting than Calcattia Yellow in terms of yield and other flowering attributing characters. The 1st January planting of Calcattia Orange had the longest duration of flowering (62 days) followed by 15th February on the same variety (56.25 days). Paradoxically, the yellow one was rejected by consumers because of its color and the producers were also not found interested due to lower yield than that of Calcattia Orange. Based on the two years result, it is concluded that among three planting dates, 1st January planting showed better results in several characters such as plant height and plant spread. It was also beneficial in improving floral characteristics like days to 1st flower initiation, number of flowers/plant and flower yield per plant. In this way, 1st January planting of Calcattia Orange seemed better for growth and development of whole crop. Thus, planting of Calcattia Orange on 1st January could be better for overall growth, development and also Flower yield and yield attributing characters at the condition of Kavre district of Nepal.

ACKNOWLEDGEMENT

The authors are highly thankful to Nepal Agricultural Research Council (NARC) for funding the experiment under the Development of Technology for off-season (winter-spring) marigold production project. Sincere thanks also go to Floriculture Association Nepal (FAN) for collaboration and all the staff of National Horticulture Research Center, Khumaltar, Lalitpur who were involved during the entire period of the experiment.

REFERENCES

1. Adhikari, D., and U. Pun. 2011. Response of Marigold (*Tagets erecta*) varieties to winter planting in Chitwan, Nepal. Pages 216 - 220, in K. P. Paudyal, P. P. Katiwada, B. B. Khatri, N. Subba, (editors), Proceedings, 7th National Horticulture Seminar. 12-14 June, 2011, Khumaltar, Lalitpur, Nepal. Horticulture Research Division, Khumaltar, Lalitpur and Nepal Horticulture Society.
2. Adhikari, P. K. Mishra, S. Marasini, R. C. Neupane, A. K. Shrestha, J. Shrestha and S. Subedi. 2020. Effect of nitrogen doses on growth and yield of marigold (*Tagetes erecta L.*) in subtropical climate of Nepal. Fundamental and Applied Agriculture 5(3): 414–420.
3. Arora, J. S. 1998. Marigold. Pages 713-731, in, T. K. Bose and L. P. Yadav, editors. Commercial flowers. Naya Prakash, India.
4. Bhati, R., and S. D. Chitkara. 1989. A Note on comparative performance of three cultivars of Marigold at Hissar. *Hariyana Journal of Horticulture Science* 18(3-4): 230-232.
5. Dhakal, M., and S. Bhattarai. 2017. Marigold (Tagetes species) winter-spring production at Kavre District of Nepal. *International Journal of Horticultural Science and Ornamental Plants* 3(1): 53-58.
6. Dhakal, M. 2016.. Sayapatri Phul Jath: Calcuttia orange Baemaushami Kheti Prabidhi (in Nepali language). Khumaltar, Lalitpur, Nepal: Nepal Agriculture Research Council, Horticulture Research Division.
7. FAN, 2013. Annual report. Floriculture Association Nepal, Baluwatar, Kathmandu, Nepal, pp. 01-55.

8. Gomez W. A., and A. A. Gomez. 1984. Statistical Procedure for Agricultural research. An International Rice Research Institute book: A Wiley inter-science publication.

9. Kumar, R., M. Ram and G. S. Gaur. 2010. Effect of GA3 and ethrel on growth and flowering of African marigold cv. pusa Narangi Gainda. *Indian Journal of Horticulture* 67: 362- 366.

10. Mohanty, C. R., T. K. Behera, and D. Samantaray, 1997. Effect of planting time and spacing on growth, flower yield of marigold (Tagets erecta) cv. African yellow. *South Indian Horticulture* 45:41-44.

11. Nair, S. R., K. K. Gopi, and K. K. Santha. 1985. Effect of planting time and spacing on growth, flower production and seed yield in Marigold. Orissa J. Hort. 13: 14-20.

12. Ravindra, H., M. Sehgal, H. B. Narasimhamurthy, K. Jayalakshmi and I. Khan. 2017. Rice root knot nematode (Meloidogyne graminicola) an emerging problem. *International Journal of Current Microbiology* and Applied Sciences 6(8): 3143-3171.

13. Sanantaray, D., C. R. Mohanty and T. K. Behers. 1999. Effect of planting time and spacing on growth, flower yield of marigold (Tagets erecta) cv. African Yellow. *Indian Journal of Horticulture* 56(4): 382-385.

14. Singh, J. and J. S. Arora. 1980. Production technology of Commercial flower crops. Pages 85-87. Proceeding, National Seminar. Tamil Nadu Agricultural University, Coimbatore.

15. www.ballseed.com Growers Fact (African Marigold Inca)" Ball Horticultural Company". West Chicago, USA, Ilinois