The influence of spraying sitofex, iron, manganese and zinc on "Anna" apple trees planted on new reclaimed calcareous land

Samia A. Asaad

Hort. Res. Institute, ARC, Egypt
samiaayoub2013@hotmail.com

Abstract: The present investigation was conducted during two successive seasons of 2011 and 2012 on "Anna" apple (Malus domestica, Borkh) budded on Malus rootstock. The trees were 5 years old and grown in the newly reclaimed calcareous soil at El-Nubaria region (El-Behira Governorate). Spraying included three concentrations of Sitofex (5ppm, 10ppm and 15ppm) accompanied by three concentrations of mixed of micronutrients (10gm Fe + 7gm Mn + 3.5gm Zn/20L water, 10gm Fe + 7gm Mn + 7gm Zn/20L water and 10gm Fe + 7gm Mn + 10.5gm Zn/20L water). Results showed that spraying with 15 ppm CPPU accompanied by 10gm Fe + 7gm Mn + 10.5gm Zn/20L water recorded the highest values of vegetative growth parameters i.e. shoot diameter, shoot length, shoots number and leaf area, leaf micronutrients content i.e. Fe, Mn and Zn. This treatment increased yield, fruit set%, fruit weight and fruit dimensions, as well as, it improved fruit physical and chemical characteristics as compared with control in the both seasons.
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1.Introduction

Apple is considered one of the major and the most important deciduous fruit crop in the world. Many investigators recorded that yield and quality of "Anna" apple fruits depended on several factors. One of the most vital factor which affects and plays an important role in this concern is spraying with some growth regulators which enhance fruit set, reduce fruit drop, consequently increase productively. Moreover, both concentration and date application are very important factors which in true reflect of increasing and improving fruit yield and fruit characteristics.

Sitofex(CPPU){(N-(2-chloro-1-pyridinyl)-N-phenylurea)} at different concentrations enhanced cell division, increased cell size, increased fruit weight, size and fruit yield. Furthermore, application of the abovementioned growth regulator improved the most fruit properties ,Jindal and Sharma (1986) on plum, Nickell (1986) on grape, El-Barkooky (1985), Greene (1989) on apple, Biasl et al., (1991) and Lowes and Woolley (1992) on Kiwi, Rizk (1998), Feng et al., (1999), Al-Ashkar (2000), Ranpise et al., (2000), Marwad (2001) on grapes, Kabeel (1999) on persimmon, Fatma et al., (2009) on apple and Guirguis et al., (2003) and Kabeel and Fawaaz (2005) on pear trees).

Some work has been carried out in Egypt concerning the effect of microelements spray on deciduous fruit trees (Awad and Atawia, 1995, Kabeel et al., 1998; Gobara 1998 on pear, El-Shazly 1999 on apple, El-Shobaky et al., 2001 on grape and Naiema 2006 on pear). Also, El-Seginy et al. (2003) reported that, foliar application of "Anna" apple trees with GA3 and/or a mixture of chelated (Fe, Zn, and Mn) is recommended to increase fruit set, yield quantity and fruit quality of trees grown on calcareous soil.

The target of this study was achieving the possibility improving growth, yield and fruit quality through spraying sitofex and micronutrients on "Anna" apple trees.

2.Materials And Methods

The current investigation was carried out in the newly reclaimed calcareous soil at El-Nubaria region, El-Behira Governorate during 2011 and 2012 years under flood irrigation system,

2.1.Materials:

2.1.1.Sample:

The study carried out on sixty trees (5 years old) of "Anna" apple (Malus domestica, Borkh) budded on Malus rootstock. Treated trees spaced at 3.5X4 meters apart. These trees were healthy and similar in their vigor as possible and were treated with common agriculture practices in both seasons. Prior to executing the experiment, the soil's physical and chemical properties of the experimental site were determined according to the method described by Black (1965), and data are presented in table (1).

2.2.Methods:

***** Study Design:***

Treatments were carried out as follows:

Four main branches as uniform as possible were chosen of the four cardinal points of each studied, tree tagged and sprayed with one of the three concentrations of sitofex (5ppm, 10ppm and 15ppm) on first February and after two weeks later of the two seasons of study. Also, the studied trees were sprayed with one of the following concentrations on first February and mid-February of the two studied years:

- 10gm Fe + 7gm Mn + 3.5gm Zn/20L water
- 10gm Fe + 7gm Mn + 7gm Zn/20L water
- 10gm Fe + 7gm Mn + 10.5gm Zn/20L water

Thus the used treatments were represented as follows:

1. Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water
2. Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water
3. Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water
4. Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water
5. Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water
6. Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water
7. Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water
8. Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water
9. Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water
10. Control (Trees sprayed with water only)

The experimental treatments were arranged in a complete randomize block design with six replicates for each treatment (10 treatments x 6 replicates = 60 trees).

Table 1: Physical and chemical analysis of the experimental soil

Clay (%)	17.5	**$CaCO_3$**	20.26
Silt (%)	12.5	**Ca^{++} (meq/L)**	6.35
Sand (%)	70	**Mg^{++}**	3.81
Texture	Sandy loam	**Na^{+}**	6.087
EC (Ds/m)	0.761	**K^{+}**	0.513
Organic matter %	3.76	**Cl^{-}**	5.5
Co3- and HCO3- (meq/L)	17.27	**So_4^{-}**	4.1
Available P (meq/L)	37.76	**Total N^{+} (ppm)**	7.1
pH	7.6	**B (ppm)**	1.539

The main factor was the sitofex spraying, and the sub main factor was the Fe, Mn and Zn spraying treatments.

2.2.1. Vegetative growth measurements:

The average of the current shoots number on the selected branch were counted, their length and diameter were measured on the end of September. Leaf area was determined in mid June, using leaf area meter (Model cl-203, CID, Inc, USA).

2.2.2. Determination of leaf mineral composition:

To determine leaf mineral status, samples of twenty mature leaves were collected at random, at the mid of May in the seasons of study. The leaves were washed several times with tap water, rinsed three times in distilled water and then dried at 70-80^{o} C in an electric air-drying oven. The dried leaves of each sample were ground in a porcelain mortar to avoid contamination with any minerals; 0.3 gm from the ground dried material of each sample was digested with H_2O_2 and H_2So_4 according to Evenhuis and Dewaard (1980). Suitable aliquots were then taken for mineral determinations. Iron (Fe), manganese (Mn) and zinc (Zn) were measured by a Perkin-Elmer Atomic Absorption Spectrophotometer model 305-B. The concentration of Fe, Mn and Zn were expressed as parts per million (ppm), on dry weight basis.

2.2.3. Fruit set percentage:

The total number of flowers on each tagged limb was counted at full bloom. The number of set fruits was counted on the same limbs after one month from full bloom. Fruit set percentage was calculated as follows:

$$\text{Fruit set percentage} = \frac{\text{Number of developing fruitlets}}{\text{Total number of flowers}} \times 100$$

(according to Westwood, 1988).

2.2.4. Determination of yield and fruit quality:

The total yield of each studied tree was determined in (Kg) at the harvest time on first June of both years of study. Twenty mature fruits from each studied tree were taken at random for determining fruit quality. In each sample, fruit weight was recorded as (gm) and fruit dimensions i.e. length and diameter. Total soluble solids (TSS%) in juice were determined using a hand refractometer and the acidity percentage as mallic acid was determined according to A.O.A.C (1990). Total sugar content% was determined according to Woodman (1941).

2.2.5.Statistical analysis:

All obtained data were statistically analyzed according to complete design plots .Sendecor and Cochran (1990). L.S.D. at 5% test was used for comparison between means of the studied treatments.

3.Results And Discussion

3.1.Shoot diameter

As shown in (Table, 1), it is appeared that spraying with CPPU and micronutrients had positive effect on shoot diameter than control in the both

seasons. It was found that spraying with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water recorded the highest values of shoot diameter (0.86 and 0.88 cm) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, but, the lowest values were obtained from control in the both seasons of study (0.68 and 0.69 cm).

Table (1): Effect of spraying sitofex, Fe, Mn and Zn on vegetative growth measurements of Anna apple trees

Treatments	Shoot diameter (cm)		Shoot length (cm)		Shoots number		Leaf area (cm2)	
	2011 season	2012 season	2011 season	2012 season	2011 season	2012 season	2011 season	2012 season
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	0.71	0.74	15.6	15.8	11.6	11.8	26.2	26.4
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	0.78	0.80	16.6	16.8	14.2	14.6	27.4	27.6
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	0.80	0.82	18.2	18.4	15.6	15.9	27.8	28.0
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	0.74	0.76	16.4	16.2	12.9	13.4	26.4	26.6
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	0.81	0.83	16.9	17.0	14.8	15.2	27.2	27.4
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	0.84	0.86	18.5	18.7	16.0	16.4	28.2	28.4
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	0.77	0.78	16.2	16.3	13.8	14.4	26.6	26.6
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	0.84	0.86	17.2	17.4	15.2	15.6	27.5	27.9
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	0.86	0.88	18.8	18.9	16.4	17.1	28.4	28.8
Control (Trees sprayed with water only)	0.68	0.69	13.2	13.4	10.6	10.9	25.6	25.8
LSD at (0.05)	0.02	0.01	0.3	0.2	0.4	0.7	0.2	0.3

3.2.Shoot length

Data in (Table, 1) revealed that spraying with CPPU and micronutrients had positive effect on shoot length than control in the both seasons. The maximum values were obtained of trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (18.8 and 18.9 cm) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, while, the minimum values were obtained from control in the both seasons of study (13.2 and 13.4 cm)

3.3.Shoots number

As shown in (Table, 1), it is appeared that spraying with CPPU and micronutrients had obvious effect on increasing shoots number than control in the both studied seasons. It was found that spraying with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water recorded the highest values of shoots number (16.4 and 17.1) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, whereas, the lowest values were obtained from control in the both seasons of study (10.6 and 10.9).

3.4.Leaf area

Data in (Table, 1) revealed that spraying with CPPU and micronutrients had clear effect in increasing leaf area than control in the both seasons.. The maximum values were recorded on trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (28.4 and 28.8 cm^2) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, while, the minimum values were obtained from control in the both seasons of study (25.6 and 25.8 cm^2).

These resulted are in line with many investigators who reported that, vegetative growth increase due to using micronutrients as being cleared by Mohamed and Ahmed, (1991) on "Anna" apple, Naiema (2006) on pear. Also, El-Khawaga (2007) on olive, Amer et al. (2010) on "Toffahy and Balahy" Indian pear trees and EL-Sisy (2011) on guava trees found that spraying nutrients was effective in stimulating leaf area.

3.5.Leaf Fe content

As shown in (Table, 2), it is appeared that spraying with CPPU and micronutrients had positive effect on leaf Fe content than control in the both seasons. It was found that spraying with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (112.76 and 116.77ppm) recorded the highest values

of leaf Fe content followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, whereas, the lowest values were obtained from control in the both seasons of study (88.16 and 89.16ppm).

3.6.Leaf Mn content

Data in (Table, 2) revealed that spraying with CPPU and micronutrients had obvious effect on leaf Mn content than control in the both seasons. The maximum values were recorded on trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (84.6 and 88.8ppm) followed by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, while, the minimum values were obtained from control in the both seasons of study (68.4 and 68.6ppm).

3.7.Leaf Zn content

As shown in (Table, 2), it is appeared that spraying with CPPU and micronutrients clearly increased leaf content of Zn than control in the both seasons. It was found that spraying with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water reflected the highest values of leaf Zn content (40.4 and 40.6ppm) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, whereas, the lowest values were obtained from control in the both seasons of study (28.6 and 28.8ppm).

These results agreed with EL-Sisy (2011) who reported that there were a significant increase in guava fruit Fe, Mn and Zn comparing with control as a result of nutrients spraying. On the other hand, EL-Gazzar et al. (1979) reported that fruits of grapes were not significantly affected by either soil or foliar application of FeSO4 and ZnSO4.

3.8.Fruit set percentage

Data in (Table, 3) revealed that spraying with CPPU and micronutrients had clear effect on fruit set percentage than control in the both seasons. The maximum values were recorded on trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (21.92 and 24.21%) followed by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, while, the minimum values were obtained from control in the both seasons of study (12.48 and 12.52%).

3.9.Fruit yield

As shown in (Table, 3), it is appeared that spraying with CPPU and micronutrients had positive effect on fruit yield than control in the both seasons. It was found that spraying with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water attained the highest values of fruit yield (36.8 and 37.8kg) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, whereas, the lowest values were obtained from control in the both seasons of study (26.2 and 26.4kg).

These results are in line with those obtained by El-Barkooky (1985) and Greene (1989) on apple, Jindal and Sharma (1986) on plum, Biasl et al., (1991) and Lowes and Woolley (1992) on Kiwi, Kabeel (1999) on persimmon and Guirguis et al., (2003) on pear trees. They found that spraying with 10 or 15 ppm CPPU increase fruit set percentage as well as fruit yield.

With respect to application of micronutrients, El-Seginy et al. (2003) reported that the chelated Fe, Zn and Mn at all rates increased total yield as compared with control of "Anna" apple trees. Also, EL-Sisy, (2011) noticed that foliar or soil application of guava

trees with mixture of chelated or sulphate (Fe + Zn + Mn) in high rates (3000 ppm) added twice annually

was the best treatment for enhancing yield. Also, Datir et al. (2012) found that the application of amino acid-micronutrients chelate like (Zn, Fe, Cu and Mn) at the concentration of 1.5% and 2.0% resulted in more fruits per plant and more total yield per plant of "Chilli" (Capsicum annum L.) plants.

Table (2): Effect of spraying sitofex, Fe, Mn and Zn on leaf mineral content of Anna apple trees

Treatments	Fe (ppm)		Mn (ppm)		Zn (ppm)	
	2011 season	2012 season	2011 season	2012 season	2011 season	2012 season
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	103.16	104.18	76.2	77.4	35.2	35.4
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	106.14	107.14	77.5	78.8	37.6	27.8
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	109.33	111.42	80.6	81.8	40.2	40.3
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	104.18	106.32	76.8	77.0	35.8	35.8
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	106.24	108.72	80.9	82.8	38.0	38.2
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	111.68	113.65	82.4	84.8	40.2	40.4
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	105.14	107.22	77.2	78.2	36.2	36.4
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	108.21	110.82	82.2	84.6	38.2	39.4
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	112.76	116.77	84.6	88.8	40.4	40.6
Control (Trees sprayed with water only)	88.16	89.16	68.4	68.6	28.6	28.8
LSD at (0.05)	1.02	1.57	4.1	3.9	0.2	0.1

3.10.Fruit weight

Data in (Table, 4) revealed that spraying with CPPU and micronutrients had significant effect on fruit weight than control in the both seasons.. The maximum values were significantly obtained of trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (199.2 and 199.6g) followed in

a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, while, the minimum values were obtained from control in the both seasons of study (162.9 and 163.8g).

Table (3): Effect of spraying sitofex, Fe, Mn and Zn on fruit set (%) and fruit yield (kg) of Anna apple trees

Treatments	Fruit set (%)		Fruit yield (kg)	
	2011 season	2012 season	2011 season	2012 season
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	14.26	14.32	29.6	30.2
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	15.62	15.85	30.8	31.2
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	16.65	18.36	32.8	33.2
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	14.32	14.38	30.8	31.0
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	15.80	16.0	31.6	32.6
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	19.55	20.42	34.6	35.6
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	14.44	14.54	31.4	32.4
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	16.12	16.18	33.6	35.8
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	21.92	24.21	36.8	37.8
Control (Trees sprayed with water only)	12.48	12.52	26.2	26.4
LSD at (0.05)	2.34	2.59	1.8	2.1

3.11.Fruit length

As shown in (Table, 4) it is appeared that spraying with CPPU and micronutrients had significant effect on fruit length than control in the both seasons. It was found that spraying with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water recorded the highest values of fruit length (6.87 and 6.91cm) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, whereas, the lowest values were obvious from control in the both seasons of study (5.64 and 5.73cm).

3.12.Fruit diameter

Data in (Table, 4) clear that spraying with CPPU and micronutrients had more effect on fruit diameter than control in the both seasons.. The maximum values were obtained from trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (5.54 and 5.68cm) followed by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water. The minimum values were obtained from control in the both seasons of study (4.29 and 4.47cm).

These results are in line with those obtained by El-Barkooky (1985) and Greene (1989) on apple, Jindal and Sharma (1986) on plum, Biasl et al., (1991) and Lowes and Woolley (1992) on Kiwi, Kabeel (1999) on persimmon and Guirguis et al., (2003) on pear trees. They found that spraying with 10 or 15 ppm CPPU improves fruit physical characteristics.

Table (4): Effect of spraying sitofex, Fe, Mn and Zn on fruit physical characteristics of Anna apple trees

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)	
	2011 season	2012 season	2011 season	2012 season	2011 season	2012 season
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	138.3	140.5	6.02	6.21	4.93	5.27
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	140.7	141.2	6.28	6.27	5.17	5.29
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	141.4	142.3	6.43	6.64	5.21	5.34
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	140.5	141.6	6.49	6.52	5.19	5.29
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	146.1	147.4	6.51	6.65	5.23	5.41
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	148.3	148.3	6.69	6.68	5.37	5.44
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	144.8	145.2	6.59	6.51	5.12	5.29
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	146.5	147.5	6.63	6.65	5.34	5.40
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	149.2	149.6	6.87	6.91	5.54	5.68
Control (Trees sprayed with water only)	112.9	113.8	5.64	5.73	4.29	4.47
LSD at (0.05)	0.8	1.1	0.14	0.19	0.17	0.23

With respect to application of micronutrients, El-Seginy et al. (2003) reported that the chelated Fe, Zn and Mn at all rates increased fruit weight and dimensions as compared with control of "Anna"

apple trees. Also, EL-Sisy (2011) noticed that foliar or soil application of guava trees with mixture of chelated or sulphate (Fe + Zn + Mn) in high rates (3000 ppm) when added twice annually was the best treatment for enhancing fruit weight. Also, Datir et al. (2012) found that application of amino acid-micronutrients chelate like (Zn, Fe, Cu and Mn) at the concentration of 1.5% and 2.0% increased fruit weight and dimensions of "Chilli" (Capsicum annum L.) plants.

3.13.Fruit TSS

Data in (Table, 5) revealed that spraying with CPPU and micronutrients had significant effect on

fruit TSS than control in the both seasons.. The maximum values were observed from trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (13.8 nd 13.9%) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water. The minimum values were obtained from control (10.8 and 11.2%) in the both seasons of study.

3.14.Fruit acidity

As shown in (Table, 5) it is cleared that spraying with CPPU and micronutrients had clear effect on fruit acidity than control in the both seasons. It was found that spraying with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water significantly increased fruit acidity (0.42 and 0.43%) followed by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water, whereas, the lowest values were obtained from control (0.36 and 0.36%) in the both seasons of study.

3.15.Fruit total sugars

Data in (Table, 5) revealed that spraying with CPPU and micronutrients had significant effect on fruit total sugars than control in the both seasons.. The maximum values were obtained from trees sprayed with 15 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water (42.28 and 42.52%) followed in a descending order by spraying with 10 ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water. The minimum values were obtained from control (36.33 and 36.33%) in the both seasons of study.

These results are in line with those obtained by El-Barkooky (1985) and Greene (1989) on apple, Jindal and Sharma (1986) on plum, Biasl et al., (1991) and Lowes and Woolley (1992) on Kiwi, Kabeel (1999) on persimmon and Guirguis et al., (2003) on pear trees, they found that spraying with 10 or 15 ppm CPPU improved fruit chemical characteristics.

With respect to application of micronutrients, Mohamed and Ahmed (1991) found that applying the three elements together (Cu + Zn + Fe) at the higher rates was also accompanied with improving total soluble solids in apple fruits.

Table (5): Effect of spraying sitofex, Fe, Mn and Zn on fruit chemical characteristics of Anna apple tree

Treatments	Fruit TSS (%)		Fruit acidity (%)		Fruit total sugars (%)	
	2011 season	2012 season	2011 season	2012 season	2011 season	2012 season
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	13.0	13.2	0.39	0.39	40.10	40.16
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	13.2	13.4	0.40	0.40	40.12	40.21
Spraying 5ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	13.4	13.5	0.41	0.42	41.24	41.46
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	13.1	13.2	0.38	0.39	40.21	40.36
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	13.5	13.5	0.40	0.41	40.36	40.42
Spraying 10ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	13.6	13.8	0.41	0.41	41.86	41.88
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 3.5gm Zn/20L water	13.3	13.4	0.38	0.38	40.55	40.65
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 7gm Zn/20L water	13.6	13.7	0.40	0.41	41.52	41.76
Spraying 15ppm CPPU + 10gm Fe + 7gm Mn + 10.5gm Zn/20L water	13.8	13.9	0.42	0.43	42.28	42.52
Control (Trees sprayed with water only)	10.8	11.2	0.36	0.36	36.33	36.36
LSD at (0.05)	0.2	0.1	0.1	0.2	0.37	0.41

Conclusion

Spraying with 15 ppm CPPU accompanied by 10gm Fe + 7gm Mn + 10.5gm Zn/20L water recorded the highest values of vegetative growth parameters (i.e. shoot diameter, shoot length, shoots number and leaf area), leaf micronutrients content (i.e. Fe, Mn and Zn), also, it increased fruit set% and yield. In addition, it improved fruits physical and chemical characteristics as compared with control in the both seasons. Hence, if apple growers apply this treatment, they will gain better vegetative growth, leaf nutrition, yield and fruit characteristics.

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