

Short communication

Impact of seasons and pinching on growth and flowering in African marigold (*Tagetes erecta* L.)

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Abstract

Two varieties of African marigold (*Tagetes erecta* L.) were evaluated for three seasons from 2014 to 2015 to study the effect of season and pinching on growth and yield parameters of African marigold. The growth characters studied were plant height, number of primary branches, number of secondary branches, leaf area, chlorophyll content and total biomass. The yield parameters studied included days to first flowering, days to 50% flowering, days to first harvest, flower weight, number of flowers per plant, flower yield per plant and duration of flowering. The analysis of variance revealed highly significant difference between pinched and non pinched plants for characters like plant height, number of primary branches, number of secondary branches, leaf area and total biomass. High variability was also found for yield parameters like days to first flowering, days to 50% flowering, days to first harvest, and flower yield per plant, indicating that pinching had significant positive effect on growth, flowering and yield of African marigold. High variability was also found among different seasons in the growth and yield parameters studied. Plant height, leaf area, and total biomass were significantly high in S2 (monsoon); days to first flowering, days to 50% flowering, and days to first harvest were significantly low in S3 (post monsoon); whereas, number of flowers per plant, and duration of flowering were significantly high in S1 (pre monsoon)

Keywords: Flowering, Growth, Marigold, Pinching, Season, Yield

Marigold is one of the most important annual flower crops commercially cultivated in India. It is used for making garlands and as cut flowers. It is also used for floral decoration and in landscaping due to its attractive flowers and wide spectrum of colours. In Kerala as well as all over India, there is high demand for marigold flowers during festive seasons and social functions like marriages. The investigation entitled "Impact of seasons and pinching on growth and flowering in African marigold (*Tagetes erecta* L.) was undertaken during the period from October 2013 to April 2015 at the College of Agriculture, Padannakkad, Kasaragod dt, Kerala, India.

The objective of the study was to investigate the effect of seasons and pinching on growth, flower yield and post harvest longevity of African marigold. The study was conducted at the College of Agriculture, Padannakkad, Kasaragod dt, Kerala. The experimental material consisted of two varieties of African marigold namely Pusa Narangi Gainda and Pusa Basanti Gainda. The seeds of Pusa Narangi Gainda were collected from the Indian Agricultural Research Institute (IARI), Pusa, New Delhi and seeds of Pusa Basanti Gainda were collected from the Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. The experiment was conducted in three seasons, viz., pre monsoon in January 2014 (S1), monsoon in May

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2014 (S2) and post monsoon in September 2014 (S3). Two varieties and two levels of pinching – no pinching (P0) and pinching at 30 days after transplanting (P1) were used in the study. The interaction effect of variety X pinching was studied for four treatments viz., $T_1 = V_1P_0$ = Pusa Narangi Gainda without pinching

$T_2 = V_1P_1$ = Pusa Narangi Gainda with pinching

$T_3 = V_2P_0$ = Pusa Basanti Gainda without pinching

$T_4 = V_2P_1$ = Pusa Basanti Gainda with pinching

The experiment was laid out in Completely Randomised Block Design (CRBD) with 4 treatments and 5 replications. The observations were recorded at monthly intervals till the end of the crop period.

The results of effect of seasons on growth and yield of African marigold are presented in Table 1. Seasons significantly influenced growth and yield in African marigold. Pusa Narangi Gainda (T_1) recorded greatest plant height (124.80 cm) in S2 and Pusa Basanti Gainda (T_3) in S3 (120.94 cm). Season had no direct influence on number of primary branches and number of secondary branches in both varieties. In both the varieties, highest leaf area (2891.76 and 4552.94 cm²) was recorded in S2. Highest total biomass (120.40 and 123.34 g) was recorded in S2. This was due to the fact that greater rain in the S2 season (May planting) favored more vegetative growth and consequently more biomass accumulation.

Yield parameters like days to first flowering, days to 50% flowering, and days to first harvest were significantly influenced by season. Lowest number of days to first flowering was in T1 and T3 (60.12, and 67.40), while least number of days to 50% flowering (85.52 and 92.90) and days to first harvest (64.32 and 71.40) were recorded in S3. This may be due to the fact that the crop grown in post monsoon season (S3) was exposed to short day conditions which were favourable for early flowering in African marigold. Similar results were reported by Rao and Reddy (2002) who found that number of days required for flower opening was

reduced from August to February because of short days coupled with low light intensity.

Highest mean for days to first flowering (91.64 and 87.52), days to 50% flowering (117.13 and 113.04) and days to first harvest (95.66 and 92.20) were observed in T2 and T4 respectively and recorded in the S2 season. In the S2 season heavy rain coupled with low sunshine hours might have resulted in more number of days for flowering and harvesting in this season as is clear from Table 2. Both the varieties with pinching (T_2 and T_4) recorded highest number of flowers per plant (125.16 and 122.48) and flower yield per plant (540.53 and 626.67 g) in S1 whereas, in S2 the number of flowers per plant (69.34 and 57.56), flower yield per plant (334.70 and 208.04 g) were lowest. This may be due to the fact that in the S2 season (May planting) heavy rains and low sunshine hours recorded at the experimental site might have promoted vegetative growth at the expense of flowering which resulted in less number of flowers per plant and flower yield per plant. Similar results in marigold were reported by Samantaray et al., (1999) who found that May planting was not found beneficial as the plant continued vegetative growth for a long period with low flower yield.

The results of effect of pinching on growth parameters of African marigold are presented in Table 1. Pinching had significant influence of growth parameters of African marigold. Pinched plants (T_2 & T_4) recorded significantly lower mean for plant height in all the three seasons than non pinched plants (T_1 & T_3). Number of primary branches, number of secondary branches, leaf area and total biomass per plant recorded significantly higher values in pinched plants (T_2 & T_4) than non pinched plants (T_1 & T_3). Similar results were reported by Bhati and Chitkara (1987), Khandelwal et al. (2003) and Sehrawat et al. (2003). Between the two varieties, plant height, number of primary branches, number of secondary branches, and leaf area were higher in the case of Pusa Basanti Gainda (T_1) than in Pusa Narangi Gainda (T_3).

Table 1. Effect of different treatments on growth and yield parameters of African marigold in different seasons

Treatments	Plant height (cm)			Number of primary branches			Number of secondary branches		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
T1	55.24	124.80	62.74	11.00	12.96	08.24	52.10	43.30	41.20
T2	38.28	114.86	58.76	14.08	11.33	11.95	62.20	81.10	57.90
T3	115.80	115.64	120.82	14.40	11.28	09.50	57.60	43.40	47.50
T4	107.90	96.41	120.90	16.40	16.00	16.20	59.48	83.00	81.00
CD(0.05)	T=18.11, S=31.75			T=1.11, S=1.92			T=7.60, S=13.18		
Treatments	Leaf area (cm ²)			Total biomass (g)			Days to 1 st flowering		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
T1	1061	2891.76	2006.44	77.48	105.84	66.18	64.92	88.00	60.12
T2	1453	4398.03	2796.80	80.16	120.40	89.12	70.10	91.64	67.42
T3	2136	2764.40	2805.90	92.08	117.54	114.30	73.48	82.36	67.40
T4	2582	4552.94	3225.72	122.74	123.34	123.40	74.20	87.52	71.80
CD(0.05)	T=332.41, S=575.82			T=19.82, S=34.32			T=2.81, S=4.89		
Treatments	Days to 50% flowering			Days to 1 st harvest			Duration of flowering(days)		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
T1	98.90	113.58	85.52	68.91	92.00	64.32	69.20	53.00	45.80
T2	104.14	117.13	92.92	74.10	95.66	71.42	65.46	52.60	46.60
T3	107.48	107.85	92.90	77.42	86.76	71.40	65.64	53.00	53.00
T4	108.20	113.04	97.30	78.20	92.20	75.80	63.82	54.00	51.20
CD(0.05)	T=2.81, S=4.89			T=2.68, S=4.64			T=2.01, S=3.47		
Treatments	Flowers per plant			Flower yield (g)			Post harvest longevity (days)		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
T1	97.00	51.46	37.60	420.85	330.62	113.54	3.14	5.80	4.00
T2	125.16	69.34	48.40	540.53	334.70	151.20	3.80	6.00	4.00
T3	88.76	43.21	56.80	490.90	151.20	237.44	3.80	5.96	4.00
T4	122.48	57.56	61.88	626.67	342.14	255.09	4.20	5.80	4.00
CD(0.05)	T=7.86, S=13.64			T=116.23, S=67.10			T=NS, S=1.29		

In the variety X pinching interaction, Pusa Basanti Gainda with pinching (T4) recorded significantly higher mean for plant height, number of primary branches, number of secondary branches, leaf area, and total biomass than Pusa Narangi Gainda with pinching (T2). Thus, it was clear that Pusa Basanti Gainda is a vigorous variety recording higher means for almost all growth parameters with pinching.

The results of effect of pinching on yield parameters of African marigold are presented in Table 1. Pinching significantly influenced yield parameters like days to first flowering, days to 50% flowering, days to first harvest, numbers of flowers per plant, flower yield per plant, and duration of flowering. Pinching significantly delayed days to first flowering, days to 50% flowering, and days to first

harvest. Similar results were reported by several workers [Srivastava et al. (2005); Sunitha et al. (2007); Kumar et al. (2013); Rajyalakshmi and Rajasekhar (2014)] in African marigold. Pinched plants (T2 & T4) recorded significantly higher number of flowers per plant and flower yield per plant than non pinched (T1 & T3) plants. Similar results were reported in African marigold by Rajbeer et al. (2009), Kumar et al. (2013) and Rajyalakshmi and Rajasekhar (2014).

The variety X pinching interaction recorded significant effect on days to first flowering, days to 50% flowering, days to first harvest, number of flowers per plant, flower yield per plant and duration of flowering. Pusa Narangi Gainda without pinching (T1) recorded less number of days to first flowering

Table 2. Monthly mean weather data during the crop period (January 2014 - December 2014)

Period	Temperature °C		Relative Humidity (%)		Total rainfall (mm)	Sunshine (h)
	Max	Min	Max	Min		
January	32.59	20.30	91.68	58.81	0.00	834
February	32.92	21.36	91.75	61.21	0.00	7.48
March	33.24	22.19	86.87	61.42	0.00	7.69
April	34.51	24.56	82.50	66.10	50.43	6.46
May	33.04	24.17	86.26	69.53	250.24	6.21
June	31.18	23.57	90.43	77.26	576.18	2.48
July	29.22	22.94	92.18	84.60	1456.38	0.66
August	29.22	22.92	93.56	79.46	754.55	2.06
September	31.00	23.34	90.38	71.39	144.74	2.44
October	31.51	23.13	89.05	69.82	168.58	3.28
November	32.30	21.31	88.54	63.09	83.65	4.49
December	32.39	21.65	89.78	59.39	0.00	4.37

Table 3. Benefit cost analysis ha⁻¹

Parameters	S1	S2	S3
	T4	T4	T4
Land preparation	42600	42600	42600
Cost of seeds	800	800	800
Nursery raising	7400	7400	7400
Transplanting	3800	3800	3800
Manures and fertilizers	66958	66958	66958
Irrigation	3000	1000	1500
Weeding	2500	4000	1500
Plant protection + pinching	6400	6400	6400
Staking	1100	1100	1100
Harvesting	42000	42000	42000
Transportation	15000	15000	15000
Total cost	191558	191058	189058
Yield (kg ha ⁻¹)	10227	4528.72	7085.6
Returns	613620	362298	425138
BCR	3.2:1	1.8:1	2.2:1

(64.92 and 60.12) in S1 and S3 than Pusa Basanti Gainda without pinching (T3) in the same season. Pusa Narangi Gainda with pinching (T2) recorded the greatest number of days to first flowering (91.64) as compared to Pusa Basanti Ganida with pinching (87.52) in S2. This indicates that along with pinching, season also influences growth and flowering in African marigold. The heavy rain and low sunshine hours in monsoon season (S2) have a role in delaying physiological maturity in these varieties of African marigold. Similar trends were

recorded in days to 50% flowering, days to first harvest, flower weight, number of flowers per plant, flower yield per plant and duration of flowering. Pinched plants recorded higher yield than non pinched plants. From the study it was found that Pusa Basanti Gainda with pinching (T₄) performed well in S1 in terms of number of flowers per plant(122.48) and flower yield per plant (626.67) and hence recoded highest B: C ratio (3.2:1) as is clear from Table 3.

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