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RESPONSE OF IRON AND ZINC ON VEGETATIVE AND REPRODUCTIVE GROWTH OF STRAWBERRY (*FRAGARIA* × *ANANASSA* DUCH.) CV. CHANDLER

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Abstract

Foliar application of 0.2% $FeSO_4$ + 0.3% $ZnSO_4$ thrice at monthly interval tended to exhibit the highest plant height and spread, number of leaves per plant, average leaf area, number of flowers, fruits, marketable fruits per plant and total yield and marketable yield per plant. These plants also took the least duration to attain the age of flowering as well as harvesting.

Micronutrients are vital to the growth of plants, acting as catalyst in promoting various organic reactions taking place within the plant and their deficiencies often limit crop productivity in fruit crops. Iron deficiency in strawberries can occur if soil pH is high and low zinc levels may occur on sandy low organic matter soils. Cool, wet weather enhances iron deficiencies, especially on soils with marginal levels of available iron. Poorly aerated or compact soils also reduce iron uptake by plants (Zehtab-Salmasi *et al.* 2008). Zinc deficiencies occur more often during cold, wet spring weather and are related to reduced root growth and activity as well as lower microbial activity decreases zinc release from soil organic matter. Zinc uptake by plants decreases with increased soil pH. Uptake of zinc also is adversely affected by high levels of available phosphorus and iron in soils (Mortvedt 2011).

Therefore, response of iron and zinc on vegetative and reproductive growth of strawberry (*Fragaria* × *Ananassa* Duch.) cv. Chandler was studied in the Division of Fruit Science, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, at Udheywalla Campus during 2011-12. The experimental soil was having sand (60.0%), silt (19.0%) and clay (21.0%) and its texture was sandy clay loam. Sixteen treatments, namely 0.1% $FeSO_4$ (T1), 0.2% $FeSO_4$ (T2), 0.3% $FeSO_4$ (T3), 0.2% $ZnSO_4$ (T4), 0.3% $ZnSO_4$ (T5), 0.4% $ZnSO_4$ (T6), 0.1% $FeSO_4$ + 0.2% $ZnSO_4$ (T7), 0.1% $FeSO_4$ + 0.3% $ZnSO_4$ (T8), 0.1% $FeSO_4$ + 0.4% $ZnSO_4$ (T9), 0.2% $FeSO_4$ + 0.2% $ZnSO_4$ (T10), 0.2% $FeSO_4$ + 0.3% $ZnSO_4$ (T11), 0.2% $FeSO_4$ + 0.4% $ZnSO_4$ (T12), 0.3% $FeSO_4$ + 0.2% $ZnSO_4$ (T13), 0.3% $FeSO_4$ + 0.3% $ZnSO_4$ (T14), 0.3% $FeSO_4$ + 0.4% $ZnSO_4$ (T15) and control (spray with distilled water) (T16) replicated thrice were given at monthly interval. The data recorded were statistically analyzed as prescribed by Panse and Sukhatme (2000).

The vegetative growth parameters in strawberry cv. Chandler *viz.*, plant height, plant spread, leaf number per plant and leaf area presented in Table 1 significantly increased with iron and zinc sprays. Maximum plant height (17.00 cm), plant spread (38.34 cm), number of leaves per plant (12.78) and leaf area (106.30 cm^2) were resulted in combined treatment of $FeSO_4$ (0.2%) and $ZnSO_4$ (0.3%) sprays, while minimum plant height (10.14 cm), plant spread (20.62 cm), number of leaves per plant (6.11) and leaf area (35.44 cm^2) was obtained under distilled water sprays (control). The foliar spray of iron increased plant length, plant spread, number of leaves per plant

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and leaf area which may be due to activated synthesis of chlorophyll, biosynthesis of cytochromes and transfer of electron in biological oxidation (Neuweiler *et al.* 1996). Zinc activates the synthesis of protein, which protects chlorophyll destruction. The increase in the availability of photosynthates might have increased the number of leaves per plant. Mohamed *et al.* (2011) improved vegetative growth characters (number of leaves, number of runners, number of secondary crowns, leaf area, foliage fresh mass and dry mass/ plant) and flowering traits (number of flower clusters/plant and earliness) significantly with the high rates of P and Zn.

Table 1. Effect of iron and zinc application on plant growth of strawberry cv. Chandler.

Treatment	Plant height (cm)	Plant spread (cm)	Leaf number per plant	Leaf area (cm^2)
T1	12.22	24.33	6.89	42.97
T2	13.05	27.42	8.67	49.67
T3	12.70	26.54	7.55	48.66
T4	12.54	26.33	7.44	45.12
T5	13.29	29.46	9.56	63.57
T6	13.12	28.18	9.44	60.08
T7	13.07	27.52	9.22	50.25
T8	15.72	36.54	11.34	91.65
T9	14.22	30.45	10.56	73.54
T10	13.09	28.07	9.33	54.47
T11	17.00	38.34	12.78	106.30
T12	15.07	34.69	11.11	84.35
T13	13.95	29.58	9.89	70.29
T14	16.67	37.53	11.45	97.54
T15	14.81	31.07	10.89	77.79
T16	10.14	20.62	6.11	35.44
CD at 5%	0.59	0.77	0.93	3.31

The data on flowering and fruiting parameters *viz.*, number of days taken to first flowering, number of flowers, fruit set, fruits and marketable fruits per plant, number of days taken to first harvest, shelf life of first harvested fruit, total fruit yield and marketable yield presented in Table 2 showed significant variation. Treatments with 0.2% $FeSO_4$ and 0.3% $ZnSO_4$ in strawberry cv. Chandler resulted in maximum number of flowers (16.45) and fruit set (16.22), fruit retention (16.22) and marketable fruits (15.00) per plant, whereas, control treatments (distilled water sprays) obtained minimum number of flowers (12.33), fruit set (11.78), fruit retention (9.00) and marketable fruits (7.56) per plant. Total fruit yield (236.57 g per plant) and marketable yield (218.75 g per plant) in strawberry cv. Chandler was highest with combined treatment of $FeSO_4$ (0.2%) and $ZnSO_4$ (0.3%), whereas control treatment i.e. distilled water sprays resulted in minimum total fruit yield and marketable yield (78.21 g and 65.71 g, respectively) per plant. The effects of foliar application with micronutrients (Zn and Fe) played critical role in crop growth, involving in photosynthesis processes, respiration and other biochemical and physiological activities and their importance in achieving higher yields. Zinc is a component of carbonicanhydrase as well as several dehydrogenases and auxin production which in turn enhance plant growth and iron is necessary for the biosynthesis of chlorophyll and cytochrome, leading to increase in the biosynthesis of materials and growth. Abdollahi *et al.* (2012) reported increased inflorescence and fruit size with $ZnSO_4$ application because of its important role in pollination and fruit set in strawberry, cultivar Selva. Increase in shelf life of berry might be due to the fact that zinc works as stimulant of amino acids and appears to be helpful in the process of photosynthesis and accumulation of carbohydrates. Mohamed *et al.* (2011) improved the early yield, marketable yield, total yield and yield/plant in strawberry with the application of higher rates of Zn.

Table 2. Effect of iron and zinc application on reproductive growth and yield of strawberry cv. Chandler.

Treat-ment	Days to first flowering	Flowers/ plant	Fruit set/ plant	Fruit retention /plant	Marketable fruits/plant	Days to 1st harvest	Shelf life of 1st harvested fruit	Total Fruit yield (g/plant)	Market-able yield (g/plant)
T1	84.11	13.11	12.78	10.22	8.33	56.78	2.11	106.75	87.06
T2	78.33	14.00	13.11	11.55	9.89	52.11	2.33	127.79	109.40
T3	79.33	13.78	13.11	11.11	9.45	53.89	2.33	122.55	104.21
T4	84.78	13.00	12.67	10.11	8.11	57.89	2.33	103.73	83.21
T5	80.55	13.56	13.00	11.00	9.00	54.78	2.55	120.08	98.25
T6	82.78	13.11	13.00	10.56	8.67	56.33	2.44	111.62	91.67
T7	77.55	14.22	13.89	12.22	11.33	50.78	2.44	137.04	127.05
T8	75.45	14.33	14.11	12.78	12.11	46.00	2.78	156.23	148.04
T9	76.56	14.33	14.00	12.33	11.44	47.78	2.67	144.10	133.77
T10	69.11	15.56	15.00	15.00	13.89	39.11	2.44	211.72	196.01
T11	68.67	16.45	16.22	16.22	15.00	38.33	2.89	236.57	218.75
T12	68.67	15.67	15.22	15.89	14.67	38.44	2.78	226.72	209.27
T13	69.56	15.00	14.67	14.00	13.11	39.44	2.55	192.24	180.02
T14	72.44	14.67	14.33	13.22	12.45	41.11	2.78	178.82	168.36
T15	74.22	14.56	14.33	13.11	12.33	44.56	2.67	166.38	156.54
T16	89.78	12.33	11.78	9.00	7.56	61.00	2.11	78.21	65.71
CD at 5%	1.06	0.41	0.50	0.48	0.46	1.11	0.49	9.35	8.82

Treatments with 0.2% $FeSO_4$ and 0.3% $ZnSO_4$ took minimum number of days to first flowering (68.67), whereas, control treatments (distilled water sprays) took maximum number of days to first flowering (89.78) in strawberry cv. Chandler. The number of days taken to first harvest was minimum (38.33) and their shelf life was maximum (2.89 days) in strawberry cv. Chandler with 0.2% $FeSO_4$ and 0.3% $ZnSO_4$ treatment, whereas distilled water sprays (control) took maximum number of days to first harvest (61.00) and resulted minimum shelf life of the fruit (2.11 days). Foliar sprays of iron and zinc reduced the days to first flowering and berry maturing which might be due to the fact that zinc is involved in the biosynthesis of plant hormone IAA and plays a vital role in nucleic acid and protein synthesis. Foliar spray of iron also decreased the number of days taken to flower and fruit development since iron is important for formation of a large number of enzymes and degradation of chlorophyll. Nawaz *et al.* (2012) also observed significant effect of zinc on days to first flowering in tomato.

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