Response of Guava Cv. Seedy Montakhab Trees to Micronutrients and Its Effect on Fruit Quality

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ABSTRACT

This investigation was carried out during 2009 and 2010 seasons on 15 years old seedy guava trees grown in sandy soil of EL-Maamoura region east of Alexandria to evaluate the effect of foliar spray or soil application with mixture of Fe + Mn + Zn in two forms, chelate and sulphate in two rates (1500 and 3000 ppm) on leaf area, leaf total chlorophyll, number of fruits, fruit weight, yield, fruit quality and leaf and fruit mineral contents.

The results revealed significant increase of leaf area, leaf total chlorophyll, yield as weight or number of fruits/ tree as well as average fruit weight, length and fruit pulp thickness, TSS %, V.C and total sugars %, reducing and non-reducing sugars comparing with control.

The best results associated with the high rate of mixture (Fe + Mn + Zn) 3000 ppm either foliar or soil application in form chelate or sulphate twice annually.

INTRODUCTION

The guava (*Psidium guajava*, L.) is an evergreen tree native to tropics.

A guava fruit tree is very popular and well known in Egypt and many countries. Generally it bears fruits within three or four years from the time of sawing the seeds. It can also easily adapt itself to different soil and climatic conditions. Moreover, the trees can tolerate drought to a great extent and the fruit is considered as available source of vitamin C.

The main problem of sandy soils is the lack of most nutrients due to poor organic matter content, low cation exchange and high pH Balba (1968) and Ali *et al*.(1977), and the soil is in demand needs to many micronutrients. The foliar application of micronutrients has become in wide use to correct the problem of micronutrients deficiency in many fruit crops.

Although micronutrients are needed in relatively very small quantities for adequate plant growth and production, their deficiencies, cause a great disturbance in the physiological and metabolic processes involved in the plant EL-Gazzar *et al*.(1979).

Microelements problems are of increasing importance in Egypt not only on calcareous soil in the newly reclaimed areas but also on alluvial soils in the Nile delta as a result of high microelements export by several crops per year Amberger (1982).

Deficiency of iron in plants is directly related to the form of iron in plants and in soil. Ferrous iron being the best form of iron to plants, it is the unstable form and it is oxidized rapidly to ferric form.

Guava suffers from some factors which affect its production. The first is their different genotype which affects fruit quality. The second is the high soil pH value which causes precipitation of Fe, Mn and Zn in an unavailable form for plants. Thus foliar application seems to be valuable in correcting the widespread occurrence of certain micronutrient deficiency symptoms Marschner (1995) and Taiz and Zeiger (1998). Some works have been carried out in Egypt concerning the effect of microelements spray on deciduous fruits EL-Shazly(1999), EL-Shobaky *et al.*(2001),EL-Seginy *et al.*(2003) and Naiema (2006). Synthetic chelating agents, which hold ferric iron in a readily available form to plant, were used intensively to correct iron deficiency.

The power of plant leaves to absorb nutrients has resulted in the fact that foliar application of nutrients becomes a recurrent method for supplying nutrients to plant, Swietlike and Faust (1984), also the plant growth stage and timing of fertilizer application affect nutrient uptake Faust (1989).

The present study was carried out to evaluate the effect of foliar spray of chelated Fe, Mn and Zn and soil feeding with sulphate form of Fe, Zn and Mn on growth yield, fruit quality and leaf and fruit mineral content of guava trees.

MATERIALS AND METHODS

This study was conducted during 2009 and 2010 growing seasons in order to evaluate the effect of different fertilization (Fe, Mn, Zn) forms and application methods on 15 years old guava trees.

The trees spaced 5 × 5 m apart and grown in sandy soil (Table1) in private orchard in EL-Mamoura zone east of Alexanderia governorate and received the normal agricultural practices adopted in this area.

Fifteen trees as uniform as possible were chosen for the present study and received the regular horticultural managements. All trees received 2¼ kg of ammonium sulphate, 1 kg of super phosphate 15.5% and 1.2 kg of potassium sulphate 48%, the K and N fertilizers were

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divided into 3 doses and applied in March, May and July whereas P_2O_5 was added in one dose in December.

The selected trees were subjected to the following fertilization treatments during the two experimental seasons.

T_1: Control, Foliar spray with water.

T_2: Foliar spray with Fe + Mn + Zn at 1500 ppm as chelated form.

T_3: Foliar spray with Fe + Mn + Zn at 3000 ppm as chelated form.

T_4: Soil application with Fe + Mn + Zn at 1500 ppm as sulphate form.

T_5: Soil application with Fe + Mn + Zn at 3000 ppm as sulphate form .

The chelated forms are :

Fe-EDDHA (12%Fe), Mn-EDTA (13%Mn) and Zn-EDTA (13%Zn).

Foliar and soil application with Fe, Mn and Zn in two forms chelate and sulphate were applied in two dates in May and July in the growing seasons. Each experimental tree received 5 liters per spray or soil under the tree.The treatments were arranged in a Complete Randomized Block Design and each treatment was replicated 3 times with a single tree for replicate with guard trees between rows.

Foliar sprays were applied using a hand pressure sprayer. Triton B emulsifier at rate of 0.2% was used as surfactant. The following parameters were determined in the two successive seasons.

1-A sample of 10 leaves was taken for measuring leaf area (cm^2).

1-1- Form measuring leaf chlorophyll:

The average of 6 readings was taken on the leaves of the middle of the shoots from all over the tree canopy using Minolta SPAD chlorophyll meter model Yadava(1986).

2- Leaf mineral content:

At the second week of August in both seasons, leaf sample of 15 leaves was taken from each experimental tree replicate at random from non-fruiting shoots. The leaves were washed with tap water, distilled water and oven dried at 70°C until a constant weight and then ground. The ground samples were digested with sulfuric acid and hydrogen peroxide according to Evenhuis and Dewaard (1980). N and P leaf contents were coloremterically determined according to Evenhuis (1976) and Murphy and Riley (1962), respectively. K content was determined against a standard by Flame photometer. Fe, Zn and Mn leaf content were measured by atomic absorption spectrophotometer. (Perkin Elmer 3300).

3- Yield and fruit quality:

The total yield of each tree was calculated using the average fruit weight in kg and the total number of fruits per each experimental tree was counted in both seasons.

At harvesting time (on first of September) of both seasons, six fruits were taken at random from each tree to determine fruit quality (average fruit weight (gm), length and diameter (cm), fruit pulp thickness and fruit firmness. In juice of each fruit sample, total soluble solids (TSS) percentage was determined by a hand refractometer, the percentage of acidity was measured according to A.O.A.C. (1980). Vitamin C was determined by titration with 2,6-dichlorophenol indophenol blue dye and expressed as mg vitamin C/ 100 ml juice. Total sugars in fruit pulp tissue, were determined by phenol sulfuric method according to Dubois *et al.* (1956) and then reducing and non-reducing sugar were calculated.

Fruit firmness was determined by using pressure tester having 5/16 pluger. Two readings were taken at two different positions on the flesh of each fruit after pealing.

Fruit acidity as percent citric acid was determined in the juice according to A.O.A.C (1980) by titration with 0.01 sodium hydroxide. A part of each fruit sample was dried, digested and both macro and micronutrients were determined in it as done with leaves.

Data were statistically analyzed according to Snedecor and Cochran (1990) and L.S.D. test at 0.05 levels was used for comparison between treatments.

Table 1. Soil analysis of the experimental orchard

Soil depth (cm)	SAR	pH	E.C dS/m	Soluble cations and anions (meq/ 100 g soil)								DTPA-Extractable (mg/ kg)		
				Na^+	K^+	Ca^{++}	Mg^{++}	CO_3^-	Cl^-	HCO_3^-	SO_4^-	Fe	Zn	Mn
8- 30	2.36	7.90	4.06	9.78	0.69	22.50	12.00	-	19.0	3.20	18.4	2.38	1.29	1.46
30-60	5.38	7.96	7.82	26.09	7.05	34.0	13.00	-	55.0	3.80	19.4	2.17	1.12	1.20

RERSULTS AND DISCUSSION

1- Vegetative growth parameters:

1-1. Leaf area (cm^2):

The data in (Table 2) indicated that all fertilizers treatments either foliar or soil application gave a significant increases in leaf area (cm^2) in both seasons of study comparing with control except treatment T2 in 2009 season. The highest value of leaf area (cm^2) associated with the foliar application with the high rate of chelated (Fe + Mn + Zn) T_3 in both seasons. These resulted were in line with many investigators who reported that, leaf area increased due to using micronutrients, Ubavicc *et al.* (1984) on apple, Chekan (1988) on spur type apple, Chekan *et al.* (1988) on sour cherry, Mohamed and Ahmed ,(1991) on Anna apple, Naiema (2006) on pear. Also, EL-Khawaga (2007) on olive and Amer *et al.* (2010) on ber trees found that spraying nutrients was effective in stimulating leaf area. Leaf area was increased by increasing rates of application and soil application was pronounced than foliar one. This increment presented as a result of foliar application of micronutrients may be attributed to their effects on formation of carbohydrates and proteins and to the effect of Zn in building up the natural auxin IAA and consequently activation of cell division process in plant tissues Nijjan(1985).

1-2. Leaf chlorophyll content:

The data presented in Table (2) showed that the different types of application foliage and soil and different rates of applied gave significant increase in total chlorophyll content compared with control in both seasons of study. The highest value of chlorophyll in leaf was associated with T_5 in both seasons.

These results were in line with those obtained with Nijjar, (1985) who found that micronutrients are necessary for chlorophyll formation which reflected on improving the synthesis and translocation of carbohydrates. Amer *et al.* (2010) on ber fruit found significant increase in total leaf chlorophyll due to fertilization and soil application was more effective in increasing total leaf chlorophyll. Moreover ,the chelated Fe, Zn, Mn at all rates play an important function in enzymatic systems and chlorophyll formation and consequently increased photosynthesis, EL-Seginy *et al*. (2003) on apple. In addition Mn is a minor constituent of plant chlorophyll which is responsible for photosynthesis, Mengel and Kirkby (1987**)**.

2- Fruit characters:

2-1. Physical fruit characters:

The data presented in (Table 3) showed the effect of foliar and soil application with micronutrients on:

2-1-1. Fruit weight (gm):

There was significant increase in fruit weight in both seasons of study for fertilization treatments comparing with control. The best value was obtained with treated with foliar application of chelated form T_2 and T_3 in two concentrations and in sulphate form T_5 in 2009 and 2010 seasons.

These findings agreed with EL-Safty *et al.* (1998), on citrus, Kumar *et al.* (1998) on guava found that Zn sulphate improved fruit weight, EL-Shazly (1999) on apple. Amer *et al.* (2010) on ber fruit found that fruit weight wasn't affect neither by increasing rate of applied micronutrients nor by method of application.

2-1-2. Average fruit number/ tree:

Data presented in (Table 3) showed that all fertilizer treatments gave significant increases in fruit number comparing with control in both seasons of study. The highest value was obtained from T_5 in both seasons of study.

Table 2. Effect of foliar and soil application of micronutrients in form chelate and sulphate on leaf area and leaf chlorophyll content of guava during 2009 and 2010 growing seasons

Treatments	Leaf area (cm^2)		Leaf chlorophyll	
	2009	2010	2009	2010
T_1	52.83	50.90	36.20	38.50
T_2	58.25	63.33	41.00	43.35
T_3	71.25	73.60	46.00	47.53
T_4	60.43	59.23	42.67	43.90
T_5	65.75	65.35	47.60	49.21
$L.S.D._{0.05}$	7.83	6.43	3.99	3.04

T_1: Control, Foliar spray with water
T_2: Foliar spray with Fe + Mn + Zn at 1500 ppm as chelated form
T_3: Foliar spray with Fe + Mn + Zn 3000 ppm as chelated form
T_4: Soil application with Fe + Mn + Zn 1500 ppm as sulphate form
T_5: Soil application with Fe + Mn + Zn 3000 ppm as sulphate form

Table 3. Effect of foliar and soil application of micronutrients in form chelate and sulphate on fruit characteristics and fruit yield during 2009 and 2010 growing seasons

Treatments	Fruit weight (gm)		Number of fruit/ tree		Yield kg/ tree		Fruit length (cm)		Fruit diameter (cm)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
T_1	82.30	112.90	327.7	321.7	26.97	36.32	6.5	5.9	5.85	5.36
T_2	122.40	127.7	397.7	416.0	48.68	53.12	6.6	6.7	5.92	5.60
T_3	126.60	132.2	387	434.0	49.0	57.29	7.2	6.9	5.97	5.69
T_4	107.80	116.9	397	401.3	42.80	46.91	7.2	6.3	5.89	5.73
T_5	110.80	125.9	439.7	441.3	48.72	55.56	7.3	7.3	6.05	5.75
L.S.D.$_{0.05}$	20.306	N.S	58.045	62.728	11.261	7.831	N.S	0.5547	NS	NS

T_1: Control, Foliar spray with water
T_2: Foliar spray with Fe + Mn + Zn at 1500 ppm as chelated form
T_3: Foliar spray with Fe + Mn + Zn 3000 ppm as chelated form
T_4: Soil application with Fe + Mn + Zn 1500 ppm as sulphate form
T_5: Soil application with Fe + Mn + Zn 3000 ppm as sulphate form

2-1-3. Yield/ tree:

The data showed that there was a significant increase in the yield/tree in both seasons which was associated by the high levels of (Fe + Zn + Mn) at two forms in T3, T5 in 2009 and in all treatments in 2010 comparing with control.

These results were in line with those obtained by Dahshan and Ali (1986) on guava who reported improving productivity with the soil application of NPK fertilizers and/ or foliar application of micronutrients and leaf feeders were more effective in increasing the yield of guava. EL-Gazzar *et al.* (1979) found that foliar application of iron, zinc and manganese increased the yield of Thompson seedless grapes, while EL-Seginy *et al.* (2003) reported that the chelated Fe, Zn and Mn at all rates increased total yield as compared with control and the different chelated mixture treatments were more effective in increasing fruit number or kg per tree. Also, Fe had an important function in enzymatic systems and chlorophyll formation and consequently increased photosynthesis which finally increased the yield Smith(1957). On the other hand, the improvement of yield as a result of Zn sprays may be explained by the fact that Zn plays a role in tryptophan synthesis which is the presource of endogenous natural hormone (IAA) Price (1970). Although foliar sprays are more effective, foliar-absorbed Zn is not easily translocated in plants, which necessitates repeated spray application Swietlik (2002). In addition Mn spray in an minor constituent of plant chlorophyll which is responsible for photosynthesis Mengel and Kirkby (1987). Also, Higazi *et al*. (1984) found that treated guava trees with N.P.K + microelements each 1500 or 3000 ppm improved fruit set, yield and improved fruit physical and chemical indices.

2-1-4. Average fruit length (cm):

It could be stated from the data in (Table 3) that fruit length (cm) was significantly increased in the second season only and the best value of length was obtained in T_3 and T_5. These results were partially agreed with Awad and Atawia (1995), EL-Shazly (1999) on apple. On the other hand, the results of this study are in hormony with those reported by EL-Seginy and Khalil (2000) on pear, Abd-Ella and EL-Sisy (2006) on fig and Amer *et al.* (2010) on ber fruit. They all reported that microelements play a role for increasing fruit length.

2-1-5. Average fruit diameter (cm):

The data presented in **(Table 3)** showed that fruit diameter of guava fruit wasn't affect neither by increasing rate of applied micronutrients nor by the form of application in both seasons 2009 and 2010.

These results didn't agree with those obtained by Abd-Ella and EL-Sisy (2006) on fig, they found that all properties of fruit quality were improved when sprayed with separate mixture of (Fe+ Zn + Mn) at 0.05% and GA_3 10 ppm.

2-1-6. Fruit pulp thickness:

The data in (Table 4) showed that T_3 and T_2, T_3, T_5 in 2009 and 2010, respectively gave a significant increase in fruit pulp thickness. Many investigators have shown the effect of zinc sulphate improving fruit quality, Kumar and Singh (1998) on guava.

2-1-7. Fruit firmness:

The data in (Table 4) indicated that there were no significant differences between the effect of fertilizer treatments on fruit firmness in both seasons of study.

3- Fruit quality:

3-1. Vitamin C content:

The data in (Table 4) indicated that there were a significant increases in V.C content as mg/ 100 ml juice in both seasons due to foliar and soil application of Fe + Mn + Zn as chelated and sulphate form, respectively. The highest value was in T_5 in both seasons.

3-2. Acidity percent:

There was no significant affect in fruit acidity percent due to all treatments in both seasons of study (Table 4) but there were a slight decrease in acidity due to all treatments. The obtained results were partially agreed with those reported by Mohamed and Ahmed (1991) on Anna apple who found a reduction in total acidity in fruit pulp due to fertilization.

3-3. Fruit total soluble solids:

The data showed that there was a significant increase in fruit TSS % due to all treatments comparing with control. The highest value was in T_5 in 2009 and in T_3 and T_5 in 2010.

The data of these parameters were in line with those of EL-Menshawi *et al.* (1997), EL-Safty *et al.* (1998) on citrus, EL-Shazly (1999). Dahshan and Ali (1986) on guava, Abd-Ella and EL-Sisy (2006) on fig. They reported that application of micronutrients increased total soluble solids, V.C content and reduced in total acidity % in the fruit pulp, and the data partially agreed with Amer *et al*. (2010) on ber fruits who found that the soil application of micronutrients showed significant effect on fruit firmness in one season only

3-4. Total sugars:

Concerning the effect of different fertilizers as foliar or soil application on total sugar %, the data presented in (Table 5) showed that there was significant increase in total sugars in fruit tissues in both seasons of study in all treatments.

Concerning the reducing sugars, T_5 in first season and T_4 and T_5 in second season gave the significant effect in reducing sugars either increase or decrease in 2009 and 2010, respectively.

Table 4. Effect of foliar and soil application of micronutrients in form chelate and sulphate on fruit characteristics and fruit yield during 2009 and 2010 growing seasons

Treatments	Fruit pulp thickness (cm)		Fruit firmness		V.C content in 100 ml juice		Fruit acidity		TSS % in juice	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
T_1	1.01	0.92	3.94	2.22	40.43	32.10	0.34	0.13	6.43	7.07
T_2	1.22	1.46	4.03	3.25	53.03	46.4	0.11	0.13	6.90	8.67
T_3	1.51	1.67	4.27	3.29	74.17	49.8	0.105	0.10	7.43	9.07
T_4	1.07	1.13	3.14	2.11	73.9	61.90	0.190	0.13	7.37	8.27
T_5	1.13	1.40	2.83	3.74	88.3	85.75	0.116	0.10	8.13	9.53
L.S.D.$_{0.05}$	0.3375	0.3512	NS	NS	11.448*	12.870	NS	NS	0.9101	1.086

T_1: Control, Foliar spray with water
T_2: Foliar spray with Fe + Mn + Zn at 1500 ppm as chelated form
T_3: Foliar spray with Fe + Mn + Zn 3000 ppm as chelated form
T_4: Soil application with Fe + Mn + Zn 1500 ppm as sulphate form
T_5: Soil application with Fe + Mn + Zn 3000 ppm as sulphate form

Table 5. Effect of foliar and soil application of micronutrients in form chelate and sulphate on fruit total sugars, reducing and non-reducing sugars of guava during 2009 and 2010 growing seasons

Treatments	Total sugar (%)		Reducing sugar (%)		Non-reducing sugar (%)	
	2009	2010	2009	2010	2009	2010
T_1	4.92	7.09	1.69	4.20	3.23	2.89
T_2	5.88	7.49	2.11	4.21	3.78	3.28
T_3	5.88	7.53	2.20	4.26	3.68	3.27
T_4	6.24	7.76	1.56	3.14	4.69	4.62
T_5	6.32	8.01	2.88	3.88	3.44	4.13
L.S.D.$_{0.05}$	0.6838	0.3422	0.5429	0.0922	0.8236	0.3237

T_1: Control, Foliar spray with water
T_2: Foliar spray with Fe + Mn + Zn at 1500 ppm as chelated form
T_3: Foliar spray with Fe + Mn + Zn 3000 ppm as chelated form
T_4: Soil application with Fe + Mn + Zn 1500 ppm as sulphate form
T_5: Soil application with Fe + Mn + Zn 3000 ppm as sulphate form

Also, the non-reducing sugars gave the same results T4 in 2009 and all treatments in 2010 gave significant increases in non reducing sugars.

The data of this study are partially in line with Dahshan and Aly (1986) on guava who found that sugar fraction was obviously better with micronutrients, EL-Seginy *et al.* (2003) found that total sugars content was improved by micronutrients. Mohamed and Ahmed (1991) stated that spraying micronutrients increased reducing and total sugars of apple.

4- Leaf mineral content:

Macronutrients:

4-1. Nitrogen %:

The data in (Table 6) showed that there were marked increases with all application treatments compared with control. The statistical analysis shows that, there were no significant differences between the leaf nitrogen content of guava trees fertilized by chelated or sulphate (Fe + Mn + Zn) in both seasons of study. This may be due to better growth and yield attained by application of micronutrients.

4-2. Phosphorus %:

Also, leaf phosphorus content in all treatments was significantly higher than that of control (T_1) in both seasons of study except T_4 (soil application in low rate) in both seasons. This increment may be attributed to the sulphate form of Fe + Mn + Zn in 1500 ppm enhances the absorption and translocation of phosphorus by plants (Girdhar and Yadav, 1982) and the reduction in leaf P content might be attributed to the antagonism between Fe and P (Nawar, 1991), these results agree to some extent with Sorour (1992) and EL-Seginy et al.(2003)

4-3. Potassium %:

The leaf potassium contents in all treatments were significantly higher than that of the control (T_1) in both seasons of study. In addition the increase of plant nutrient status resulted from spraying different solutions might be attributed to quick absorption via leaves and the limited loss of the nutrients when they were sprayed Marschner(1995). Also, spraying Zn in chelated or non-chelated form on guava trees gave significant increase in N and K content in leaf but no remarked increase in P content ,Sarma (1989).

Micronutrients in leaf [Fe, Mn and Zn (ppm)]:

The data presented in (Table 6) showed that foliar and soil application of (Fe + Mn + Zn) in the two forms and rates (1500 or 3000 ppm) gave significant increases in Fe, Mn and Zn concentration comparing with control except T_2 and T_4 (low rate 1500 ppm) in two forms in 2009 and 2010 seasons and the highest level was in Fe and Mn, and Zn in T_3 and T_5 in the two seasons of study. These results may be attributed to the rapid growth of the plants. These results partially agreed with those obtained with Sourour (1992), Kabeel *et al.* (1998), EL-Shazly (1999), EL-Seginy and Khalil (2000) and EL-Seginy *et al.* (2003) who worked on deciduous fruit trees. On the other hand, Amer *et al.* (2010) on ber fruits found that Fe concentration increased more when fertilizer was applied as foliar application than soil application. Also, Abd-Ella and EL-Sisy (2006) on fig, reported that micronutrients concentration was increased in all spraying treatments.

5- Fruit mineral contents:

The data in (Table 7) showed the effect of rates and methods of micronutrients application on fruit mineral content. The data indicated that:

Macronutrients % in fruit:

For the N content in fruit, the data show that there were no significant effects for all treatments comparing with control in 2009 and 2010 seasons.

Also, for the P content in fruit, data showed that there were no significant affects on fruit P content due to application treatments in both seasons of study.

K: Concerning the effect of treatment on K%, the data indicated that all treatments either rates or methods of application comparing with control gave a significant increase in fruit K% content of guava fruits in second season only.

Micronutrients in fruits [Fe, Mn and Zn]:

There were a significant increase in fruit Fe and Mn and Zn content in all treatments in T_3, T4 and T_5 comparing with control in both seasons of study. The high level of Fe was associated with T_3 and T_5 (high rates of application either foliar or soil). The same trend was observed for the Mn content in fruit tissue. As for zinc content, the highest levels associated with T_5 (soil application with high rate of sulphate form in both seasons of study). Mango and Josan (2000) on kinnow mandarin reported that the increase in Zn content in leaves was more pronounced when spraying of Zn was conducted alone rather than in combination with Fe and Mn.

The data partially agreed with those of Keleg *et al.* (1979) who reported that fruits of kernel were not significantly affected by either soil or foliar application of $FeSO_4$ and $ZnSO_4$.

Table 6. Effect of foliar and soil application of micronutrients in form chelate and sulphate on leaf mineral contents of guava trees during 2009 and 2010 growing seasons

Treatments	N%		P%		K%		Fe ppm		Mn ppm		Zn ppm	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
T_1	2.23	2.13	0.13	0.710	1.39	0.91	110	100	39.7	41.67	51.7	51.6
T_2	2.60	2.37	0.22	0.75	2.14	1.81	148	116	62.3	73.02	68.0	56.0
T_3	2.71	2.02	0.20	0.89	2.25	2.23	308	240	214	85.8	213.3	111.47
T_4	2.41	2.37	0.19	0.74	1.96	1.93	136	119	72.3	36.84	64.0	80.01
T_5	2.37	2.67	0.24	0.89	2.17	2.10	276	229	204	77.35	312.7	120.80
L.S.D.$_{0.05}$	NS	NS	0.0637	0.1344	0.3255	0.2404	71.306	62.105	64.599	33.457	18.474	18.55

T_1: Control, Foliar spray with water
T_2: Foliar spray with Fe + Mn + Zn at 1500 ppm as chelated form
T_3: Foliar spray with Fe + Mn + Zn 3000 ppm as chelated form
T_4: Soil application with Fe + Mn + Zn 1500 ppm as sulphate form
T_5: Soil application with Fe + Mn + Zn 3000 ppm as sulphate form

Table 7. Effect of foliar and soil application of micronutrients in form chelate and sulphate on fruit mineral content of guava trees during 2009 and 2010 growing seasons

Treatments	N%		P%		K%		Fe ppm		Zn ppm		Mn ppm	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
T_1	1.30	1.01	0.243	0.79	1.88	1.06	116.7	122.1	48.54	61.2	7.67	14.6
T_2	1.34	1.35	0.283	0.77	1.82	1.47	199.7	222.1	64.2	73.98	15.33	20.74
T_3	1.48	2.13	0.216	0.86	1.91	1.50	233.0	269.8	119.55	142.8	19.87	25.0
T_4	1.37	2.07	0.233	0.77	2.00	1.47	242.3	212.3	90.17	103.4	11.73	20.5
T_5	1.54	2.36	0.261	0.85	2.12	1.50	357.7	460.4	155.6	258.8	15.67	27.83
L.S.D.$_{0.05}$	NS	NS	NS	NS	NS	0.1971	76.77	61.618	32.13	26.6	2.6445	2.4234

T_1: Control, Foliar spray with water
T_2: Foliar spray with Fe + Mn + Zn at 1500 ppm as chelated form
T_3: Foliar spray with Fe + Mn + Zn 3000 ppm as chelated form
T_4: Soil application with Fe + Mn + Zn 1500 ppm as sulphate form
T_5: Soil application with Fe + Mn + Zn 3000 ppm as sulphate form

CONCLUSION

The obtained results in the present research strongly provide that foliar or soil application of guava trees with mixture of chelated or sulphate (Fe + Zn + Mn) in high rate 3000 ppm added twice annually was the best treatment for enhancing vegetative growth, leaf chlorophyll, fruit number/ tree, fruit weight, yield and fruit quality.

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الملخص العربي

إستجابة أشجار الجوافة صنف بذرى منتخب للتغذية بالعناصر الصغرى وأثر ذلك على جودة الثمار

وفاء على أحمد زكى السيسى

أجرى هذا البحث خلال عامى 2009 و2010 على أشجار جوافة بذرية عمر 15 سنة نامية فى مزرعة خاصة بمنطقة المعمورة شرق الإسكندرية لدراسة تأثير الرش الورقى أو الإضافة الأرضية لمخلوط من (حديد + زنك+ منجنيز) فى صور مخلبية أو صورة كبريتات بتركيزين 1500 جزء فى المليون و 3000 جزء فى المليون على المساحة الورقية والكلورفيل الكلى فى الورقة وعدد الثمار ووزنها والمحصول وجودة الثمار وكذلك المحتوى المعدنى للأوراق والثمار.

وقد أوضحت النتائج أن هناك زيادة معنوية فى المساحة الورقية والكلوروفيل الكلى والمحصول وزناً وعدداً للثمار/ شجرة. وكذلك صفات الثمار ومتوسط وزن الثمرة وطولها وسمك اللب ومحتواها من المواد الصلبة الكلية ومحتواها من فيتامين C والسكريات الكلية والسكريات المختزلة والغير مختزلة، مع انخفاض فى نسبة الحموضة وذلك مقارنة بالكنترول.

وارتبطت أفضل النتائج بالتركيز العالى من مخلوط (الحديد والزنك والمنجنيز) 3000 جزء فى المليون سواء أضيف للتربة بصورة كبريتات أو رشاً على الاوراق بصورة مخلبية مرتين سنوياً.