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Response of planting geometry and pinching on flower yield and economic feasibility of African marigold (*Tagetes erecta* Linn) CV. Pusa Narangi

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Abstract
An experiment was conducted at experimental station of Narendra Deva University of Agriculture and Technology, Kumarganj Faizabad, U.P. to assess the impact of economic profitability and yield of African marigold through various levels of planting geometry and pinching. The treatment comprises with three level of manual pinching i.e. 30, 40, 50 days after transplanting and two level of spacing i.e. 50 x 40 cm and 50 x 50 cm. the experiment was planned under Factorial Randomize Block Design with four replication. The acceptance of any agricultural recommendation is mainly depending on its benefit: cost ratio. Number of flower/plant, yield of flower/plant (kg), Yield of flower (q/ha), gross income (Rs. /ha), net profit (Rs. /ha) and benefit: cost ratio was recorded and analysed during the experiment. The maximum yield of flower/plant (0.50 kg), yield of flower/bed (14.94kg), yield of flower/ha (250 q/ha), highest net return (Rs.150000) and benefit: cost ratio (1:1.86) were significantly registered with (P_1S_1) closer spacing of 50 x40 cm and 40 days pinching after transplanting.

Keywords: Spacing, Pinching, Economic feasibility, yield

Introduction
Marigold (*Tagetes erecta* Linn.) is an important commercial flower of India belonging to family Compositae. It originated in central and south America especially Mexico (IItus, 1945) [5]. African marigold represents vulgar minds whereas; French marigold is a symbol of jealousy (Anon., 1963) [3]. It is also known as friendship flower in the United States. It is very popular due to easy to grow and wider adaptability. Flowers are sold in the market as loose or for making garlands. Flowers are traditionally used as offering in temples, churches and in festivals, beautification and landscape. It is highly suitable for pot culture, bedding purpose and window boxes. It contains medicinal and nematicidal properties and recommended for growing as a trap crop with the tomato and onion to reduce the menace of fruit borer in IPM system (Meena *et al.* 2015) [10]. It occupies prim position among the traditional loose flowers grown in India and ranks next only to Jasmine in terms of production. It is grown in 42 880 hectare area with production of 360 000 MT (National Horticulture Board) [12]. Planting of marigold at closer spacing accommodate the more number of plants per hectare but produces poor quality flowers, while, wider spacing accommodate lesser number of plants and flowers which are not economical (Kumar *et al.* 2019) [9].The acceptance of any agricultural recommendation is mainly depending on its economic feasibility i.e. flower yield (q/ha), cast of cultivation (Rs/ha), grass income (Rs./ha), net profit (Rs./ha) and benefit: cost ratio. The maximum return is ultimate objective of farmers which is depending on yield of flower. The yield was directly varying with application of input and other cultural practices. Keeping the above facts in view, the present investigation was planned and executed to assess the effect of pinching and spacing on yield and economic feasibility of African marigold.

Materials and Methods
An experiment was conducted to assess the economic profitability and yield of African marigold CV Pusa Narangi through application of various level of planting geometry and pinching at the main experimental Station, Department of Horticulture-Fruit Science, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Faizabad (U.P.) during 2007-08. The experimental site was situated about 40 km away from Faizabad district head quarter at 26.47 °N latitude and 82.12 °E longitude on an elevation of about 113 meters above the mean sea level in the Gangetic alluvial plain of eastern, Uttar Pradesh. The treatment comprises with three level of manual pinching i.e. 30, 40, 50 days after transplanting

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and two level of spacing i.e. 50 x 40 cm and 50 x 50 cm. the experiment was planned under Factorial Randomize Block Design with four replication. The seeds were obtained from Seed Production Unit, IARI, New Delhi and seedlings were grown in raised bed nursery. Four week old seedlings (4-6 leaf stage) were transplanted as per treatment in the plots having 3 m x 2 m size in the month of July. Economic components of different treatments were worked out under cost of cultivation (Rs./ha), gross income (Rs./ha), net profit (Rs./ha) and cost : benefit ratio. The cost of cultivation was workout by taking all consideration of expenditure incurred on the basis of existing market rate, whereas, gross income was calculated by multiplying per hectare yield of flower under various treatments prevailing selling rates of flower in the market. The benefit: cost ratio was computed by adopting following formula:

Benefit: Cost ratio=Net return (Rs./ha)/Cost of cultivation (Rs./ha)

The statistical analysis of data recorded in all observation was analyzed statistically following the method suggested by (Fisher and Yates 1949) [4].

Results and discussion

The data presented in Fig.1&2 is clearly indicated that the interaction between spacing and pinching was influenced significantly on yield of flower per plant and flower yield per bed. The maximum yield of flower per bed (14.94 kg) and yield of flower per plant (0.50 kg) was recorded with S_1P_2 treatment where plant was pinched at 40 days after transplanting in combination with closer spacing of 50 x 40 cm. This was due to the fact that more number of plants was accommodated in closer spacing and pinching influenced due to breaking of apical dominance which produced more number of lateral branches resulted more yield than the other treatments by producing of more number of primary and secondary branches. Similar result has also been observed by (Sharma et al. 2006; Kumar et al 2017; Singh and Arora 1988; Arora and Saini 1976) [13, 8, 12, 2] in marigold.

Data presented in table-1 indicated that Yield of flower per hectare was significantly influenced by different level of spacing. The maximum yield of flower per hectare was recorded with closer spacing S_1 (50 x 40 cm) treatment. This might be due to the fact that more number of plants were accommodated in closer spacing. Similar results have also been reported by (Mohanty et al. 1993; Kumar et al. 2012; Gowda and Jayanthi 1988) [11, 7, 5] in marigold. The pinching significantly influenced the yield of flower per hectare. The maximum yield of flower was recorded with P_2 treatment. This was mainly due to production of more number of branches which resulted bearing more number of flowers, by removing apical dominance of main shoots. Similar results have also been observed by (Sharma et al.2006; Arora and Khanna 1986; Shrivastava. 2002) [13, 1, 15] in marigold.

The interaction between spacing and pinching was influenced significantly on yield of flower per hectare. The maximum yield per hectare was recorded with S_1P_2 treatment it was due to the fact that closer spacing accommodated more number of plants per unit area and pinching at 40 days produced maximum number of branches per shoots resulting maximum yield of flower per hectare.

The data presented in Table-2 Cleary indicated that the highest cost of cultivation was calculated with an expenditure of 52363 Rs/ha while, the minimum cost of cultivation Rs.51500. The maximum gross income of (150000 Rs./ha) was calculated from pinching after 40 days of transplanting planted at closer spacing at 50 x 40 cm (P_2S_1) treatment. Net profit (Rs. /ha) was calculated by subtracting the cost of cultivation from the gross income. The maximum net profit (97637 Rs. /ha) was recorded with P_2S_2 treatment which is best from other treatments. However, the minimum net income (96000 Rs./ha) was worked out from P_3S_2 treatment. The maximum cost: benefit ratio (1:1.86) was noted from P_2S_2 treatment. However, minimum cost: benefit ratio (1:082) was recorded from P_3S_2. The economics of crop production is a very important part of cultivation of any crops. The cost of cultivation was directly associated with various inputs viz. cost of seed, fertilizers, insecticide and pesticide, irrigation, harvesting etc. grass income was found directly associated with the yield of marketable flower under various treatments. In present investigation the treatment P_2S_1 come out to be the best in gross income followed by P_1S_1.
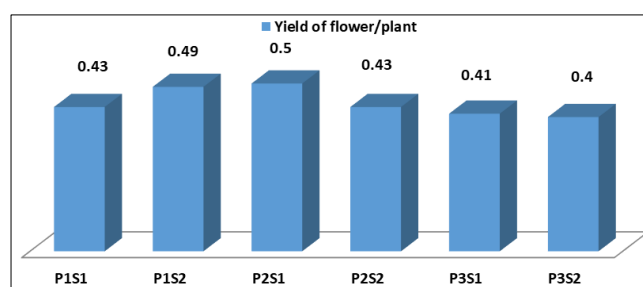

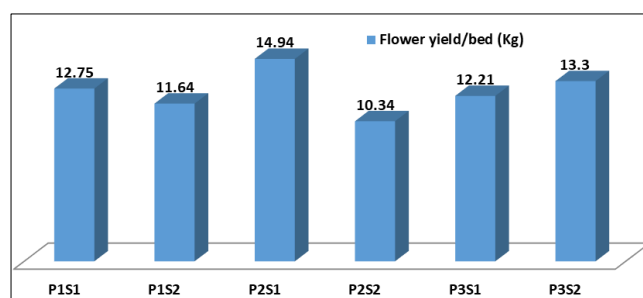**Fig 1:** Effect of planting geometry and pinching on yield of flower/plant (kg)

Fig 2: Effect of planting geometry and pinching on flower yield/bed (Kg)

Table 1: Effect of planting geometry, pinching and their interaction on flower yield per hectare (quintal) of marigold (*Tagetes erecta* L.).

Treatments	Yield per hectare (qha^{-1})	Treatments (PXS)	Yield per hectare (qha^{-1})
P_1 (30 DAP)	205.50	P_1S_1	215.00
P_2 (40 DAP)	211.00	P_1S_2	196.00
P_3 (50 DAP)	182.50	P_2S_1	250.00
SEm±	5.012	P_2S_2	172.00
C.D. at 5%	15.103	P_3S_1	205.00
S_1 (50 x40 cm)	223.33	P_3S_2	160.00
S_2 (50 x 50 cm)	176.00	SEm±	7.087
SEm±	4.092	C.D. at 5%	21.36
C.D. at 5%	12.332		

Table 2: Effect of planting geometry and pinching on economics of the crop production of marigold (*Tagetes erecta* L.).

Treatment combination	Yield (q/ha)	Grass income (Rs./ha)	Cost of cultivation (Rs./ha)	Net income (Rs./ha)	Cost : Benefit ratio
P_1S_1	215.00	129000.00	52363.00	76636.00	1:1.46
P_1S_2	196.00	117000.00	51500.00	65500.00	1:1.27
P_2S_1	250.00	150000.00	52363.00	97637.00	1:1.86
P_2S_2	172.00	103000.00	51500.00	51500.00	1:1.00
P_3S_1	205.00	123000.00	52363.00	70637.00	1:1.32
P_3S_2	160.00	96000.00	52500.00	43500.00	1:0.82

Conclusion

According to experimental findings, following important conclusion and recommendation has been drawn for adoption the technology of marigold on commercial basis in the eastern part of Uttar Pradesh.

-The highest net return (97637 Rs/ha) and highest cost: benefit ratio (1:1.86) have been calculated by the application of pinching at 40 days after transplanting with closer plant spacing 50 x 40 cm (P_2S_1).

-It is concluded that higher economic return was obtained from high flower yield with P_2S_1. Pinching at 40 days after transplanting is optimum time of pinching because of maximum flower yield/plant, yield/bed and yield/ha recorded from pinching at 40 DAT.

-50 x 40 cm of planting distance is suitable and accommodated more number of plants per hectare which resulted in higher flower yield/ha.

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