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Effect of integrated weed management on quality and flower yield of African marigold (*Tagetes erecta* L.)

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Abstract
The present investigation entitled "Integrated weed management in African marigold (*Tagetes erecta* L.)" was conducted during summer 2017 at ASPEE college of Horticulture and Forestry, NAU, Navsari (Gujarat). The experiment was laid out in Randomized Block Design with twelve treatments along with three replications. Maximum plant height (67.77 and 104.33 cm), plant spread 33.60 and 46.07 cm in North-South and 52.67, 64.47 cm in East-West direction, number of primary branches (6.53 and 9.47) and number of secondary branches (11.27 and 14.40) during 60 DATP and at final harvest were recorded in treatment T_6 (Pendimethalin 1.0 kg/ha as PE + IC & HW both at 20 DATP + Organic mulching). Moreover the minimum days (43.40) taken to first flower open, maximum flowering duration (61.80 days), flower diameter (6.54 cm), number of flower per plant (69.73), flower yield (555.60 g/plant and 9.75 t/ha) were noted in treatment T_6 (Pendimethalin 1.0 kg/ha as PE + IC & HW both at 20 DATP + Organic mulching) and weed index on the basis of best flower yielded treatments T_6 and T_{10} recorded lower weed index (6.95%).

Keywords: Weed management, African marigold, Pendimethalin, inter-culturing, hand weeding and organic mulch, weed index.

1. Introduction
In India, marigold is one of the most commonly grown flowers and use extensively on religious and social functions in different forms. Marigold occupies in ornamental horticulture, is one of the most important commercially exploited flower crop grown across the country which belongs to the family Asteraceae. *Tagetes erecta* L. (2n=24) is known as African marigold, originated from Mexico. African marigold is commercially highly popular as loose flowers and has more application in garlands and decor. Marigold also use as trap crop in tomato field. The essential oil which is extracted by steam distillation is used in the perfumery industry, while extraction of xanthophylls is used in cosmetic and poultry food. Lutein is the major constituent about 80-90 per cent is present in the xanthophylls.

The growth and yield of plant are mainly depend on the adequate plant population, nutrition, moisture, weed management, plant population, plant protection, *etc*. However, efforts are still being continued in these direction to boost up the yield (Rami, 2012) [9]. Weed is an unwanted plant, it not only competes with crop plants for nutrients, soil moisture, space and sunlight but also serves as an alternative hosts for several insect pest and diseases (Bond and Oliver, 2006) [2]. Weed control has been observed as one of the most important practice in crop production because good weed control will ensure maximum yield and high quality of farm produce (Njoroge 1999) [7]. A major challenge with crop management is the increased invasion by weed species taking into consideration.

Flower growers of Gujarat are facing serious weed problems because of varied agro-climatic conditions and great diversity in the ecology of weed flora. Moreover, weed species differ in their proportion from field to field due to variation in cropping pattern and soil fertility in the farmer's field. South Gujarat soil type is heavy black cotton soil. It has good water holding capacity, medium to poor drainage with flat topography. Keeping in a view, this experiment was conducted to objectives to examine the effect of weed management practice on the growth and yield of African marigold.

2. Materials and methods

The present investigation was carried out at Floriculture Research Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari. The experiment was laid out in Randomized Block Design with three replication and twelve treatments *viz*, T_1 =Weedy check (control), T_2 =IC at 20 & 40 DATP, T_3 =IC at 20 & 40 DATP + HW at 20, 40, 60, & 80 DATP, T_4 =IC & HW both at 20 DATP + Organic mulching , ,, T_5 =Pendimethalin 1.0 kg/ha as PE, T_6 =T_5 + T_4, T_7 =T_5 + IC & HW both at 20 DATP + Propaquizafop 0.1kg/ha as POE, T_8 =T_5 + Propaquizafop 0.1 kg/ha at 20 & 40 DATP as POE, T_9 =Oxadiargyl 0.90 kg/ha as PE, T_{10} =T_9 + T_4, T_{11} = T_9 + IC & HW both at 20 DATP + Propaquizafop 0.1kg/ha at 40 DATP as POE, T_{12} = T_9 + Propaquizafop 0.1 kg/ha at 20 & 40 DATP as POE. Application of pre-emergence herbicides like Pendimethalin and Oxadiargyl has been done at day after transplanting and post emergence Propaquizafop has been done at 20 and 40 day after transplanting in respective treatments. The cultural practices like irrigation, hoeing and weeding, plant protection measure were done as required by the crop time. The vegetative parameters and flowering parameters were recorded the period of crop. The weed index was calculated by formula given by (Gill and Kumar, 1969) [6]. The obtained data were analyzed statistically using standard method as suggested by (Panse and Sukhatme, 1967) [8].

3. Results and discussion

It is revealed from the data presented in Table 1 that treatment T_6 (Pendimethalin 1.0 kg/ha as PE + IC & HW both at 20 DATP + Organic mulching) gave the maximum vegetative growth in case of plant height i.e 67.77 cm, 104.53 cm, plant spread in N-S direction 33.60 cm, 46.07 cm and in E-W direction 52.67 cm, 64.47 cm, number of primary branches 6.53, 9.47 and secondary branches 11.23 and 14.40 recorded at 60 DATP and at final harvest, respectively. This might be due to Pendimethalin and inter-culture operation at early stage of growth may increased the capacity of the crop in utilizing soil moisture, light and nutrient in building new tissue that accounted for improving the vegetative growth (Sharma *et al*., 2014) [10]. Furthermore, mulching provides a favorable micro climate for growth which resulted in more vigorous and healthier plants. Similar findings are in agreement with (Chawla, 2006) [5] in African marigold; (Bakht and Khan, 2014) [1] in tomato and (Tripathi *et al*. 2015) [11] in spray chrysanthemum. Data presented in Table 2 revealed that flowering quality and yield of flowers were influenced significantly due to IWM. Significantly minimum days (43.40 days) taken to first flower open, maximum duration of flowering (61.80 days), flower diameter (6.54 cm), number of flower per plant (69.73), fresh flower yield (555 g/plant and 9.75 t/ha) and weed index on the basis of best flower yielded were observed in treatment T_6 (Pendimethalin 1.0 kg/ha as PE + IC & HW both at 20 DATP + Organic mulching) and T_{10} recorded lower weed index (6.95%). Better quality yield in the weed management treatments maybe attributed to higher chlorophyll content and photosynthetic rate due to effective control of weeds at critical weed competition stage (Channappagoudar *et al*., 2006) [4]. Similar findings are in agreement with (Chahal *et al*. 1994) [3] in gladiolus and (Sharma *et al*. 2014) [10] in chrysanthemum.

4. Conclusion

Based on the results of present investigation, it can be concluded that imposing of Pendimethalin 1.0 kg/ha as PE + Inter-culturing & Hand weeding both at 20 DATP + Organic mulching with sugarcane trash treatment gives better response in growth which leads to qualities flowers production in African marigold field during summer season under south Gujarat conditions.

Table 1: Effect of Integrated Weed Management on vegetative parameters in African marigold.

Treatment	Plant height (cm)		Plant spread (cm)				No. of branches			
			E-W		N-S		Primary		Secondary	
	60 DATP	At final harvest	60 DATP	At final harvest	60 DATP	At final harvest	60 DATP	At final harvest	60 DATP	At final harvest
T_1	42.17	67.00	35.70	49.00	25.07	33.00	4.67	6.80	6.27	7.93
T_2	55.57	87.60	42.00	55.40	27.80	37.87	5.60	8.00	8.53	11.73
T_3	59.23	94.27	46.73	62.80	32.80	43.57	6.20	9.07	9.60	12.47
T_4	62.77	97.47	48.93	62.93	32.87	44.00	6.27	8.87	9.87	12.53
T_5	54.63	85.37	43.27	53.33	26.13	35.47	5.53	8.07	8.60	9.87
T_6	67.77	104.33	52.67	64.47	33.60	46.07	6.53	9.47	11.27	14.40
T_7	56.17	89.10	43.20	55.13	28.00	37.87	5.60	8.00	9.13	11.93
T_8	52.90	79.20	40.33	54.53	27.20	37.73	5.27	7.60	7.93	10.67
T_9	52.97	81.87	40.53	54.67	25.87	35.40	5.47	7.87	8.13	9.40
T_{10}	63.70	100.80	51.00	63.00	33.00	44.93	6.33	9.13	10.60	12.80
T_{11}	55.97	88.40	44.73	55.33	27.87	37.87	5.53	7.93	9.13	12.07
T_{12}	46.83	73.50	39.53	54.27	26.80	36.40	5.13	7.40	7.73	9.20
S.Em.±	3.37	5.36	2.69	3.02	1.89	2.79	0.31	0.49	0.55	0.73
C.D. at 5%	9.88	15.73	7.90	8.87	5.56	8.18	0.91	1.43	1.60	2.15
C.V. %	10.43	10.63	10.59	9.18	11.31	12.32	9.46	10.34	10.64	11.27

Table 2: Effect of Integrated Weed Management on flowering parameters in African marigold.

Treatment	Days to first flowering	Flowering duration (days)	Flower diameter (cm)	No. of flower/ plant	Fresh flower yield		Weed Index (%)
					g/plant	t/ha	
T_1	60.60	39.60	4.80	38.80	158.47	4.18	57.22
T_2	51.87	52.07	5.67	48.00	346.60	6.46	33.89
T_3	48.07	54.00	6.11	60.80	473.41	8.62	11.42
T_4	46.00	57.07	6.23	60.93	466.10	8.14	16.60
T_5	55.13	47.20	5.31	47.47	283.00	5.62	40.95
T_6	43.40	61.80	6.54	69.73	555.60	9.75	-
T_7	50.93	54.67	5.74	50.60	361.97	6.71	30.50
T_8	52.53	50.50	5.62	42.87	315.07	6.02	38.14
T_9	57.07	45.27	5.24	45.67	257.97	5.38	44.50
T_{10}	45.67	58.07	6.41	64.20	478.47	9.05	6.95
T_{11}	51.00	52.60	5.70	49.07	355.40	6.45	33.79
T_{12}	53.13	46.20	5.54	42.73	297.37	5.87	39.80
S.Em.±	2.44	2.91	0.27	4.64	30.92	0.62	
C.D. at 5%	7.16	8.56	0.79	13.62	90.69	1.82	
C.V. %	8.24	9.80	8.17	15.54	15.36	15.66	

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