



E-ISSN: 2278-4136  
P-ISSN: 2349-8234  
JPP 2019; 8(1): 819-822  
Received: 15-11-2018  
Accepted: 17-12-2018

**Vijay Kumar**

Department of Horticulture  
Fruit Science, Nalanda College of  
Horticulture, Noorsarai, Bihar  
Agricultural University, Sabour,  
Bhagalpur, Bihar, India

**RS Singh**

Department of PBG, MBAC,  
Agwanpur, Saharsa, BAU,  
Sabour, Bhagalpur, Bihar, India

**M Pal**

Department of Horticulture  
Fruit Science, Nalanda College of  
Horticulture, Noorsarai, Bihar  
Agricultural University, Sabour,  
Bhagalpur, Bihar, India

**MD Ojha**

Department of Vegetable &  
Floriculture, NCOH, Noorsarai,  
BAU, Sabour, Bhagalpur, Bihar,  
India

**RB Verma**

Department of Vegetable  
& Floriculture, Bihar  
Agricultural College, (BAU),  
Sabour, Bhagalpur, Bihar, India

**RK Verma**

Krishi Vigyan Kendra, Halsi,  
Lakhisarai (BAU) Sabour,  
Bhagalpur, Bihar, India

**Neeraj Kumar**

Technical Assistant, Nalanda  
College of Horticulture,  
Noorsarai, BAU, Sabour,  
Bhagalpur, Bihar, India

**AP Singh**

Department of Vegetable &  
Floriculture, NCOH, Noorsarai,  
BAU, Sabour, Bhagalpur, Bihar,  
India

**Correspondence****Vijay Kumar**

Department of Horticulture  
Fruit Science, Nalanda College of  
Horticulture, Noorsarai, Bihar  
Agricultural University, Sabour,  
Bhagalpur, Bihar, India

## Growth and flower yield attributes of African marigold (*Tagetes erecta* L.) as influenced by planting geometry and varieties

Vijay Kumar, RS Singh, M Pal, MD Ojha, RB Verma, RK Verma, Neeraj Kumar and AP Singh

**Abstract**

An experiment was conducted at experimental field of Nalanda College of Horticulture, Bihar Agricultural university Sabour (Bhagalpur), Bihar to assess the influence of planting density and varieties on growth and flowering of African marigold (*Tagetes erecta* L.). The two varieties viz- Pusa Narangi and Pusa Basanti were planted with four spacing 50 x 50 cm, 50 x 40 cm, 50 x 30 cm, 40 x 30 cm. and arranged in factorial randomized block design replicated thrice. The data were collected on account of plant height (cm), number of branches/plant, number of flower/plant, flower diameter (cm.), average flower weight (g) and flower yield per plant (kg), per plot (kg) and per hectare (q/ha). It was observed that all the growth and yield attributing traits were significantly influenced due to several treatment and recorded higher values with the wider spacing 50 x 50 cm and 50 x 40 cm., respectively, except, plant height, flower yield/plot and per hectare, which were maximum at closer spacing (40 x 30 cm). Between the varieties, Pusa Narangi recorded maximum number of flowers /plant, flower diameter, flower yield/plant, flower yield/plot and per hectare while, Pusa Basanti produced maximum plant height. The maximum flower yield (q/ha) was recorded with the Pusa Narangi planted at closer spacing 40 x 30 cm (S4V2).

**Keywords:** Growth characters, Flower yield, Marigold, Planting distance, Varieties

**Introduction**

Marigold (*Tagetes sp.* L.) is one of the important commercial flowers in India belongs to the family Compositae. It occupies prominent position among the traditional loose flowers and ranks next only to Jasmine in terms of production. It originated in central and south America especially Mexico (Htus, 1945)<sup>[1]</sup>. African marigold represents vulgar minds whereas; French marigold is a symbol of jealousy (Anon., 1963)<sup>[2]</sup>. It is also known as friendship flower in the United States. The genus *Tagetes* have about 33 species, among these *T. erecta* L. and *T. patula* L. are the most important species used for commercial cultivation (Arora, 1989)<sup>[3]</sup>. Marigold gained popularity amongst farming communities on account of its easy culture and wider adaptability. Some species of the marigold have industrial potential and frequently used to extract essential oil and carotenoid pigments. Besides, African marigold as inter-crop controls nematodes as well as reduces the fungal attack and traps more number of *Helicoverpa armigera* eggs and larvae when used as inter-crop. It is an annual plant with strong, vigorous and erect stem, bushy and branching towards the apex. Leaves profuse, brilliant green elegantly divided into dentate lanceolate segments. There are many types and strain varying in plant height, growth habit, flower shape and size. The flowers have lemon yellow to yellow, golden yellow to orange and shades of these light yellow, canary yellow, golden yellow, bright yellow, cadmium orange, golden orange, deep orange and bright orange. Since marigold can be grown in all the three seasons i.e. rainy, winter and summer therefore, the climatic factors are beyond the control of human agency during the cultivation of marigold flower on commercial scale, but the growth, flowering behaviour and flower production of marigold can be improved to a large extent by judicious cultural operation i.e. application of suitable fertilizers, appropriate planting distance, weeding and pinching etc. Plant required a certain area for their normal growth and development as they compete for the space and an inappropriate planting distance affects the plant growth and flower yield, adversely indicating that the economic yield (flower) can only be achieved after providing proper planting space. Closer planting distance accommodates more number of plants per unit area but produces poor quality of flowers whereas, wider spacing accommodates lesser number of plants per unit area and the production is not economical. Traditional varieties being due genetically impure have low yielding potential and require the replacement with improved high yielding improved

/hybrid varieties. Keeping these acts in consideration the present experiment was planned and executed to explore the suitable varieties and optimum plant density for optimum growth and yield of marigold flowers.

### Materials and Methods

An experiment was conducted at Nalanda College of Horticulture, Noorsarai, Nalanda, campus of Bihar Agricultural University Sabour, Bhagalpur, Bihar during 2014-15 and 2015-16 to assess the effect of planting geometry and varieties on growth and flower yield of marigold. The experimental site was situated about 10 km away from Nalanda district head quarter and 65 km from Patna city at 25°27' latitude and 85°45' longitude and 57 meters above the mean sea level. Eight treatments comprised of two varieties viz, Pusa Narangi and Pusa Basanti and four spacing 50 x 50 cm, 50 x 40 cm, 50 x 30 cm and 40 x 30 cm accommodating 24, 30, 40 & 50 plants / 6m<sup>2</sup> areas respectively, were arranged in Randomized Block design with three replications. The seeds of marigold variety Pusa Narangi Gainda and Pusa Basanti Gainda were obtained from Seed Production Unit, IARI, New Delhi and sown in the last fortnight of September on 1.2 x 3 x 0.15 m (W x L x H) raised nursery beds keeping 45 cm path cum irrigation channel between each beds. The beds were mulched with paddy straw till germination. Four week old seedlings (4-6 leaf stage) were transplanted in the main field having plot size of 3 m x 2 m in the month of October 2014 and 2015, respectively. Plants were irrigated through watering can just after transplanting to establish the plants in the field. Pinching in the plants was followed after 40 days of transplanting to produce more number of auxiliary shoots that results more number of flowers. The data recorded on. plant height (cm), number of branches/plant, number of flowers /plant, flower diameter (cm.), average flower weight (g), flower yield/ plant (kg), per plot (kg) and per hectare (q/ha) were subjected for statistical analysis by the method suggested by (Fisher and Yates 1949) [4].

### Results and Discussion

All the growth and flower yield parameters were influenced significantly due to various spacing (Table 1&2). Data collected on account of spacing have significant impact towards plant height and recorded maximum plant height (85.42 cm) with closer (40 x 30 cm) planting distance. The increase in plant height at the closer spacing was mainly due to the fact that closely spaced plants tend to grow vertically for more light, air and space. The results are in close conformity with the findings of (Srivastava *et al.* 2002; Kumar *et al.* 2012; Kumar *et al.* 2017; Meena *et al.* 2015) [5, 6, 7, 13]. Both the varieties also brought significant improvement in plant height and the maximum height 93.10 cm was recorded with Pusa Basanti. The data collected on account of spacing have significant impact on number of branches/plant, number of flowers / plant, Flower diameter (cm), average flower weight (g) and flower yield/plant (kg). The maximum branches/plant (27.50) was recorded at wider (50 x 50 cm) planting distance. It was due to least competition and making availability of proper sunlight, space and moisture for optimum growth and development. These results are in close conformity with (Pal and Pandey 2007, Shrivastva *et al.* 2002) [8, 5] in marigold. The number of flowers per plant was significantly influenced by various spacing. The maximum number of flowers 60.00 being at par with 61.83 was recorded with wider spacing 50 x 50 cm and 50 x 40 cm respectively. This was due to less competition among the plants for proper

space, light and nutrition. The similar pattern has also been reported by (Ramesh *et al.* 2005) [9] in marigold.

The spacing progressively influenced the diameter of flower (cm) and recorded maximum diameter of flower (7.15 cm and 6.90 cm) with 50x50 cm and 50x40 cm respectively; while minimum (6.73 cm) was found with the planting at closer spacing 40x30 cm. (Shrivastava *et al.*, 2002) [5] also obtained maximum average size and weight of flowers under 40 x 60 cm spacing. An evaluation of data showed in the Table-2 revealed that various treatments have their significant role on average flower weight (g) and flower yield/plant (kg). The maximum average flower weight (8.71g) and flower yield/plant (0.53 kg) was recorded with wider (50 x 50cm) spacing (S<sub>1</sub> treatment), which was significantly superior to S<sub>2</sub> treatment. The increase in flower weight and flower yield/plant at wider spacing could be attributed to availability of greater space and light for photosynthesis with higher availability and uptake of nutrients by plants which could have enhanced cell division, cell elongation as well as protein synthesis and greater accumulation of dry matter in larger sized sink (flower). Similar result has also been reported by (Manoj kumar Rolaniya *et al.* 2017) [10].

Flower yield/bed (Kg) and per hectare (q/ha) was significantly influenced by various spacing. The maximum yield of flower per bed (17.80, 15.70 kg) and per hectare (267.00, 235.00 q/ha) was recorded with closer spacing (S<sub>4</sub> & S<sub>3</sub> treatment) planted at 40 x 30 cm and 50 x 30 cm. Even though the weight of flowers per plant was significantly maximum with 50 x 50 cm spacing but it failed to result in more flower yield per hectare because of accommodation of less number of plants per unit area. Hence, 40 x 30 cm was optimum spacing, where the plants per unit area were optimum which facilitated better growth of the plants that resulted in higher flower yield /ha as compared to other spacing of 50 x 30 cm, 50 x 40 and 50 x 50 cm. Similar pattern have also been recorded by (Lakshmi *et al.*, 2014; Karuppaiah and Krishna, 2005; and Srivastava *et al.*, 2002) [11, 12, 5] in marigold.

Both the varieties did not show pronounced effect on number of branches/plant and flower weight, while number of flowers /plant (60.42), flower diameter (7.00 cm), flower yield/plant (0.47 kg), per bed (14.97 kg) and per hectare (224.47 q/ha) influenced significantly due to varieties and recorded higher values with Pusa Narangi. However, Pusa Basanti recorded maximum height of plant (93.10cm). It may probably be due to varietal characteristics and adoptability in specific region.

### Interaction effect

The interactions among the various combinations of planting geometry and varieties had a significant effect on flower yield (q/ha). Planting of Pusa Narangi Gainda at spacing of 40 x 30 cm (S<sub>4</sub>V<sub>2</sub>) produced the highest flower yield (277.50 q/ha) as compare to S<sub>4</sub>V<sub>1</sub> treatment. The increase in flower yield might be due to the fact that the optimum plant population per unit area with both varieties resulted more flower yield/ha. Similar pattern has also been reported by (Lakshmi *et al.*, 2014) [11]. However the most of the growth and yield contributing traits i.e. height of plant, number of branches/plant, number of flowers /plant, flower size, flower weight and flower yield/plant showed non-significant differences.

### Conclusions

On the basis of present finding, it may be concluded that the 40 x 30 cm planting distance is optimum for both the varieties for getting maximum flower yield per bed as well as per hectare.

**Table 1:** Influence of planting geometry and varieties on growth and flowering of African marigold (*Tagetes erecta* L.).

Treatment/Characters	height of plant (cm.)	number of branches/plant	number of flowers / plant	flower diameter (cm)
<b>Spacing</b>				
S <sub>1</sub>	79.85	27.50	64.00	7.15
S <sub>2</sub>	80.90	23.50	61.83	6.90
S <sub>3</sub>	82.60	21.00	56.50	6.90
S <sub>4</sub>	85.42	18.50	53.500	6.73
SEm±	1.00	0.89	1.12	0.07
C.D. (P=0.05)	3.06	2.74	3.43	0.21
<b>Variety</b>				
V <sub>1</sub>	93.10	23.25	57.50	6.84
V <sub>2</sub>	71.28	22.00	60.42	7.00
SEm±	0.71	0.63	0.79	0.05
C.D. (P=0.05)	2.17	NS	2.428	0.15

S<sub>1</sub>=50 x 50cm; S<sub>2</sub>=50 x 40cm; S<sub>3</sub>=50 x 30cm; S<sub>4</sub>=40 x 30cm; V<sub>1</sub>=Pusa Basanti; V<sub>2</sub>=Pusa Narangi**Table 2:** Influence of planting geometry and varieties on flower yield of African marigold (*Tagetes erecta* L.).

Treatment/Characters	Average flower weight (g)	flower yield/plant (kg)	flower yield/plot (kg)	flower yield (q/ha)
<b>Spacing</b>				
S <sub>1</sub>	8.71	0.53	11.54	173.10
S <sub>2</sub>	8.30	0.49	13.40	201.00
S <sub>3</sub>	8.00	0.43	15.70	235.50
S <sub>4</sub>	7.80	0.39	17.80	267.00
SEm±	0.151	0.009	0.29	0.60
C.D.	0.462	0.02	0.82	1.845
<b>Variety</b>				
V <sub>1</sub>	8.07	0.45	14.25	213.82
V <sub>2</sub>	8.33	0.47	14.97	224.47
SEm±	0.21	0.006	0.19	0.42
C.D.	NS	0.02	0.58	1.30

S<sub>1</sub>=50 x 50cm; S<sub>2</sub>=50 x 40cm; S<sub>3</sub>=50 x 30cm; S<sub>4</sub>=40 x 30cm; V<sub>1</sub>=Pusa Basanti; V<sub>2</sub>=Pusa Narangi**Table 3:** Interaction effect between planting geometry and varieties on growth and flower yield of African marigold (*Tagetes erecta* L.).

Treatment/Characters	plant height(cm)	number of branches/plant	number of flowers/ plant	flower diameter (cm)
S <sub>1</sub> V <sub>1</sub>	91.20	28.00	62.00	7.10
S <sub>1</sub> V <sub>2</sub>	68.50	27.00	66.00	7.20
S <sub>2</sub> V <sub>1</sub>	92.50	24.00	61.00	6.90
S <sub>2</sub> V <sub>2</sub>	69.30	23.00	62.66	6.90
S <sub>3</sub> V <sub>1</sub>	93.10	22.00	55.00	6.70
S <sub>3</sub> V <sub>2</sub>	72.10	20.00	58.00	7.10
S <sub>4</sub> V <sub>1</sub>	95.60	19.00	52.00	6.66
S <sub>4</sub> V <sub>2</sub>	75.25	18.00	55.00	6.80
SEm±	1.41	1.26	1.58	0.101
C.D. (P = 0.05)	NS	NS	NS	NS

S<sub>1</sub>=50 x 50cm; S<sub>2</sub>=50 x 40cm; S<sub>3</sub>=50 x 30cm; S<sub>4</sub>=40 x 30cm; V<sub>1</sub>=Pusa Basanti; V<sub>2</sub>=Pusa Narangi**Table 4:** Interaction effect between planting geometry and varieties on flower yield of African marigold (*Tagetes erecta* L.).

Treatment/Characters	Average flower weight (g)	flower yield/plant (kg)	flower yield/plot (kg)	flower yield (q/ha)
S <sub>1</sub> V <sub>1</sub>	8.50	0.53	11.42	171.30
S <sub>1</sub> V <sub>2</sub>	8.92	0.54	11.66	174.90
S <sub>2</sub> V <sub>1</sub>	8.20	0.48	13.00	195.00
S <sub>2</sub> V <sub>2</sub>	8.40	0.51	13.80	207.00
S <sub>3</sub> V <sub>1</sub>	7.90	0.42	15.50	232.50
S <sub>3</sub> V <sub>2</sub>	8.10	0.44	15.90	238.50
S <sub>4</sub> V <sub>1</sub>	7.70	0.38	17.10	256.50
S <sub>4</sub> V <sub>2</sub>	7.90	0.41	18.50	277.50
SEm±	0.21	0.01	0.39	0.852
C.D. (P = 0.05)	NS	NS	NS	2.60

S<sub>1</sub>=50 x 50cm; S<sub>2</sub>=50 x 40cm; S<sub>3</sub>=50 x 30cm; S<sub>4</sub>=40 x 30cm; V<sub>1</sub>=Pusa Basanti; V<sub>2</sub>=Pusa Narangi**References**

1. Iltis H. Bud nutrition in marigold. J. Heredity. b. 1945; 36:291-295.
2. Anonymous. Complete Library of the Garden. The Reader's Digest Association Ltd., London. 1963, 344.
3. Arora JS, Marigold, In Bose TK, Yadav LP. (Ed.). Commercial flowers. Naya Prakash, Culcutta, India. 1989, 713-731.
4. Fisher RD, Yates F. Statistical table for biological and medical research. Oliver and Boyd. Edberg (London). 1949, 3<sup>rd</sup> Ed.

5. Srivastava SK, Singh HK, Srivastava AK. Study on spacing and pinching on growth and flowering of 'Pusa Narangi Gaiinda' marigold (*Tagetes erecta* L.). Indian Journal of Agricultural Sciences. 2002; 72:611-612.
6. Kumar V, Singh HK, Kumar A, Singh AK, Pratap B. Effect of planting distance and pinching on growth and flowering behavior of African marigold (*Tagetes erecta*) cv. Pusa Narangi in rainy season. Current Advances in Agricultural Sciences. 2012; 4(1):79-81.
7. Kumar V, Singh RS, Pal M, Verma RK, Ojha MD, Singh PK *et al.* Impact of planting geometry and varieties on growth and seed yield of African marigold (*Tagetes erecta*). Progressive Research-An International Journal. 2017; 12:2358-2360.
8. Anju P, Pandey AK. Effect of plant spacing on growth and flowering in African marigold (*Tagetes erecta* L.) under Bundelkhand region. Prog. Res. 2007; 2(1, 2):70-72
9. Baboo R, Ahamad N, Singh D. Growth and flowering of African marigold (*Tagetes erecta*L.) as affected by Nitrogen and Phosphorus under varying intra-row spacings. Journal of Ornamental Horticulture. 2005; 8(4):312-313.
10. Rolaniya MK, Khandelwal SK, Choudhary A, Jat PK. Response of African marigold to NPK, biofertilizers and spacings. Journal of Applied and Natural Science. 2017; 9(1):593-597.
11. Lakshmi, Pandey RK, Dogra S, Laishram N, Bhat D, Singh A *et al.* Studies on effects of planting dates and spacing in African marigold (*Tagetes erecta* L.) Progressive Horticulture. 2014; 46(1):149-152.
12. Karuppaiah P, Krishna G. Response of spacings and nitrogen levels on growth flowering and yield characters of French marigold (*Tagetes patula* L.). J. Orn. Hort. 2005; 8(2):96-99.
13. Meena Y, Siroh HS, Tomar BS, Kumar S. Effect of planting time, spacing and pinching on growth and seed yield traits in African marigold (*Tagetes erecta*) cv. Pusa Narangi Gaiinda. Indian Journal of Agricultural Sciences. 2015; 85(6):797-801.