



Research Article

Marigold (*Tagetes* species) winter-spring production at Kavre District of Nepal

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A field experiment was conducted to evaluate the growing conditions and cultivars on winter-spring production of marigold at Katunjabeshi Village Development Committee of Kavre district of Nepal. This trial was conducted in two factorial randomized complete block design at open field and under plastic tunnel with four marigold cultivars namely: Calcuttia orange, Marigold garland orange, MSGY and MSNY7. There were eight treatments with three replications. In total, 24 treatments combinations were evaluated. The vegetative parameters of Calcuttia orange were higher with earlier days to 50% flowering at open field. The Calcuttia orange showed earlier days to first harvest and longer duration of flowering under plastic tunnel. The Calcuttia orange showed longer duration of flowering i.e., four months under plastic tunnel and three months at open field. Similarly, a total yield and total number of flower were 1.5 kg plant⁻¹ and 265 plant⁻¹ under plastic tunnels whereas 1 kg plant⁻¹ and 200 flowers plant⁻¹ at open field respectively. It was concluded that Calcuttia orange performed superior on almost all of characters and recommended for winter-spring production.

Keywords: Cultivars, Kavre district, Marigold, Plastic tunnel, Yield

INTRODUCTION

A variety is a plant that is different in some way, and continues to be different, from the rest of the species but is not different enough for it to be classified as a new species or as a sub-species. Variations come about by natural evolutionary process to which most plants are subject. Different varieties of a species will be able to breed together if given the opportunity (Wikipedia, 2017). In this study, four marigold cultivars namely: Calcuttia orange, Marigold garland orange, MSGY and MSNY7 were used.

Marigolds (*Tagetes* species) are hardy annual or perennial commercially exploited flowering crops belonging to the family Asteraceae encompassing 129 species (including varieties and sub species), worldwide (Tropicos, 2017). *Tagetes erecta* (African marigold) and *Tagetes patula* (French marigold) are popular for commercial purpose in Nepal. The crosses between African and French marigolds have resulted in triploid cultivars. Thus, the three major

horticultural types are the African, French and Triploid (Dhakal, 2073).

Tagetes species differ in height. Most species have pinnate green leaves. Flowers colours naturally occur in orange, yellow, golden and white. Floral heads consists of both ray and disc florets. The plant grows well in almost any sort of soil but best in good drainage soil. African marigold is very good bedding plants with globe shaped large flower. The flowers are yellow to orange but do not include red colour. French marigold flowers are small with red, orange and yellow but red and orange bicolor patterns are also found and are ideal for edging flowerbeds and in mass plantings (Priyanka *et al.*, 2013).

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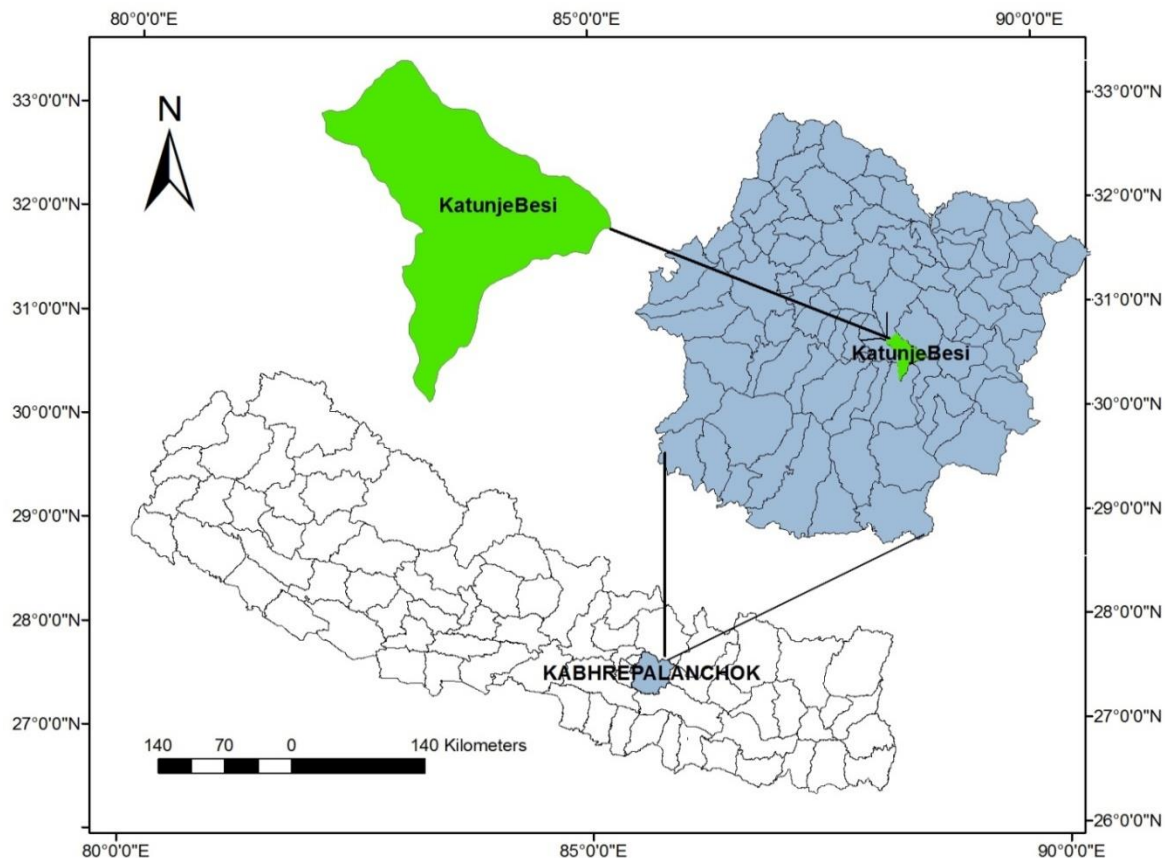


Figure 1: Map of the Katunjesi Village Development Committee of Kavre District of Nepal

People have been using marigold flowers for different purposes because of its religious and cultural significance. Flowers are used to offer god and goddess and as garland in religious and social functions (Pun, 2004). Garlands are widely used in Nepalese fest and festivals. Many farmers grow it in commercial level. Some farmers have been benefitted economically from its cultivation during normal and off seasons (Adhikari and Pun, 2011). This can be a good substitute economic crop because of its high per unit returns (Dhakal, 2073).

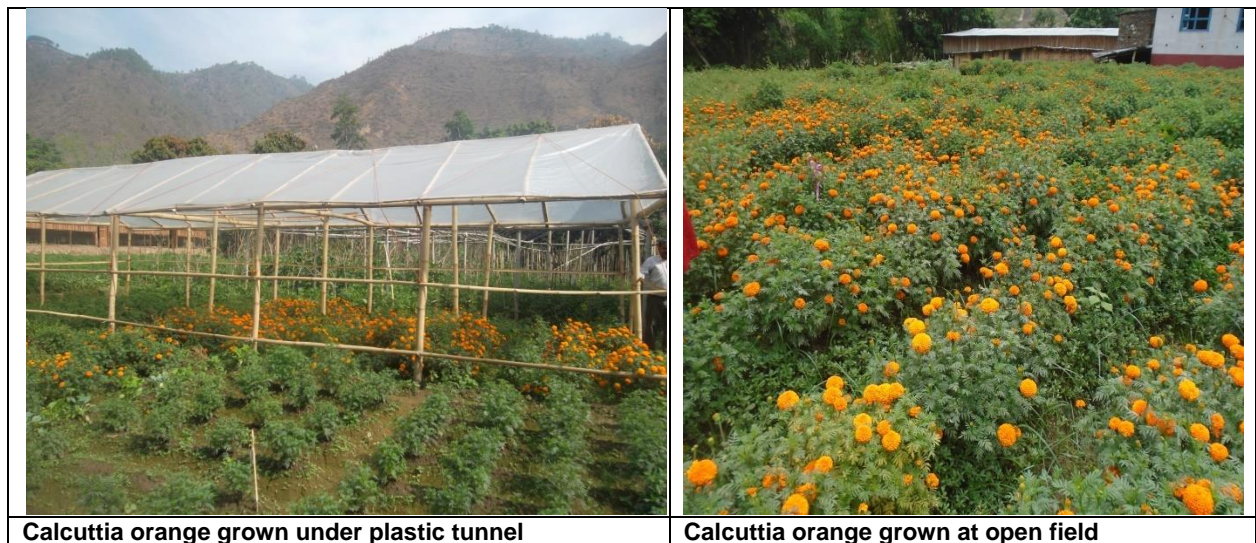
Marigold plant has also been valued for other purposes. *Tagetes minuta* is native to South America is an essential oil yielding plant used to prepare high grade perfumes and an insect repellent. Dried flower petals are important source of carotenoids used as poultry feed in order to improve the colour of egg yolk as well as broiler's skin. It is also being grown as a trap crop (Pandey, 2015). *Tagetes* species have strong, pungent odor and great value in cosmetic treatment, also effective for the treatment of skin problems. The leaves are effective against piles, kidney troubles, muscular pain, ulcers and wounds (Priyanka *et al.*, 2013).

The plant has a potentiality for year round flower production. In Nepal, the flower demand during festival and wedding seasons is very high, but the production is limited

for June to October due to limited knowledge and technology for winter-spring season production. The demand is currently fulfilled by import from India. Nepal imports worth NRs. 8.1 million flowers and 1.5 million garlands in 2012 for domestic markets (FAN, 2013).

Marigold requires mild climate for luxuriant growth and profuse flowering. Marigold production is concentrated around the Kathmandu valley, Janakpur and Chitwan districts, but these areas has not friendly climate for winter-spring production. However, there are a lots of pocket areas having diverse and fog-free microclimates that could capitalize on its special advantage for winter-spring production. Marigold cultivation is easy because of its wide adaptability, short duration of marketable flowers production and gaining popularity due to its attractive colour, shape, size and good keeping quality. In recent years, the increasing market demand has attracted the farmers. The work to standardize the suitable production for offseason growing condition is meager. Hence, the present work was undertaken to standardize agro-techniques in terms of cultivars and growing condition for winter-spring production in mid-hills of Nepal.

Kavre is a hilly district situated in central part of the country with altitudinal range of 300 to 3018 m, with Dhulikhel as its district headquarters. The district lies



Calcuttia orange grown under plastic tunnel

Calcuttia orange grown at open field

Figure 2: Example of selected cultivar of marigold at two different growing conditions

between 85° 24' to 85° 49' east longitude and 27° 22' to 27° 85' north longitude and covers an area of 1404.86 sq. km. District climate varies from subtropical to cool temperate. Agricultural land occupies 43.80 % of the total district area (GoN, 2013). The district is located in the central hills and bordered by Ramechhap and Dolakha to the east, Kathmandu, Lalitpur and Bhaktapur to the west, Sindhupalchok to the north, and Makwanpur and Sindhuli to the south (Figure 1).

MATERIALS AND METHODS

The research was conducted in the farmer's field at Katunjabeshi Village Development Committee in Kavre district of Nepal at an altitude of 890 m. A field experiment was laid out on silty loam soil having pH 7.5. A factorial randomized trial was carried out from August 2014 to October 2016 (Dhakal, 2073). The treatment consists of four cultivars (Calcuttia orange and Marigold Garland orange) in two growing (plastic tunnel and open field) conditions (Figure 2). There were eight treatments with three replications. In total, 24 treatment combinations were evaluated. The treatments were randomly allocated by using random table (Gomez and Gomez, 1984).

Twenty-eight days old seedling 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 m² with 60 X 60 cm² row to row and plant to plant distance. The space between replication and plot 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 plowed to around 40-50 cm. The seeds of Calcuttia orange were sown in 7 cm apart lines covering with straw. Regular evening supply of water was

provided until germination. The total dose for Nitrogen (N) is 200 Kg ha⁻¹ followed by Phosphorus (P) and Potash (K) is 100 Kg ha⁻¹ each. Twenty tones ha⁻¹ well decomposed Farm Yard Manure (FYM) was applied in each plots before two weeks of planting. Half dose of N and full dose of P and K were applied as a basal dose. The remaining half dose of N was divided equally and applied as top dressing in 30 days and 45 days after planting of seedlings. Nitrogen was applied through Urea (46% N), Potash through murate of potash (60% K₂O) and Phosphorus through diammonium phosphate (46% P₂O₅ and 18% N). In this research, only the temperature inside the plastic tunnel and open field was measured during the research periods (August 2014 to October 2016). The minimum temperature inside the plastic tunnel and at open field ranges from 0° C to 28° C and 0° C to 32° C respectively.

The flowers were harvested when 75% petals were unfolded. Data were recorded on various vegetative (plant height, plant spread, number of primary branches) and flowering parameters which includes yield and quality parameters (size of flower, fresh weight of single flower, number of flower per plant, flower yield per plant, days to 50% flowering, days to first harvest, days to last harvest and duration of flowering). The recorded data on different parameters were analyzed by using Genstat4.

RESULTS AND DISCUSSION

Vegetative growth

The effects of growing conditions were not significant on plant height, number of primary branches but highly significant with plant spread. On the other hand, the different cultivars were highly significant with plant height and plant spread but non-significant with the number of primary branches. The results showed that the Marigold garland orange has highest plant height (103.93 cm) followed by Calcuttia orange (95.44 cm), MSGY (76 cm)

Table 1: Effect of growing conditions and cultivars on vegetative, flowering characters and yield attributes of marigold at Kavre District of Nepal

Treatments	Plant height (cm)	Plant spread (cm)	No. of primary branches	Days to 50% flowering	Days to first harvest	Days to last harvest	Duration of flowering	Fresh wt. of single flower (gm)	Size of single flower (cm)	No. of flower/plant	Flower yield/plant (gm)
Growing condition											
Plastic tunnel	86.77	84.18	11.02	43.57	74.63	135.35	60.72	5.625	6.05	106.51	506.72
open field	85.02	84.79	11.20	45.72	73.25	122.38	49.12	5.033	5.3	90.70	450.02
F-value	0.018	<0.001	0.72	0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001
LSD (0.05)	1.40	0.27	1.09	0.915	1.4	1.71	2.65	0.15	0.11	1.37	1.22
Cultivars											
Calcuttia Orange	95.44	92.01	10.53	48.23	57.5	162.5	105	5.3	5.43	242.67	1109
MSGY	76	73.95	11.15	41.77	55.15	95.43	40.28	5.7	5.65	52.80	308.92
MSNY7	68.22	69.13	10.95	45.45	94.95	124.5	29.53	6.15	6.3	42.31	260.07
Marigold Garland Orange	103.93	102.85	11.80	43.12	88.15	133.03	44.87	4.15	5.4	56.65	235.51
F-value	<0.001	<0.001	0.39	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
LSD (0.05)	1.98	0.38	1.5	1.29	2	2.43	3.74	0.21	0.15	1.94	1.73
Growing condition x Cultivars											
Plastic tunnel x Calcuttia Orange	92.43	93.4	11.07	46.4	55	175	120	5.7	5.6	265.33	1513
Plastic tunnel x MSGY	78.9	73.4	11	42.1	55	95.47	40.47	6.3	6.4	56.82	357.9
Plastic tunnel x MSNY7	68.3	69.67	10	43.9	95.2	127.8	32.6	6.2	6.3	43.62	270.04
Plastic tunnel x Marigold Garland Orange	107.47	100.3	12	41.7	93.3	143.13	49.83	4.3	5.9	60.28	259.01
Open field x Calcuttia Orange	98.45	90.67	10	50	60	150	90	4.9	5.26	220	1078
Open field x MSGY	73.1	74.5	11.30	41.3	55.3	95.4	40.1	5.1	4.9	48.79	250.1
Open field x MSNY7	68.15	68.6	11.9	47	94.71	121.2	26.46	6.1	6.3	41	250.1
Open field x Marigold Garland Orange	100.40	105.4	11.6	44.5	83	122.93	39.9	4	4.9	53	212
Mean	85.90	84.48	11.11	44.64	73.94	128.87	54.92	5.32	5.69	98.61	523.8
F-value	<0.001	<0.001	0.24	0.010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
LSD (0.05)	2.8	0.54	2.18	1.83	2.9	3.43	5.3	0.3	0.22	2.75	38.68
CV%	1.9	0.4	11.3	2.4	2.3	1.5	5.6	3.3	2.3	1.6	0.3

Keys: LSD: Least Significant Difference, F-value: Probability; CV: Coefficient of Variance; No: Number; Wt. Weight; gm. Gram; Cm. Centimeter

and MSNY7 (68.22 cm) (Table 1). Differences in plant height among four different experimented marigold cultivars might be due to varietal characteristics (Adhikari and Pun, 2011). Variation in vegetative parameters is due to African garland orange and Calcuttia orange are of tall types and they were under African groups whereas French cultivar MSGY and MSNY7 are of short types and bushy from their origin and lies under French groups. Marigold garland orange has highest plant spread (102.85 cm) and

primary branches (11.80) (Table 1).

The interaction effect of growing conditions and cultivars were significant with plant height and spread but non-significant with primary branch formation. The highest plant height showed by Marigold garland orange is 107.4cm and 100.40cm under plastic tunnel and at open field respectively, followed by Calcuttia orange 98.45 cm at open field and 92.43 cm under plastic tunnel (Table1).

The vegetative growth was not significantly affected whether different cultivars were grown under plastic tunnel or at open field. The differences in vegetative growth in the cultivars of marigold can be attributed to their genetic composition because plant height, spread and number of branch are principally governed by genetic characters.

Days to flowering

Marigold is a short day plant. During long day conditions plant produces more vegetative growth and delay flowering. Marigold takes about 55-60 days to complete vegetative growth and then enter into reproductive stage. The combined effect of growing condition and varieties highly influenced on duration of flowering (Singh and Arora, 1980).

The growing conditions of marigold showed less significant effect on days to 50% flowering and high significant on days to first harvest, days to last harvest and duration of flowering. On the other hand, among the cultivars the earlier days to 50% flowering was shown by MSGY (41.77 days) followed by 43.12 days by Marigold Garland orange, 45.45 days by MSNY7 and 48.23 days by Calcuttia orange (Table 1). Similarly, the flowering duration of Calcuttia orange showed longest duration (105 days) and MSNY7 showed shortest duration (29.53 days). The duration of flowering of Calcuttia orange is 120 days under plastic tunnel and 90 days at open field. Similarly, the duration of flowering of Marigold Garland orange is 49.83 days under plastic tunnel and of MSGY is 40.1 days at open field (Table 1).

The combined effect of cultivars and growing condition has no any significant effect. Days to 50% flowering was showed by MSGY (41.3 days) at open field followed by 41.7 days by Marigold Garland orange, 42.1 days by MSGY under plastic tunnel and 43.9 days by MSNY7 under plastic tunnel. The delay in 50% flowering was 46.4 days by Calcuttia orange under plastic tunnel (Table 1). Overall, the treatments, the days to first harvest was 55 days under plastic tunnel showed by Calcuttia orange which was at par with MSGY under plastic tunnel. The day to second earlier harvest was 55.3 days for MSGY followed by 60 days for Calcuttia orange, 83 days for Marigold Garland orange all at open field (Table 1).

The longest duration was four months and three months for Calcuttia orange under plastic tunnel and at open field, followed by 49.81 days for Marigold Garland orange under plastic tunnel. The shortest duration was 32.6 days for MSNY7 under plastic tunnel and 26.46 days for MSGY at open field. Thus, the flowering duration ranges from 120 days to 26.46 days which may be due to cultivar traits (Table 1). In this research, Calcuttia orange took longest period of flowering at both growing conditions, may be due to cultivar effect. At open field, there might be sufficient

light whereas under plastic tunnel there is ample light and high temperature. High temperature and light increases the photosynthetic activities producing sufficient food materials resulting better development of flower. During this time period optimum temperature could be obtained only under plastic tunnel rather than in open field.

Flower characters

The growing conditions have significant effect on size of single flower *viz*; 5.3 cm was observed at open field and 6.05 cm under plastic tunnel. Similarly, number of flower per plant at open field is mean value of 90.70 and 106.51 under plastic tunnel and flower yield 450.02 per plant at open field and 506.72 under plastic tunnel. The duration of flowering and number of flowers per plant are linked with total yield of flower. Thus, longest duration was observed by Calcuttia orange resulting 1.5 kg and 1.07 kg of flower under plastic tunnel and at open field respectively. The number of flower per plant was 265.33 and 220 for Calcuttia orange under plastic tunnel and at open field respectively. The effect of growing condition on fresh weight of single flower showed non-significant while varieties showed significant ranging from 4.15 to 6.15 g. The combination of cultivar and growing conditions showed significant effect and size of flower varies from 4 g at open field by Marigold Garland orange to 6.3 g under plastic tunnel showed by MSGY (Table 1).

The size of single flower (in diameter) had significant effect *viz*: 5.3 cm at open field and 6.05 under plastic tunnel. The Marigold Garland orange has single flower of 5.4 cm whereas 6.3 cm for MSNY7. The size of flower for French group (MSGY and MSNY7) is 6.4 and 6.3 cm whereas African group (Calcuttia orange and Marigold Garland orange) showed 5.6 and 5.9 cm respectively (Table 1).

While comparing the relationship between vegetative growth and flower characters of the studied marigold cultivars, it was observed that the vegetative growth was recorded maximum for Marigold garland orange but the flower production was less. The vegetative growth of Calcuttia orange was less in comparison to Marigold garland orange but the flower production was highest among the cultivars. The chance of the observed results is due to genetic composition among the cultivars.

CONCLUSION

This research concluded that the reasonable preeminent results in most of the studied parameters were accomplished under plastic tunnels in comparison to those at open fields in Kavre district of Nepal. The Calcuttia orange is more practicable for winter-spring production and recommended for higher yield and longest duration of flowering.

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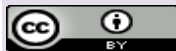
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