

RESEARCH ARTICLE

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Effect of planting date and spacing on performance of marigold (*Tagetes erecta* Linn) cv. PUSA NARANGI under North Bihar agro-ecological conditions

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ABSTRACT : A field trial was carried out for two years to ascertain performance of marigold (var. *Pusa Narangi*) planted at three spacings and on six different dates at bimonthly interval *i.e.* on first day of March, May, July, September, November and January. The crop planted on 1st March showed early flowering compared to other planting dates. The best performance with respect to flower size, weight and number of flowers per plant was recorded with 1st September planting. The highest number of branches and plant canopy spread were attained with May and July plantings. In both the years wider spacing of 40 cm × 40 cm produced best results with respect to maximum flower diameter, weight of individual flower and number of flower per plant. However, the total best yield per unit area was higher when the crop was planted on 1st September at 40cm × 20 cm spacing.

KEY WORDS : Marigold, *Tagetes erecta* Linn, Planting time, Spacing, Flower quality, Yield

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INTRODUCTION

Marigold is one of the most important commercial grown flowers crop in India. Its loose flowers are sold in the markets in the form of garlands and extensively used for religious and social functions. Small and marginal farmers of Bihar grow this crop due to its wider adoptability, ease in cultivation and lucrative return. The area under marigold cultivation is about 550 hectares in

Bihar. Both *Tagetes erecta* Linn. and *Tagetes patula* Linn. are mainly grown during winter season. The cultivation of marigold in other seasons is also expected to give good return. *Tagetes erecta* (cv. PUSA NARANGI) produces orange red, medium size compact flowers with good keeping quality. This cultivar is gaining popularity among the flower grower of Bihar and other parts of the country. According to Samantarary *et al.* (1999) it is possible to grow African yellow marigold beyond the winter season. Although the cv. PUSA NARANGI is having potential for year round flower production, no work has been done to standardize its suitable planting time and spacing in Bihar agro-ecological conditions. Therefore, the present study was undertaken with the objectives to

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standardize agro-technique in terms of planting time and spacing for the north Bihar plains.

EXPERIMENTAL METHODS

A field experiment was laid out on calcareous sandy loam soil having pH 8.3 at Horticulture production area of RAU, Pusa (Samastipur) adopting a Factorial Randomized Block Design with 3 replications. The trial was carried out for two years (2009 to 2011) under the irrigated condition. The treatments consisted of six date of plating dates, viz., 1st March, 1st May, 1st July, 1st September, 1st November and 1st January and three spacings 40 cm × 20 cm, 40 cm × 30 cm and 40 cm × 40 cm. Thus, a total of 18 treatments combinations were evaluated. Well-rooted terminal cuttings with uniform growth and vigor were planted as per the treatment combinations and other cultural practices were followed uniformly throughout the experimentation. Irrigation was given immediately after planting and fertilization. Thereafter, it was applied as and when felt necessary depending upon the field and crop conditions. The plot size was 3.60 m × 2.40 m. A uniform dose of 20 tons FYM, 150 kg N, 60 kg each of P₂O₅ and K₂O/ha was

applied to all the treatments. Full dose of FYM, P₂O₅, K₂O and half dose of the nitrogen was applied before transplanting in form of urea, single super phosphate and muriate of potash, respectively. Remaining quantity of nitrogen was given as top dressing in three equal split doses at 15, 30 and 45 days after transplanting. To encourage auxiliary branches plants were pinched at 15 and 30 days stage. The data on vegetative characters and yield were taken during both the years.

Statistical analysis:

The obtained data was analyzed by statistical significant at P<0.05 level, S.E. and C.D. at 5 per cent level by the procedure given by (Gomez and Gomez, 1984).

EXPERIMENTAL RESULTS AND ANALYSIS

Planting time significantly influenced vegetative characters like plant height, number of branches and plant canopy spread (Table 1). The highest plant heights (71.12 cm and 68.02 cm) were recorded with planting on 1st May and followed by the next planting date *i.e.* 1st July in both the years. This observation is in conformity with

Table 1 : Effect of planting time and spacing of vegetative growth of marigold during, 2009-10 and 2010-11

Treatments	Plant height (cm)			Mean	Number of branches			Mean	Plant spread (cm)			Mean
	S ₁	S ₂	S ₃		S ₁	S ₂	S ₃		S ₁	S ₂	S ₃	
2009-10												
D ₁ (1 st March)	30.46	30.95	31.05	30.82	17.67	19.40	20.23	19.10	49.56	50.73	52.76	51.02
D ₂ (1 st May)	69.23	71.23	72.90	71.12	33.50	34.57	36.56	34.87	68.83	65.46	66.66	65.32
D ₃ (1 st July)	55.00	55.70	57.03	55.91	24.10	25.16	25.97	25.07	67.16	67.20	70.83	68.73
D ₄ (1 st Sept.)	38.75	40.06	42.06	40.29	16.06	17.76	18.63	17.48	39.63	41.63	42.93	41.40
D ₅ (1 st Nov.)	52.10	53.71	54.56	53.46	10.03	10.96	12.27	11.08	57.83	59.86	61.16	59.62
D ₆ (1 st Jan)	22.58	23.86	24.90	23.78	6.16	8.53	10.53	8.41	15.60	16.43	17.50	16.51
Mean	44.68	45.92	47.08		17.92	19.40	20.70		48.93	50.38	51.97	
	D	S	D x S		D	S	D x S		D	S	D x S	
S.E. ±	1.048	0.741	1.815		0.674	0.476	1.167		1.259	0.89	2.18	
L.S.D. (P=0.05)	2.905	2.054	5.032		1.868	1.321	3.237		3.49	2.46	6.04	
C.V. (%)	6.851				10.458				7.49			
2010-11												
D ₁	25.16	28.25	29.62	27.67	16.25	18.02	19.85	18.04	41.62	47.25	55.15	48.00
D ₂	62.65	68.20	73.21	68.02	29.62	32.85	34.15	32.20	55.72	58.50	63.81	59.34
D ₃	48.62	53.40	56.29	52.77	37.65	43.26	45.72	42.21	62.25	64.15	66.85	64.41
D ₄	38.35	42.05	44.62	41.67	20.15	23.50	26.52	23.39	35.21	38.65	43.63	39.16
D ₅	43.31	50.20	54.75	49.42	10.25	12.50	13.75	12.16	32.85	36.25	38.62	35.90
D ₆	24.45	28.43	30.15	27.67	6.25	8.05	11.61	8.63	28.15	32.25	30.62	30.34
Mean	40.42	45.08	48.10		20.02	23.03	25.26		42.63	46.17	49.78	
	D	S	D x S		D	S	D x S		D	S	D x S	
S.E. ±	1.021	0.722	1.786		1.061	0.750	1.839		1.290	0.912	2.236	
L.S.D. (P=0.05)	2.830	2.001	4.902		2.943	2.081	5.098		3.578	2.530	6.197	
C.V. (%)	6.877				13.988				8.383			

Table 2 (a) : Effect of planting time and spacing on flowering attributes and flower yield of marigold during, 2009-10 and 2010-11

Treatments	Days taken to flowering			Flower diameter (cm)			Individual flower weight (g)					
	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean	S ₁	S ₂	S ₃	Mean
2009-10												
D ₁ (1 st March)	29.16	30.57	32.67	30.80	2.73	2.89	3.05	2.89	3.08	3.48	3.70	3.42
D ₂ (1 st May)	96.63	99.93	101.70	99.42	2.76	2.85	3.05	2.88	2.92	3.12	3.18	3.07
D ₃ (1 st July)	92.17	89.67	96.80	92.91	3.56	3.80	3.90	3.75	3.60	3.92	4.04	3.85
D ₄ (1 st Sept.)	65.40	66.23	67.76	66.46	4.41	4.57	4.70	4.56	4.32	4.53	4.69	4.51
D ₅ (1 st Nov.)	49.93	51.20	52.90	51.34	3.65	3.83	4.03	3.83	3.60	4.00	4.13	3.91
D ₆ (1 st Jan.)	29.07	32.13	34.67	31.95	2.35	2.58	2.72	2.55	2.25	2.17	2.65	2.35
Mean	60.39	61.63	64.41		3.24	3.42	3.57		3.29	3.53	3.73	
S.E. ±	D	S	D × S		D	S	D × S		D	S	D × S	
L.S.D. (P=0.05)	0.928	0.656	1.607		0.050	0.035	0.087		0.094	0.067	0.164	
C.V. (%)	2.572	1.819	4.455		0.140	0.099	0.242		0.263	0.186	0.455	
	4.479				4.447				8.088			
2010-11												
D ₁	36.52	40.18	43.79	40.16	2.84	2.89	3.18	2.97	3.18	3.34	3.78	3.43
D ₂	95.21	100.88	103.30	99.79	2.88	2.96	3.08	2.97	3.91	3.18	3.22	3.43
D ₃	92.29	96.25	98.72	95.75	3.67	3.92	4.00	3.86	3.52	3.81	4.00	3.77
D ₄	62.52	68.20	73.80	68.17	4.51	4.68	4.82	4.67	4.42	4.61	4.72	4.58
D ₅	42.72	48.90	52.15	47.97	3.76	3.93	4.14	3.94	3.62	4.07	4.10	3.93
D ₆	35.33	38.25	40.79	38.12	2.46	2.69	2.82	2.65	2.20	2.15	2.55	2.30
Mean	60.76	65.44	68.75		3.35	3.51	3.67		3.47	3.52	3.72	
S.E. ±	D	S	D × S		D	S	D × S		D	S	D × S	
L.S.D. (P=0.05)	1.988	1.406	3.444		0.162	0.114	0.281		0.027	0.019	0.047	
C.V. (%)	5.511	3.897	9.546		0.449	0.318	0.779		0.075	0.053	0.131	
	9.178				13.857				2.288			

the findings of Nair *et al.* (1985). The highest plant spread was recorded with transplanting on 1st July in both the years of experimentation. Significant variation in plant height, number of branches and spread of the plant was observed when the plants were grown at different spacing in both the years. The linear growth of the plant increased with increase in plant population. Similar trend was reported by Sunitha *et al.* (2007). Plants grown at a distance of 40cm × 40 cm produced the largest number of branches per plants. Almost similar type of observation was reported by Mohanty *et al.* (1977) in cv. AFRICAL YELLOW. The average spread of the plant increased with increase in plant population per unit area. Here maximum spread was recorded with plant spacing of 40 cm × 40 cm.

Reproductive attributes :

Data presented in Table 2 revealed that among the six planting dates, planting on 1st March (D₁) showed the

earliest flowering while planting on 1st May took the longest duration (99.42 and 99.79 days) to flower in both the years. January planting showed results similar to March planting so far days taken to flowering is concerned. Significant variation was observed in days taken from flower bud emergence to bud opening stage under different planting dates. Different planting dates significantly influenced the flower diameter, fresh weight of individual flower, number of flowers per plant and flower yield per plot (Table 2). The diameter of flower showed a range of 2.88 cm to 4.56cm and 2.65 cm to 4.67cm in 2010-11. Crop planted on 1st September recorded significantly higher diameter 4.56 cm and 4.67 cm and weight of individual flower (4.51 g and 4.58 g) in both the years. Similar trend was also reported by Mohanty *et al.* (1977). September planting produced 19.20 and 19.12 kg flower per plot (8.64 m²) while planting on 1st May and 1st January produced only 3.01, 3.47 and 3.46,

Table 2 (b) : Effect of planting time and spacing on flowering attributes and flower yield of marigold during, 2009-10 and 2010-11

Treatments	Number of flower per plants			Mean	Flower yield kg/plot			Mean
	S ₁	S ₂	S ₃		S ₁	S ₂	S ₃	
2009-10								
D ₁	32.02	33.50	35.15	33.55	10.65	8.39	7.02	8.68
D ₂	11.55	14.25	15.50	13.76	3.40	2.98	2.66	3.01
D ₃	37.62	38.90	39.50	38.67	14.63	10.99	8.67	11.43
D ₄	52.35	54.14	56.07	51.18	24.42	17.66	15.53	19.20
D ₅	43.58	44.70	46.67	44.98	16.94	12.87	10.74	13.51
D ₆	18.18	19.41	20.80	19.46	4.42	3.03	2.97	3.47
Mean	32.55	34.15	35.61		12.41	9.32	7.93	
	D	S	D x S		D	S	D x S	
S.E. ±	0.929	0.657	1.610		0.303	0.214	0.526	
L.S.D. (P=0.05)	2.576	1.821	4.462		0.842	0.595	1.458	
C.V. (%)	8.176				9.217			
2010-11								
D ₁	32.00	33.41	35.25	33.55	10.99	8.05	7.19	8.74
D ₂	11.45	13.15	15.35	13.31	4.71	3.01	2.66	3.46
D ₃	37.52	38.82	39.97	38.77	14.26	10.64	8.56	11.15
D ₄	52.45	54.25	56.20	54.30	25.03	18.00	14.33	19.12
D ₅	43.32	44.42	46.52	44.75	16.93	13.81	10.29	13.67
D ₆	18.10	19.25	20.41	19.25	4.30	2.97	2.81	3.36
Mean	32.47	33.88	35.61		12.70	9.41	7.64	
	D	S	D x S		D	S	D x S	
S.E. ±	0.172	1.121	0.298		0.263	0.186	0.456	
L.S.D. (P=0.05)	0.477	0.337	0.827		0.730	0.516	1.265	
C.V. (%)	1.521				7.360			

336 kg/plot flower, respectively in both the years (Table 2 a and b).

The overall response for planting marigold in September was better due to availability of favourable temperature and day length (duration of light) before the onset of flower bud initiate and flowering. The effect of spacing had marked influence on flower diameter, fresh weight, number of flowers per plant and flower yield in both the years. Crops planted with wider spacing *i.e.* 40 cm × 40 cm produced flowers larger in size, heavier in weight with appreciably larger number of flowers per plant in both the years (Table 2a and b). This is in conformity with the findings of Mohanty *et al.* (1977). The results revealed that spacing of 40 cm × 20 cm produced higher yield of flowers than at the wider spacing 40 cm × 40 cm. However, in all the planting date plants reached their peak production in 30 to 35 days after commencement of the commercial harvest. In September planting, the duration of commercial harvest of flowers was maximum for 66 and 68 days, whereas, this was minimum for only 30 days in January and March plantings in respective of plant spacing in both the years. Similar findings are also reported by Karuppaiah and Krishna (2005); Imran *et al.* (2012); Kour *et al.* (2012); Thumar *et al.* (2013) and Kaushik *et al.* (2013). Bimonthly planting of African marigold cv. PUSA NARANGI revealed that the best result with respect to flower yield and quality was obtained with on 1st September planting at a spacing of 40 cm × 20 cm.

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