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Effect of Micronutrients on Growth and Flowering of Marigold cv. Siracole

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ABSTRACT

A field experiment was conducted to evaluate the effect of $FeS0_4$, $MnS0_4$ and their combination on growth and flowering of *Tagetes erecta* cv. Siracole. Highest linear growth (68.88cm) of marigold was recorded in plants treated with 0.25%$MnS0_4$+ 0.25%$FeS0_4$. Plant spread (63.79cm), number of branches (19.10), leaf area (5.36cm.sq.), fresh and dry matter accumulation (431.69g & 105.59g), crop growth rate (7.98 g/m.sq./days), biomass duration (2783.03 g.days), number of flowers per plant (78.66), yield of flowers (35.99 t/ha) and petal meal per kilogram of fresh flowers (390.3 g/kg) and carotene content (2.26mg/g) were recorded highest in plants treated with 0.5 % $FeS0_4$+ 0.25 %$MnS0_4$ at all stages of crop growth. Plant chlorophyll and iron content were recorded highest with 0.5%$FeS0_4$ while manganese content was significantly increased with the application of $MnS0_4$@0.5%.

Key words: Growth, Marigold, Micronutrients.

INTRODUCTION

Marigold (*Tagetes erecta* L.), belonging to the family Asteraceae is one of the most important commercially grown flower crop in India. It is gaining popularity among the small and marginal farmers of West Bengal due to its easy culture, wide adaptability and short term lucrative return (Ghosh and Pal, 2008). Use of macronutrient balanced with micro fertilizers is of mammoth importance for better performance of the crop in floriculture. Therefore, nowadays use of micronutrients are gradually gaining momentum among the flower growers because of their beneficial nutritional support and at the same time to ensure better harvest and returns. In addition to NPK, micronutrients have a great bearing in influencing the yield attributes and flower production (Khader *et al.,* 1985). This advantage could be due to the fact that micronutrients activate several enzymes and are involved in various physiological activities.

MATERIALS AND METHODS

The experiment was undertaken during the whole year from April 2012-June 2014 at the Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The details of the treatment combinations were as follows: T0- control, T1- 0.25% $FeS0_4$, T2-0.5% $FeS0_4$, T3- 0.25% $MnS0_4$, T4- 0.5% $MnS0_4$, T5-0.25% $MnS0_4$+ 0.25 % $FeS0_4$, T6-0.25% $MnS0_4$+ 0.5% $FeS0_4$, T7- 0.5%$MnS0_4$ + 0.25% $Fe0_4$, T8- 0.5% $MnS0_4$ + 0.5% 0.5%. Eight treatments with different levels of micronutrients were laid out in randomized block design with three replications. All the plots received the recommended dose of fertilizer (RDF) 200: 100:100 kg /ha N, P and K respectively. The entire amount of phosphorus (single super phosphate) and half of nitrogen (urea) and half of potassium (muriate of potash) was applied as basal. The remaining half dose of urea and MOP was applied 20 days after planting. A basal dose of well rotten FYM (5kg/ m^2) was applied at the time of planting. Each plot received three sprays of micronutrient in doses as per the treatment, with the first application made at 30 DAP; thereafter the subsequent sprays were made at 20 days interval.

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RESULTS AND DISCUSSION

In the present investigation, plants treated with 0.25% $MnS0_4$+ 0.25 % $FeS0_4$ (T_5) recorded the highest linear growth of marigold cv. Siracole while least elongation of the plant was observed in control during both the years of investigation (Table 1). The application of Fe and Mn at different levels encouraged linear growth significantly, compared to control treatment. The increased plant height with application of micronutrients might be attributed to the role of iron in promoting growth characters, being a component of ferrodoxin, electron transport proteins thus aiding in photosynthesis and better vegetative growth (Basavarajeshwari *et al.,* 2008). Treatment T6 exhibited a significant effect in the number of branches and plant spread in both the years of study (Table 1). Increase in the micronutrient content in leaves might have increased the production of metabolites synthesized and thus the plant had the chance to bear more branches and hence increased canopy spread. Similar trend was found by Elayan (2008) on cotton plants. The foliar spray of micronutrients had a

significant influence on the variation in leaf size. The increase in leaf area might be due to the fact that the micronutrients enhance synthesis of carbohydrates in the leaves leading to formation of amino acids, proteins, chlorophyll, alkaloids and amides. These complex compounds are responsible for building up of new tissues and are associated in a number of metabolic processes that favours better development of plants thus increase in leaf area. Highest fresh matter accumulation was noted in treatment T6 (431.69g/plant) which was found to be statistically superior over rest of the treatments and recorded 27.81% higher fresh matter accumulation compared to control (Table 2). Maximum variation in dry weight was recorded between T6 and T0 (30.85 g/plant) while negligible difference was seen between T1 and T7 (0.05g/plant). Micronutrients play a vital role in production of vegetative growth and ultimately encouraged the number of primary branches, secondary branches, leaves and shoots of plants by involving in oxidation-reduction process and photosynthesis process. This in turn leads to increase in fresh weight and ultimately dry weight of the plant. These findings were in close conformity with the findings of Muthumanickam *et al.* (1999) in gerbera and Sabale *et al.* (1992) in rose. The fresh and dry matter yields during the experimental period were reduced when Mn concentration was increased from 0.25 % to 0.5 % when applied with $FeS0_4$ as foliar spray. This may be due to the effect of increase in manganese that might have brought about a decrease in the soluble iron and an increase in the percentage of insoluble iron in the plant. Furthermore, since the oxidation potential of manganese is higher than that of iron it may exert a preventive action against the reduction of iron by the reducing systems of the plant, as shown by the work of Hopkins (1930). Treatment T6 registered higher values for crop growth rate and biomass duration (Table 2) which may be attributed to increased number of branches, plant spread and leaf area.

The micronutrients exhibited a significant influence on the flowering and yield parameters (Table 3). Maximum flower diameter and highest number of flowers per plant in treatment T6 might be attributed to increased vegetative growth and healthy green leaves leading to more production of food materials. Similar results were also recorded by Jadhav *et al*. (2005) in gerbera.

The increase in yield maybe attributed to the micronutrient spray as these nutrients stimulate the

Table 1: Effect of micronutrients on vegetative parameters of marigold cv. Siracole.

Treatment	Plant height (cm)			Plant spread (cm)			No. of branches			Leaf area (cm. sq.)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
T0	51.80	52.10	51.95	49.19	48.30	48.75	11.93	12.93	12.43	3.97	3.94	3.96
T1	59.47	62.71	61.09	58.41	59.54	58.97	16.87	15.93	16.40	4.67	4.77	4.72
T2	62.00	66.01	64.00	60.99	62.36	61.68	16.93	15.95	16.44	4.72	5.01	4.86
T3	57.76	58.40	58.08	52.29	58.19	55.24	15.40	14.93	15.17	4.03	4.15	4.09
T4	54.40	54.54	54.47	52.73	54.80	53.77	14.27	14.73	14.50	3.97	4.07	4.02
T5	68.41	69.36	68.88	60.70	62.01	61.35	17.87	16.93	17.40	4.96	5.21	5.09
T6	64.14	66.57	65.36	63.38	64.20	63.79	19.33	18.87	19.10	5.43	5.30	5.36
T7	57.56	58.97	58.27	57.59	57.90	57.75	15.80	15.00	15.40	3.82	4.06	3.94
T8	53.58	51.63	52.61	47.54	50.96	49.25	13.87	13.77	13.82	3.93	4.02	3.98
S.Em (±)	0.68	0.53	0.56	0.53	0.36	0.52	0.37	0.19	0.24	0.12	0.12	0.11
CD at 5%	2.05	1.60	1.60	1.59	1.09	1.50	1.13	0.57	0.70	0.04	0.04	0.04

Table 2: Effect of micronutrients on growth of marigold cv. Siracole.

Treatment	Fresh weight / plant (g)			Dry weight / plant (g)			Biomass duration (g. days)			Crop growth rate (g/m. sq/ days)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
T0	343.23	332.27	337.75	75.05	74.43	74.74	1999.40	1945.85	1972.63	3.93	4.47	4.20
T1	390.58	385.80	388.19	84.89	91.50	88.19	2286.60	2367.85	2327.23	4.04	5.86	4.95
T2	426.50	393.06	409.78	102.06	100.40	100.23	2608.40	2619.75	2614.08	4.05	7.97	6.01
T3	388.01	379.00	383.51	81.21	82.60	81.91	2237.10	2191.05	2214.08	3.10	4.46	3.78
T4	363.63	366.47	365.05	79.79	80.06	79.93	2214.92	2025.10	2120.01	2.78	5.86	4.32
T5	422.76	407.08	414.92	95.03	100.65	97.84	2564.50	2591.85	2578.18	4.45	6.65	5.55
T6	432.64	430.74	431.69	98.16	113.03	105.59	2712.15	2853.90	2783.03	7.62	8.35	7.98
T7	382.08	369.96	376.02	87.13	89.14	88.14	2270.70	2276.35	2273.53	5.34	6.19	5.77
T8	359.81	359.45	359.63	88.77	94.24	91.50	2229.50	2308.03	2268.77	6.74	8.07	7.41
S.Em (±)	1.50	1.85	2.65	0.34	0.54	1.09	15.32	18.98	24.18	0.28	0.30	0.35
CD at 5%	4.54	5.58	7.59	1.04	1.64	3.14	46.32	57.39	69.35	0.86	0.91	1.00

Table 3: Effect of micronutrients on flowering and yield of marigold cv. Siracole.

Treatment	Individual flower diameter (cm)			No of flowers per plant			Yield of flowers (t/ha)			Petal meal (g/kg)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
T0	5.02	4.91	4.97	67.71	62.68	65.2	26.85	25.37	26.11	369.14	341.87	355.5
T1	5.7	5.09	5.39	74.08	72.56	73.32	34.18	29.19	31.69	394.8	367.3	381.05
T2	5.79	5.29	5.54	79.49	74.94	77.21	34.81	29.31	32.06	382.27	373.67	377.97
T3	5.16	5.2	5.18	74.05	71.97	73.01	30.88	29.01	29.95	377.97	357.6	367.78
T4	5.29	4.95	5.12	70.03	69.12	69.58	29.75	26.97	28.36	371.53	350.53	361.03
T5	5.87	5.38	5.63	76.41	75.67	76.04	35	31.79	33.4	389	382.07	385.53
T6	5.84	5.46	5.65	79.06	78.26	78.66	38.05	33.93	35.99	394.13	386.47	390.3
T7	5.33	5.03	5.18	73.38	71.23	72.3	30.56	27.93	29.24	374.33	356.47	365.4
T8	5.22	4.92	5.07	68.72	65.49	67.1	29.92	26.67	28.3	367.7	344.33	356.02
S.Em (±)	0.05	0.09	0.07	0.29	0.48	0.44	0.52	0.71	0.5	4.05	1.57	2.67
CD at 5%	N.S	0.20	0.19	0.88	1.46	1.26	1.58	2.15	1.44	12.24	4.75	7.66

Table 4: Effect of micronutrients on carotene, chlorophyll, iron and manganese content of marigold cv. Siracole.

Treatment	Carotene content (mg/g)			Chlorophyll content (mg/g)			Fe (ppm)			Mn (ppm)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
T0	1.66	1.70	1.68	1.42	1.48	1.45	210.47	202.12	206.3	68.91	63.95	66.43
T1	2.06	2.03	2.05	2.25	2.09	2.17	271.34	267.8	269.57	89.95	89.39	89.67
T2	2.15	2.08	2.12	2.51	2.38	2.44	280.43	273.7	277.07	84.73	84.6	84.67
T3	2.02	1.95	1.98	2.00	1.93	1.96	241.98	218.01	230.00	90.70	90.6	90.65
T4	1.86	1.79	1.83	1.90	1.83	1.87	234.35	212.1	223.22	96.35	98.00	97.18
T5	2.23	2.10	2.17	2.08	2.01	2.05	274.96	271.45	273.21	92.64	93.26	92.95
T6	2.33	2.18	2.26	2.15	2.07	2.11	281.3	268.99	275.15	81.29	79.38	80.34
T7	1.95	1.96	1.95	2.01	1.95	1.98	270.61	259.96	265.28	84.28	82.57	83.43
T8	1.74	1.72	1.73	1.97	1.75	1.86	266.56	255.65	261.11	80.03	79.27	79.65
S.Em (±)	0.03	0.01	0.02	0.04	0.02	0.03	2.2	2.79	2.29	1.05	0.73	0.71
CD at 5%	0.09	0.04	0.06	0.11	0.07	0.07	6.66	8.42	6.56	3.17	2.21	2.04

metabolic activity by having a stimulating effect on the cell wall loosening, increased cell elongation along with cell enlargement. All these have a positive influence on the leaf area which enhances the photosynthetic area thus causing an increase in carbohydrate level and ultimately higher yield. The results were in close conformity with the findings of Nanjan and Muthuswamy (1975) and Patil (2001) in rose. In terms of petal meal there was substantial volume shrinkage of flowers during normal air drying in all the treatments. However, plants treated with $MnS0_4$ 0.25% and $FeS0_4$ @ 0.5% resulted in 9.78 % increase in petal meal compared to control (no spray). The difference in the petal meal yield per kilogram of fresh flower weight might be related to the flower yield per plant and flower weight. The present results were in conformity with the research findings of Anuradha *et al*. (1990) and Naik (2003) in marigold.

Highest chlorophyll content was recorded in plants treated with 0.5% $FeS0_4$ (2.44 mg/g) which was statistically superior over rest of the treatments (Table 4). The increase in chlorophyll content maybe attributed to the application of iron as there is often a good correlation between the level of Fe supply and chlorophyll content (Gauch 1957). Iron + manganese significantly influenced optimum carotene content in marigold cv. Siracole. The high carotene content maybe due to the increased chlorophyll content as Kopsell *et al*. (2005) has stated that carotenoid content was significantly and positively correlated with chlorophyll content.

Maximum iron concentration was recorded in plants sprayed with 0.5 % $FeS0_4$ (277.07 ppm) while minimum iron level was detected in control. Similarly manganese content was highest in plants treated with 0.5% $MnS0_4$ (97.18 ppm). This trend might be a result of application of the nutrient which must have exerted a direct influence on its own composition. Similar findings were reported by Bhatt and Srivastava, 2006 in tomato.

CONCLUSION

Regarding the effect of micronutrients, vegetative, floral and yield parameters of *Tagetes erecta* cv. Siracole was significantly influenced with foliar spray of $FeS0_4$ @ 0.5%+ $MnS0_4$ @ 0.25% in West Bengal conditions.

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