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Effect of cultivars of African marigold (*Tagetes erecta* L.) with planting spacings on vegetative growth and flower yield under Chhattisgarh plains

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Abstract
A field experiment was conducted at Ramprasad Potai College of Agriculture and Research station Kanker under Chhattisgarh plains during 2020-21 to find out the effect of cultivars with different spacings on vegetative growth and flower yield of African marigold. The experiment was laid out in Factorial RBD comprising treatment combination of three cultivars of African marigold *i.e.*, Pusa Bahar Gainda, Pusa Basanti Gainda and Pusa Narangi Gainda with four planting spacings *viz.*, 60 x 40 cm, 50 x 40 cm, 50 x 30 cm and 40 x 40 cm, respectively. The result indicated that the growth and flower yield were significantly influenced by different cultivars with different planting spacings. Plant height recorded significantly maximum (68.47 cm) in cultivar Pusa Basanti Gainda followed by Pusa Bahar Gainda (64.13 cm) while, minimum plant height (53.92 cm) was measured in Pusa Narangi Gainda. The maximum plant height was observed with closer spacing 40 x 40 cm as compared to wider spacing 60 x 40 cm. The maximum number of flowers plant^{-1} (69.84) was recorded under treatment combination V_1S_1 (cv. Pusa Bahar Gainda and spacing 60 x 40 cm) whereas, maximum flower yield ha^{-1} was obtained by V_1S_3 (Cv. PBG and spacing 50 x 30 cm) could be developed more lateral branches plant^{-1}.

Keywords: African marigold, *Tagetes erecta* L., spacings, vegetative growth, flower yield

Introduction
African marigold (*Tagetes erecta* L.) is one of the important commercial annual flower crop belonging to the family Asteraceae. Among the flower crops, marigold is one of the most common flower that is cultivated commercially as loose flowers in various parts of the country. It is popular throughout the world because of wide spectrum of attractive colours, shape and good keeping quality which has attracted the attention of flower growers. They are extensively used as loose flower, potted plant and also as a bedding plant. Loose flowers are in great demand for garland making as well as in religious and social functions. It has medicinal and nematicide properties, and certain varieties have industrial potential (Meena *et al.*, 2015) [10]. To achieve successful growth with flower yield and quality there is a need to choose good and healthy plant materials.

Plants require a certain amount of area for normal growth and yield otherwise they compete for space and improper planting distance affects plant growth and flower yield. The economic flower yield can be achieved by providing proper space and selection of varieties for commercial cultivation. Traditional varieties produce lower yields and are genetically impure or mixed, while varieties such as Pusa Narangi Gainda and Pusa Basanti Gainda produce higher yields (Raghava, 1998) [15]. Since, a large area of marigold cultivation is under local varieties due to a lack of knowledge among the growers about improved varieties and also improper plant population hampering the yield and causing economic losses. Thus choosing the suitable variety fit for the certain agro-climatic situation is uttermost important and by maintaining optimum plant population leads toward maximum economic yield. Thus, keeping the above facts present study was undertaken to find out the suitable cultivar and proper planting spacing for better growth and flowering yield of African marigold under Chhattisgarh Plains.

Materials and Methods
The present experiment was carried out during *Rabi* 2020-21, at the Instructional Farm, College of Agriculture and Research station, Singarbhat Kanker (C. G.). The experiment was laid out in Randomized Block Design (Factorial) with three replications comprising twelve

treatment combinations of four levels of planting geometry *viz.*, 60 x 40 cm (S_1), 50 x 40 cm (S_2), 50 x 30 cm (S_3) and 40 x 40 cm (S_4), respectively and three varieties *viz.*, Pusa Bahar Gainda (V_1), Pusa Narangi Gainda (V_2) and Pusa Basanti Gainda (V_3) of African marigold. The seeds were sown during first fortnight of December on raised nursery beds measuring 150 x 100 x 15 cm^3. Seeds were sown on 10th December and germinated within 5-6 DAS (days after sowing). Seedlings of African marigold were raised in the beds of the nursery. Four weeks old seedlings were transplanted on the experimental field. Initially, water was supplied with water cane on alternate days. Observations were taken on parameters such as plant height, number of flowers $plant^{-1}$ and yield q ha^{-1} were analyzed statistically using techniques of analysis given by Panse and Sukhatme (1984) [14].

Table 1: Effect of cultivars on growth and yield of African marigold (*Tagetes erecta* L.)

Varieties (V)	Plant height (cm)			Number of flowers $plant^{-1}$	Flower yield ha^{-1}
	30 DAT	60 DAT	90 DAT		
V_1	38.10	60.51	64.13	62.77	192.48
V_2	37.79	51.00	53.92	57.14	160.70
V_3	38.08	67.27	68.47	59.35	176.56
Sem±	0.36	0.64	0.81	0.18	0.90
CD (p=0.05)	NS	1.87	2.36	0.51	2.63

* V_1 = Pusa Bahar Gainda, V_2 = Pusa Narangi Gainda, V_3 = Pusa Basanti Gainda

Table 2: Effect of planting spacings on growth and yield of African marigold (*Tagetes erecta* L.)

Spacings (S)	Plant height (cm)			Number of flowers $plant^{-1}$	Flower yield ha^{-1}
	30 DAT	60 DAT	90 DAT		
S_1 (60x40cm)	37.70	56.90	58.93	65.38	160.89
S_2 (50x40cm)	38.05	58.22	60.60	61.65	177.44
S_3 (50x30cm)	38.22	63.67	67.00	52.22	191.41
S_4 (40x40cm)	38.35	67.00	69.17	53.97	186.69
Sem±	0.41	0.74	0.93	0.20	1.04
CD (p=0.05)	NS	2.16	2.73	0.59	3.04

Table 3: Interaction between cultivars and planting spacings on growth and yield of African marigold (*Tagetes erecta* L.)

Treatments (VxS)	Plant height (cm)			Number of flowers $plant^{-1}$	Flower yield ha^{-1}
	30 DAT	60 DAT	90 DAT		
V_1S_1	37.99	57.37	59.16	69.84	180.10
V_1S_2	38.08	57.80	62.15	63.83	188.39
V_1S_3	38.22	66.37	71.09	54.64	208.96
V_1S_4	38.37	69.86	71.61	56.34	203.12
V_2S_1	37.30	49.90	52.24	62.63	145.89
V_2S_2	37.92	50.29	52.71	59.31	164.88
V_2S_3	38.15	52.82	56.80	49.47	171.32
V_2S_4	38.27	58.73	62.16	52.07	169.57
V_3S_1	37.81	63.41	65.39	63.67	156.68
V_3S_2	38.16	66.59	66.93	61.82	179.04
V_3S_3	38.27	71.81	73.09	52.55	193.96
V_3S_4	38.42	72.43	73.75	53.49	187.37
Sem±	0.72	1.27	1.61	0.35	1.79
CD (p=0.05)	NS	NS	NS	1.03	5.26

Results and Discussion

Plant height

Influence of Varieties and spacings

The result on plant height influenced due to various planting spacing and cultivars of African marigold (*Tagetes erecta* L.) at 30, 60 and 90 DAT are shown in Table 1, 2 and 3. The observation on plant height at 30 DAT showed non-significant differences among the treatments. Plant height at 60 and 90 DAT showed significant variations among the cultivars and Pusa Basanti Gainda (V_3) recorded maximum plant height (67.27 and 68.47 cm, respectively) followed by Pusa Bahar Gainda (V_1) (60.51 and 64.13 cm, respectively).On the other hand, minimum plant height (51.00 and 53.92 cm, respectively) was measured in Pusa Narangi Gainda (V_2). The variation in plant height among varieties could be due to their different genotypic characters and environmental fluctuations in the region to express their dominant genes. Shiv Kumar *et al.* (2015) [17], Netam *et al.* (2019) [11] and Kumar *et al.* (2020) [8] findings also confirmed similar results in Marigold. The plant height at 60 and 90 DAT differed significantly with planting distance. It was observed that closer spacing *i.e.*, S_4 (40 x 40 cm) attained maximum plant height (67.00 cm and 69.17 cm) followed by S_3 (50 x 30 cm) while, minimum plant height was recorded in S_1 (56.90 cm and 58.93 cm). The increase in plant height with closer spacing might be due to growth competition between plants as they grow vertically for light, space and air. Those results were found similar with the findings of Kumar *et al.* (2012) [5], Lakshmi *et al.* (2014) [8], Singh *et al.* (2018) [20] and Kumar *et al.* (2019) [7] in African marigold and Khobragade *et al.* (2012) [3] in China Aster.

Number of flowers

Effect of cultivars and spacings

The data on number of flowers $plant^{-1}$ was recorded during three pickings are shown in Table 1, 2 and 3. The number of flowers $plant^{-1}$ varied significantly among cultivars and recorded maximum number of flowers $plant^{-1}$ (62.77) under Pusa Bahar Gainda (V_1) while, minimum number of flowers $plant^{-1}$ (57.14) was observed in Pusa Narangi Gainda (V_2). The variation could be due to more number of lateral branches, genotypic and environmental conditions. Similar results were also reported by Singh and Singh (2006) [18], Narsude *et al.* (2010) [12], Pandey *et al.* (2014) [13] and Kumar *et al.* (2015) [6] in Marigold. The data influenced due to different levels of spacing showed significant differences on number of flowers $plant^{-1}$ and recorded maximum number of flowers $plant^{-1}$ (65.38) under S_1 (60 x 40 cm) followed by treatment S_2 (50 x 40 cm) while, minimum number of flowers $plant^{-1}$ (52.22) was recorded under S_3 (50 x 30 cm). The increase in number of flowers under wider spacing could be due to production of more number of lateral branches $plant^{-1}$ which eventually produced more number of flowers $plant^{-1}$. The present findings were in accordance with the findings of Sunitha *et al.* (2007) [22] and Singh *et al.* (2015) [19] in Marigold and Kour (2009) [4] and Dorajeerao *et al.* (2012) [2] in Chrysanthemum. The treatment combinations showed significant differences and recorded maximum number of flowers $plant^{-1}$ (69.84) under treatment combination V_1S_1 (cv. Pusa Bahar Gainda and spacing 60 x 40 cm) followed by V_1S_2 and V_3S_1 while, minimum number of flowers $plant^{-1}$ (49.47) was noticed under treatment combination V_2S_3 (cv. Pusa Narangi Gainda and spacing 50 x 30 cm).

Flower yield

Effect of cultivars and spacings

The data on flower yield ha^{-1} was recorded and given in Table 1, 2 and 3. The result on flower yield ha^{-1} showed significant differences among the cultivars and recorded significantly maximum flower yield q ha^{-1} (192.48) with Pusa Bahar

Gainda (V_1) whereas, minimum flower yield q ha^{-1} (160.70) was obtained in cv. Pusa Narangi Gainda (V_2). The difference could be genetically and proper spread, maximum number of lateral branches and flower buds in plants also affect the flower yield. Similar results were obtained with the findings of Shiv Kumar *et al.* (2015) [17], Khobragade *et al.* (2019) [3], Kumar *et al.* (2019) [7], Shukla *et al.* (2019) [21] and Kumar *et al.* (2020) [8] in Marigold. The data showed significant differences on flower yield ha^{-1} due to different planting spacings. The maximum flower yield q ha^{-1} (191.41) was recorded under closer spacing of 50 x 30 cm (S_3) followed by 40 x 40 cm (S_4) while, yield ha^{-1} was found minimum (160.89 q) under wider spacing of 60 x 40 cm (S_1). The data clearly showed maximum flower yield with closer spacing, it may be due to more plant population and environmental conditions for the plants. The above result was also similar with the findings of Sunitha *et al.* (2007) [22], Deshmane *et al.* (2012) [1], Kour *et al.* (2012) [4], Kumar *et al.* (2012) [5] and Rajput *et al.* (2020) [16] in Marigold. The combined effect between cultivars and spacing levels found significant for this character. However, flower yield ha^{-1} was recorded significantly maximum (208.96 q) under treatment combination V_1S_3 (cv. Pusa Bahar Gainda and spacing 50 x 30 cm) followed by V_1S_4 and V_3S_3 While, minimum flower yield ha^{-1} (145.89 q) was obtained under V_2S_1.

Conclusion

It can be concluded from the present investigation that cv. Pusa Basanti Gainda was observed to be superior in terms of plant height. The maximum number of flowers plant^{-1} as well as flower yield q ha^{-1} were recorded under cv. Pusa Bahar Gainda. Whereas, The treatment combination of Pusa Bahar Gainda with closer spacing of 50 x 30 cm produced highest number of flowers plant^{-1} and flower yield ha^{-1}.

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