Effect of Foliar Application With some Micronutrients on 'Florida Prince' Cultivar Peach Tree

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ABSTRACT : This study was carried out during the two successive seasons 2015 and 2016 on five years old 'Florida prince' peach trees (*Prunus persica* L.) budded on '*Nemagard*' peach rootstock, grown in sandy soil under drip irrigation system in a private orchard located at El-Nubaria region, El-Behira Governorate, Egypt. The aims of this research was to investigate the effect of some micronutrients foliar as Boric acid (H_3BO_3), Zinc sulphate ($ZnSO_4$) and Fe-EDTA on yield, fruit quality and elemental composition of 'Florida prince' peach trees. The followed experimental design was randomized complete block design with five replicates. Results indicated that all the foliar application treatments, significantly increased the yield (kg /tree) and fruit weight (g) as compared with control. The highest yield and fruit weight were recorded with 0.2% Fe-EDTA foliar application treatment (99.85 and 104.40 kg/tree, for two seasons) as compared with the control (36.87 and 37.38 kg/tree, respectively). Moreover, all Boric acid, Zinc sulphate and Fe-EDTA foliar treatments increased length (cm), diameter (cm), firmness (Ib/inch^2), total soluble solids (%), acidity (%), and total sugars (%) as compared with control ones during both seasons. On the other hand, A gradual elemental increases in Boron, Iron and Zinc in leaves (%) were recorded with the micronutrient treatments as compared with the control plants.

Key words: 'Florida prince', Peach, Boric, Zinc, Iron, micronutrients, yield, fruit quality.

INTRODUCTION

Peach (*Prunus persica* L.) is one of the most important stone fruits, due to its heavy loading dietetic value and as a rich source of carbohydrate, protein and vitamins especially; A, B and C and some mineral nutrients according to FAOSTAT (2017), Egypt ranges third in the Arab production of peaches. The area cultivated with peach in Egypt is 58800 feddans, and total product of peach fruits is 360723 tons. To expand the peach market and to prolong the time of marketing, some early, mid and late season low chilling peach cultivars such as Florida sun, Florida prince, Desert Red, Early grand and swelling were introduced in the last several years, mainly from the U.S.A. by the Agriculture Development System (Mansour *et al*., 1982; Stino *et al*., 1982 and Shaltout, 1995).

There is strong evidence that zinc is an essential minor element for fungi and higher plants; but, it is found as traces. The low zinc supplies to plants in water cultures prevent moderate growth. Zinc plays an important role in several plant metabolic processes; it activates enzymes and is involved in protein synthesis and carbohydrate, nucleic acid and lipid metabolism (Pahlsson, 1989). Zinc is most important in the flowering and fruit set and the effect of foliar application of zinc on zinc uptake, yield and fruit quality of mango was investigated (Bahadur *et al*., 1998). In addition, Mahrous and El-Fakhrani (2000) mentioned that zinc sulphate significantly increased fruit weight, diameter, firmness and T.S.S. of apricot, meanwhile it decreased fruit acidity when compared with other treatments and the control. Also, Orphanos (2000) reported that apple zinc foliar application during the growing season increased the Zn content of the sprayed leaves even if they were just beginning to grow at the time of spraying. He added that spraying Zn-EDTA when the apical bud was bursting did not increase Zn in leaves produced from the lateral buds.

Boron deficiency causes fruit disorders and cracking or seaming (Benson *et al*., 1983). Kilany and Kilany (1991) working on ‘Anna’ apple and reported that boron sprays significantly increased the shoot length and diameter, boron has been recognized as an essential element for plant growth for more than later sixty years. Also, on ‘Anna’ apple trees, boric acid caused insignificant effect on fruits diameter, length volume and weight, but sprays increased acidity, total sugars and anthocyanin content (Mostafa *et al*., 1999). Moreover, has an important role in fruit quality is boron has an effect on cell wall structure and also has a major effect on cell elongation (Pollen tube) and root growth (Mahnaz *et al* ., 2010).

Iron had an important function in enzymatic systems and chlorophyll formation and consequently increased photosynthesis, which finally increased the yield (Aly *et al.,* 2014). Iron spray was effective in increasing pear vegetative growth. Larue and Johanson (1989) stated that, foliar fertilizers as chelated should be easily absorbed by the plants and rapidly transported and should be easily release their ions to affect the plant of peach, plum nectarine. Pear trees suffer from colorosis on calcareous soil and iron can greatly correct this phenomenon (Westwood, 1993).The aim of this study is to investigate the effect of Zn, B and Fe at different levels of application on yield, fruit quality and leaf mineral content of 'Florida prince' peach trees grown under sandy soil conditions.

MATERIALS AND METHODS

This investigation was conducted during two successive seasons 2015 and 2016 on five years old ‘Florida prince’ peach trees (*Prunus persica* L.) budded on ‘*Nemagard*’ peach rootstock, planted at 4 x 3 meters apart, grown in sandy soil under drip irrigation system in a private orchard located at El-Nubaria region, El-Behira Governortate, Egypt. Fifty trees as uniform as possible were selected for achieving this study. Trees were of normal growth, uniform in vigour and received normal fertilization and cultural practices as scheduled in the farm.

The physical determinations of pH and EC and organic matter % were measured. In addition, chemical determinations were carried on 1:5 soils: water extract, for total nitrogen content in soil (mg/kg), samples of soil were used for extraction of total nitrogen content (mg/kg) using Kjeldahl method. Samples of soil were used for extraction of phosphorus by using sodium bicarbonate method. Phosphorus was determind colorimetrically using the spectrophotometer at wave length of 660 nm according to James *et al*. (1989). Moreover soil samples for extraction of potassium by the distilled water (1:25) extraction. Potassium was determined by using the flame photometry according to James *et al*. (1989). Ca, Mg, Na, K, Cl, total carbonate and SO_4 were determined according to AOAC (1985). The analysis of experimental soil and was illustrated in Tables (1).

Table (1).The physical and chemical properties of the experimental soil

Parameter	0-30 cm	30-60 cm
Mechanical Analysis (%)		
Sand	96	98
Silt	--	--
Clay	4	2
Textural class	Sand	Sand
pH (1:1, water suspension)	8.24	8.53
EC (1:1,water extract), dS/m	0.32	0.30
$CaCO_3$ (%)	2.6	5.0
O.M (%)	0.05	0.09
Soluble cations (meq/L)		
Ca^{2+}	2.72	3.06
Mg^{2+}	1.70	0.34
Na^{+}	1.85	1.63
K^{+}	0.32	0.22
Soluble anions (meq/L)		
HCO^{-}_3	4.86	8.10
Cl-	5.40	4.86
SO^{-}_4	1.45	1.77
Available nutrients (mg/kg)		
Nitrogen (N)	202.61	222.14
Phosphorus(P)	9.5	20.0
Potassium (K)	250	300

Fifty uniform trees, more or less, were selected for this study and all of them were subjected to the same cultural practices during both successive seasons.

The experiment involved the following treatments

1- Control (untreated trees)
2- 0.05 % Boric acid (H_3BO_3).
3- 0.1 % Boric acid (H_3BO_3).
4- 0.2 % Boric acid (H_3BO_3).
5- 0.05 % Zinc sulphate ($ZnSO_4$).
6- 0.1 % Zinc sulphate ($ZnSO_4$).
7- 0.2 % Zinc sulphate ($ZnSO_4$).
8- 0.05 % Fe-EDTA.
9- 0.1 % Fe-EDTA.
10- 0.2 % Fe-EDTA.

Treatments sprayed with Boric acid, Zinc sulphate and Fe-EDTA at two equal doses on the two taken after fruit set, and the month later. The previous treatments were applied and arranged in a randomized complete block design. Each treatment included five replicates with one tree for each replicate. The effect of the previous treatments were investigated via evaluating their influence on the follollowing parameters:

1. Yield

The produced fruit yield on each replicate tree resulting from the applied treatments was expressed as number of fruits/tree and weight of fruits in kg/ tree which was attained at harvest stage.

2. Physical fruit characteristics

Sample of 10 fruits per tree from each replicate was collected randomly at late April in both seasons, and then transported quickly to the laboratory to determine the physical and chemical fruit characteristics.

Average fruit weight (g/ fruit), fruit samples were weighted and the average fruit weight for each replicate was calculated.

Average fruit length (L) and diameter (D), in cm were measured by using hand caliper. **fruit firmness was expressed** as (Ib/inch^2) according to **(Magness and Taylor, 1982).** Flesh firmness was measured in two opposite sides of the fruit using the Magness and Taylor Pressure.

Anthocyanin content (mg/100 g, f.w): anthocyanin content was determined at the stage of coloration (mg/100g fresh weigh) according to Rabino *et al*. (1977).

3. Chemical fruit characteristics

Regarding chemical fruit characteristics, samples of 10 fruits from each replicate was picked randomly at harvest to determine the following parameters:

Total soluble solids (TSS %), was used to determine the percentage of TSS by hand refractometer according to Chen and Mellenthin (1981).

Total acidity (%) was determined as in fruit juice according to Chen and Mellenthin (1981). Five milliliters from the obtained juice were used to determine the titratable acidity.

Total sugars (%); were determined in fresh fruit samples according to Malik and Singh (1980). Sugars were extracted from 5 gram fresh weight and determined by phenol sulfuric and Nelson arsenate – molybadate colorimetric methods for total and reducing sugars, respectively. The non-reducing sugars were calculated by the difference between total sugars and reducing sugars.

Boron, iron and zinc concentration were determined in leaves in both seasons by 20 leaves/tree samples which were taken from each treatments. The samples were washed with tap water and distilled water, and then oven dried at 70°C to constant weight and then ground. To determine the leaf mineral contents, ground material of each sample was digested with H_2SO_4 and H_2O_2 according to Wolf (1982). In the digested material, micronutrients (Fe, Zn and B) leaf contents were determined by Perkin Elmer Atomic Absorption Spectrophotometer according to Carter (1993). Boron was determined colorimetrically by the carmine method according to Hatcher and Wilcox (1950). The concentrations of B, Fe and Zn were expressed as mg/kg , on dry weight basis.

4. Statistical analysis

Results of the measured parameters were subjected to computerized statistical analysis using RCBD for analysis of variance (ANOVA) and means of treatments were compared using L.S.D at 0.05 probability level according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

1. Yield components:

1.1 Number of fruits per tree:

The results representing the effect of the above mentioned treatments on number of fruits per tree ‘Florida prince’ peach trees during both 2015 and 2016 seasons are show in Table (2). In general, the obtained results indicated that all foliar application treatments, significantly ($p \leq 0.05$) increased number of fruit per tree as compared with the control during both experimental seasons. Foliar application with 0.2 % Fe-EDTA treatments, gave rise to the highest increment in number of fruits per tree, followed by 0.1 % Fe-EDTA foliar treatment in the first seasons and 0.2% $ZnSO_4$ treatment in second seasons as compared with the control during both 2015 and 2016 seasons.

A gradual increase in number of fruits per tree was observed with trees treated with 0.2 % Fe-EDTA foliar treatments (851.33 and 874.67, each in turn) as compared with the control (482.67 and 487.90, each in turn). And, 0.1 % Fe-EDTA foliar application treatment (764.44), followed by 0.2% $ZnSO_4$ foliar application treatment (757.92), and 0.1 % H_3BO_3 foliar application treatment (747.35) in the first seasons as compared with the control (482.67). While, in the second season 0.1 % Fe- EDTA (771.67), and 0.1 % Boric acid foliar application treatments (763.67) as compared with the control (487.90).

The increment of number of fruit per tree comparing to check plot may be due to the direct effects of Khalifa *et al*. (2009) on ‘Anna’ apple trees sprayed with boric acid increase the average number of fruit per tree and yield. Also, Aly *et al.* (2014) on ‘Anna’ apple trees who reported that the treatment of boric acid significantly increased the number of fruit per tree. Also, Abd El-Rahman (2019) on ‘Canino’ apricot trees found that all foliar boric acid application significantly increased number of fruits per tree as compared with the control during both experimental seasons.

1.2 Fruit weight (g):

As for the effects of zinc sulphate, boric acid and Fe- EDTA foliar treatments on fruit weight of ‘Florida prince’ peach trees during both 2015 and 2016 seasons, results in Table (2) showed that all treatments, ($p \leq 0.05$) increased fruit weight as compared with the control treatment. 0.2 % Fe-EDTA foliar application treatment gave rise to the highest fruit weight (117.33 and 119.33 g each in turn), followed by 0.1 % Fe-EDTA foliar treatment (100.40 and 101.33 g each in turn), and 0.05 % Fe-EDTA foliar treatments (99.00 and 101.00 g each in turn), and 0.1% $ZnSO_4$ foliar application treatment (92.67 and 94.67 g) as compared with the control (76.33 and 76.67 g) during both 2015 and 2016 seasons. Generally, foliar application with Fe-EDTA caused higher fruit weigh during both 2015 and 2016 seasons as compared with the control.

These results are in agreement with those reported by Asad *et al.* (2013) they found that, foliar applications of micronutrients on ‘Le- Conte’ pear trees increased yield as kg/tree and fruit weight. Also, Aly *et al*. (2014) found that significant difference was achieved by foliar application of H_3BO_3 treatments on average fruit weight (g/ fruit) of ‘Anna’ apple trees in both seasons.

1.3 Yield (kg/tree):

The results concerning the effect of zinc sulphate, boric acid and Fe-EDTA foliar treatments on yield (kg/tree) of 'Florida prince' peach trees during both 2015 and 2016 seasons, listed in Table (2). The average values of both experimental seasons indicated that all treatments, significantly ($p \leq 0.05$) increased yield (kg/tree) as compared with the control. It was evident that the application of 0.2 % Fe-EDTA foliar application treatment, take about the highest increment in yield (kg), followed by 0.1 % Fe-EDTA foliar treatment as compared with the control during both seasons 2015 and 2016.

Increasing in yield (kg/tree) was observed with trees treated with 0.2 % Fe-EDTA foliar application treatment (99.85 and 104.40 kg, each in turn) and 0.1 % Fe-EDTA foliar application treatment (76.82 and 78.14 kg, each in turn), followed by 0.1% $ZnSO_4$ foliar application treatment (69.34 and 71.91 kg, each in turn) as compared with the control (36.87 and 37.38 kg, each in turn) during both 2015 and 2016.

These results are in agreement with those reported by Wojcik (2002) on 'junagod' apple fruits, they found that increasing B concentration decreased fruit weight and when tree yield was high, mean fruit weight was can consistently lower. Also, Aly *et al.* (2014) on 'Anna' apple trees who noticed that the treatment of boric acid significantly increased yield (kg/tree) as compared with the control treatment.

Table (2).The influence of the foliar application of zinc, boron and iron on number of fruits/tree, fruit weight (g) and yield (kg/tree) of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	Number of fruits/ tree		Fruit weight (g)		Yield (kg/tree)	
	2015	2016	2015	2016	2015	2016
1- Control	482.67^{d}	487.90^{f}	76.33^{c}	76.67^{d}	36.87^{f}	37.38^{g}
2- 0.05 % $ZnSO_4$	652.33^{c}	682.67^{c}	85.50^{bc}	87.50^{bcd}	55.73^{de}	59.75^{def}
3- 0.1 % $ZnSO_4$	747.08^{b}	760.00^{b}	92.67^{bc}	94.67^{bc}	69.34^{bc}	71.91^{bc}
4- 0.2 % $ZnSO_4$	757.92^{b}	776.67^{b}	88.00^{bc}	90.00^{bcd}	66.67^{bcd}	69.89^{bcd}
5- 0.05% H_3BO_3	632.44^{c}	637.33^{e}	78.33^{c}	80.33^{cd}	49.53^{e}	51.21^{f}
6- 0.1 % H_3BO_3	747.35^{b}	763.67^{b}	85.00^{bc}	87.00^{bcd}	63.53^{cd}	66.43^{cde}
7- 0.2 % H_3BO_3	655.67^{b}	656.00^{de}	87.27^{bc}	88.61^{bcd}	57.22^{de}	58.13^{ef}
8- 0.05 % Fe-EDTA	647.33^{c}	667.67^{cd}	99.00^{b}	101.00^{b}	63.92^{cd}	67.58^{bcde}
9- 0.1 % Fe-EDTA	764.33^{b}	771.67^{b}	100.40^{ab}	101.33^{b}	76.82^{b}	78.14^{b}
10- 0.2 % Fe-EDTA	851.33^{a}	874.67^{a}	117.33^{a}	119.33^{a}	99.85^{a}	104.40^{a}

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

2. Fruit physical parameters:

2.1 Fruit length (cm):

The results representing the effect of above mentioned treatment on fruit length (cm) of 'Florida prince' peach trees was calculated and tabulated in Table (3).The obtained results indicated that all treatments, significantly ($p \leq 0.05$) increased fruit length as compared with the control during both seasons 2015 and 2016.

A gradual increase in fruit length was observed trees treated with 0.1 % Fe-EDTA foliar application treatment (5.68 cm), and for the 0.05 % $ZnSO_4$ foliar application treatment (5.64 cm), also 0.2 % Fe-EDTA foliar treatment (5.62 cm), follower by 0.2 % Zinc sulphate foliar application treatment (5.61 cm) in the first seasons. While in the second seasons, a gradual increase was observed with trees treated with 0.1 % Fe-EDTA foliar application treatment (5.77 cm), and 0.2 % Fe-EDTA foliar application treatment (5.70 cm), and 0.05 % $ZnSO_4$ foliar application treatment (5.67 cm), followed by 0.1 % Boric acid foliar treatment (5.58 cm) as compared with the control (5.12 cm).

The obtained results were previously explained by Asad *et al.* (2013) who mentioned that foliar applications of micronutrients on 'Le- Conte' pear trees increased fruit length, diameter. Also, Aly *et al*. (2014) noticed that foliar application of 0.3 % H_3BO_3 achieved the highest average fruit length as compared with the control during both experimental seasons. Also, Abd El-Rahman (2019) found that boric acid at 1.5 % g/l application on 'Canino' apricot trees treatment significantly increased fruit length as compared with the control during both experimental seasons.

2.2 Fruit diameter (cm):

Results express the effect of experimental treatments on fruit diameter (cm) of 'Florida prince' peach trees during both 2015 and 2016 seasons are showed in Table (3). The obtained results indicated that all Zinc sulphate, Boric acid and Fe-EDTA foliar treatments, significantly ($p \le 0.05$) increased fruit diameter as compared with the control during both seasons 2015 and 2016.

The increase in fruit diameter was observed with trees treated with 0.05 % Fe-EDTA foliar application treatment (5.37 cm), and 0.1 % H_3BO_3 foliar application treatment (5.29 cm), followed by0.2 % H_3BO_3 foliar application treatment (5.28 cm), also 0.2 % Fe-EDTA application treatment (5.24 cm) as compared with the control (4.54 cm) in the first seasons. while in the second seasons a gradual increase was observed with trees treated with 0.1 % Fe-EDTA and 0.05 % Fe-EDTA foliar application treatments (5.43 cm and 5.43 cm), and 0.1 % H_3BO_3 treatment (5.36 cm), and 0.2 % Fe-EDTA foliar application treatment (5.34 cm), followed by 0.2 % $ZnSO_4$ foliar application treatment (5.25 cm) as compared with the control (4.63).

The percentage increase of fruit diameter comparing to check my be due to the direct effects of these results are in agreement with those reported by Asad *et al.* (2013) reported that, foliar applications of micronutrients on 'Le-Conte' pear trees increased yield as kg/tree, fruit weight, diameter, firmness. Also, boron and potassium increase the rate of transport to actively growing regions and also in developing fruits.

2.3 Fruit firmness (lb/inch^2):

In regard to the results concerning the effect of studied foliar applications with boric acid, zinc sulphate and Fe-EDTA foliar treatments on the fruit firmness (lb/inch^2) of 'Florida prince' peach trees during both 2015 and 2016 seasons are listed in Table (3). The average values of both experimental seasons indicated that all foliar application treatments, significantly ($p \le 0.05$)

increased fruit firmness as compared with the control during both experimental seasons.

The increase in fruit firmness (Ib/inch^2) was observed with trees treated with 0.2% $ZnSO_4$ foliar application treatment (32.11),0.2 % Fe-EDTA foliar treatment (31.19) and 0.1 % Fe-EDTA foliar treatment (25.78) and 0.05 % $ZnSO_4$ foliar application treatment (23.68) as compared with the control (17.30) While, in second seasons 0.2 % Fe-EDTA foliar treatment (32.26) and 0.1 % $ZnSO_4$ foliar application treatment (32.25) and 0.1 % Fe-EDTA treatment (26.33) and 0.05 % $ZnSO_4$ foliar application treatment (25.42) as compared with the control (18.92).

The increase in firmness might be related to the increase of fruit calcium content. Also, Khalifa *et al*. (2009) found that increasing B concentration increased fruit firmness of 'Anna' apple trees. Also, Asad *et al*. (2013) reported that, foliar applications of micronutrients on 'Le-Conte' pear trees increased yield as kg/tree, fruit weight, diameter, firmness, TSS and acidity, while decreased total sugars.

Table (3). The influence of the foliar application of zinc, boron and iron on Fruit length (cm), fruit diameter (cm) and fruit firmness (lb/inch^2)of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	Fruit Length (cm)		Fruit diameter (cm)		Fruit firmness (lb/inch^2)	
	2015	2016	2015	2016	2015	2016
1- Control	5.07^{b}	5.12^{b}	4.54^{b}	4.63^{b}	17.30^{c}	18.92^{bc}
2- 0.05 % $ZnSO_4$	5.64^{a}	5.68^{a}	5.19^{a}	5.25^{a}	23.68^{b}	25.42^{abc}
3- 0.1 % $ZnSO_4$	5.25^{ab}	5.45^{ab}	5.07^{a}	5.08^{a}	32.11^{a}	32.25^{a}
4- 0.2 % $ZnSO_4$	5.61^{a}	5.57^{a}	5.15^{a}	5.25^{a}	18.80^{c}	20.42^{bc}
5- 0.05% H_3BO_3	5.35^{ab}	5.38^{ab}	5.12^{a}	5.12^{a}	17.22^{c}	18.56^{c}
6- 0.1 % H_3BO_3	5.52^{ab}	5.58^{a}	5.29^{a}	5.36^{a}	17.18^{c}	18.53^{c}
7- 0.2 % H_3BO_3	5.44^{ab}	5.50^{ab}	5.28^{a}	5.23^{a}	16.95^{c}	18.26^{c}
8- 0.05 % Fe-EDTA	5.52^{ab}	5.47^{ab}	5.37^{a}	5.43^{a}	21.51^{bc}	22.33^{bc}
9- 0.1 % Fe-EDTA	5.68^{a}	5.77^{a}	5.17^{a}	5.43^{a}	25.78^{b}	26.33^{ab}
10- 0.2 % Fe-EDTA	5.62^{a}	5.70^{a}	5.24^{a}	5.34^{a}	31.19^{a}	32.26^{a}

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

3. Fruit chemical parameters:

3.1 Total soluble solids (%):

In concerning with influence of boric acid, zinc sulphate and Fe-EDTA foliar application treatments on the total soluble solids of 'Florida prince' peach trees during both 2015 and 2016 seasons, data in Table (4) cleared that all treatments, significantly ($p \leq 0.05$) increased total soluble solids as compared with the control during both experimental seasons. A gradual increase in total soluble solids was observed with trees treated with 0.2 % H_3BO_3 foliar treatment (11.33 and 12.33 %, each in turn), and 0.1 % H_3BO_3 foliar treatment (11.04 and 12.00%, each in turn), and 0.1 % $ZnSO_4$ treatment (10.81 and 11.75 %, serially), followed by 10.67 and 11.67, respectively) as compared with the control during both experimental seasons.

The percentage increase of total soluble solids (%) comparing to check may be due to the direct effects of these results are in agreement with those reported by Mahrous and El-Fakhrani (2000) mentioned that zinc sulphate increased significantly T.S.S. of apricot. Also, Wally *et al*. (2012) found that spraying chelated zinc at 0.2% +0.5% urea on ‘Canino’ apricot recorded the highest yield and improved fruit quality as compared with control. Also, Abd El-Rahman (2019) on ‘Canino’ apricot trees found that boric acid at 0.5, 1 and 1.5 g/l application treatments significantly increased total soluble solids as compared with the control during both experimental seasons.

3.2 Acidity (%):

Results concerning the effect of foliar with zinc sulphate, boric acid and Fe-EDTA application treatments on the acidity (%) of ‘Florida prince’ peach trees during both 2015 and 2016 seasons are listed in Table (4). Fe-EDTA treatments, significantly ($p \leq 0.05$) increased acidity (%) as compared with the control during both experimental seasons, while no significantly differences were recorded between Zinc sulphate and Boric acid treatments as compared with the control during both 2015 and 2016 seasons.

A gradual increase in acidity (%) was observed with trees treated with 0.2 % Fe-EDTA foliar treatment (0.60 and 0.62 %, each in turn) and 0.1 % Fe-EDTA foliar treatment (0.59 and 0.61 % serially), followed by 0.05 % Fe-EDTA foliar treatment (0.56 and 0.57 %, respectively) as compared with the control (0.52 and 0.52%, each in turn) during both 2015 and 2016 seasons. But, no significantly differences were recorded between $ZnSO_4$ and H_3BO_3 foliar treatments as compared with the control during both 2015 and 2016 seasons.

The percentage increase of acidity (%) comparing to check plot may be due to the direct effects as reported by Mahrous and El-Fakhrani (2000) mentioned that zinc sulphate increased significantly T.S.S. of apricot; meanwhile it decreased fruit acidity as compared with other treatments and the control. Also, Aly *et al*. (2012) on ‘le-Conte’ pear trees found that all boric acid concentrations decrease acidity % as compared with the control. Abd El-Rahman (2019) on ‘Canino’ apricot trees reported that a gradual decrease in fruit juice acidity was observed with trees treated with boric acid at 1.5 g/l treatment as compared with the control during both experimental seasons.

3.3 Anthocynin (mg/100 g f.w.):

In concerning the effect of zinc sulphate, Fe-EDTA and boric acid foliar treatments on anthocynin of ‘Florida prince’ peach during the both 2015 and 2016 seasons, are listed in Table (4). The results of both experimental seasons indicated that, all treatments, significantly ($p \leq 0.05$) increased anthocynin as compared with the control, while no significantly between the Fe-EDTA foliar treatment and control during both 2015 and 2016 seasons.

A gradual increase in anthocyanin was observed with trees treated with 0.2 % H_3BO_3 foliar treatment (20.91 and 22.84 mg/100g f.w, each in turn), and 0.1 % H_3BO_3 foliar treatment (20.16 and 21.97 mg/100g f.w, serially), followed by 0.05 % H_3BO_3 foliar treatment (19.13 and 21.02 mg/100 g f.w, respectively) and 0.2% $ZnSO_4$ foliar treatment (18.61 and 20.58 mg/100 g f.w, each in turn) as compared with the control (17.65 and 19.54 mg/100 g f.w.) during both experimental seasons.

The percentage increase of anthocynin comparing to check plot may be due to the direct effects as reported by Aly *et al*. (2014) who found that increasing rates of K and B as foliar application gradually led to increasing content of anthocynin (mg/100g) significantly in ‘Anna’ apple fruits as all remainder and control treatments in both seasons.

3.4 Total sugars (%):

The results given in Table (4) represent the effect of used treatments on total sugars (%) of ‘Florida prince’ peach during the both studied seasons. The results indicated that boric acid and zinc sulphate foliar application treatments, significantly ($p \leq 0.05$) increased total sugars as compared with the control. While, no significant effect recorded between the Fe-EDTA treatment and control treatment during both 2015 and 2016 seasons.

A gradual increase in fruit total sugars was observed with trees treated with 0.2 % H_3BO_3 foliar treatment (7.44 and 8.07 %, each in turn), and 0.2% $ZnSO_4$ foliar treatment (6.89 and 7.86%, each in turn) as compared with the control (6.63 and 7.54 %, each in turn), and increase in fruit total sugars was observed with trees treated with 0.05 % $ZnSO_4$ foliar treatment (6.88%) and 0.1 % H_3BO_3 foliar treatment (6.85 %) in the first seasons as compared with the control (6.63%). While in the second seasons increase in fruit total sugars was observed with trees treated with 0.1 % H_3BO_3 foliar treatment (7.83%), and 0.05 % $ZnSO_4$ foliar treatment (7.74%) as compared with the control (7.54%).

The percentage increase of total sugars (%) comparing to check plot may be due to the direct effects as reported by Khalifa *et al.* (2009) on ‘Anna’ apple fruits who reported that increasing B concentration increased sugars in fruit. Also, Aly *et al* .(2014) on ‘Anna’ apple fruits found that the application of Ca or Zn did not affect significantly on total sugars %, while foliar application of H_3BO_3 treatments significantly increased the total sugars % in fruits as compared with the control treatment in both experimental seasons. Also, Abd El-Rahman (2019) on ‘Canino’ apricot trees reported that 1.5 g/l gave the highest treatments on total sugars (%) in two seasons (2017 and 2018) as compared with the control during both experimental seasons.

Table (4). The influence of the foliar application of zinc, boron and iron on TSS (%), acidity (%), anthocynin (mg/100g.f.w.) and total sugars (%) of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	TSS (%)		Acidity (%)		Anthocynin (mg/100g.f.w.)		Total sugars (%)	
	2015	2016	2015	2016	2015	2016	2015	2016
1- Control	8.58^{e}	8.50^{d}	0.52^{c}	0.52^{c}	17.65^{d}	19.54^{d}	6.63^{b}	7.54^{de}
2- 0.05 % $ZnSO_4$	9.83^{d}	10.67^{c}	0.48^{d}	0.49^{d}	17.84^{d}	19.76^{d}	6.88^{b}	7.74^{bc}
3- 0.1 % $ZnSO_4$	10.81^{abc}	11.75^{abc}	0.46^{de}	0.47^{de}	17.81^{d}	19.70^{d}	6.78^{b}	7.69^{c}
4- 0.2 % $ZnSO_4$	10.33^{bcd}	11.33^{abc}	0.46^{de}	0.47^{de}	18.61^{c}	20.58^{c}	6.89^{b}	7.86^{b}
5- 0.05% H_3BO_3	10.33^{bcd}	11.33^{abc}	0.48^{d}	0.49^{d}	19.13^{c}	21.02^{c}	6.84^{b}	7.73^{bc}
6- 0.1 % H_3BO_3	11.04^{ab}	12.00^{ab}	0.45^{e}	0.46^{e}	20.16^{b}	21.97^{b}	6.85^{b}	7.83^{b}
7- 0.2 % H_3BO_3	11.33^{a}	12.33^{a}	0.41^{f}	0.42^{f}	20.91^{a}	22.84^{a}	7.44^{a}	8.07^{a}
8- 0.05 % Fe-EDTA	8.83^{e}	9.17^{d}	0.56^{b}	0.57^{b}	17.37^{d}	19.26^{d}	6.69^{b}	7.63^{cd}
9- 0.1 % Fe-EDTA	10.00^{cd}	11.00^{bc}	0.59^{a}	0.61^{a}	17.31^{d}	19.23^{d}	6.60^{b}	7.43^{e}
10- 0.2 % Fe-EDTA	10.67^{abcd}	11.67^{abc}	0.60^{a}	0.62^{a}	17.24^{d}	19.12^{d}	6.17^{c}	7.08^{f}

Means not sharing the same letter (s) within each column for each are significantly different at 0.05 level of probability.

4. Effect of foliar application on some leaf micronutrients (B, Fe and Zn mg/kg) contents:

4.1 Boron (mg/kg)

The results given in Table (5) represent the effect of the tested foliar treatments on leaf boron of 'Florida prince' peach during the both studied seasons. The results indicated that zinc sulphate, boric acid and 0.05 Fe-EDTA foliar treatments, significantly increased leaf boron as compared with the control during both seasons of study. While, no significantly differences were recorded among the two foliar applications of 0.1% and 0.2 % Fe-EDTA foliar treatments and control treatment during both experimental seasons.

A gradual increase in leaf boron with trees treated with 0.2 % H_3BO_3 foliar treatment (95.19 mg/kg), and 0.2 % $ZnSO_4$ foliar treatment (87.99 mg/kg), followed by 0.2 % H_3BO_3 foliar treatment (86.76 mg/kg), and 0.1 % $ZnSO_4$ foliar treatment (76.76 mg/kg) as compared with the control (73.75 mg/kg) in the first season. While, in second season a gradual increase in leaf boron with trees treated with 0.2 % H_3BO_3 foliar treatment (96.08 mg/kg), 0.2 % $ZnSO_4$ foliar treatment (88.85 mg/kg), also 0.1 % H_3BO_3 foliar treatment (87.56 mg/kg), and 0.05 % H_3BO_3 foliar treatment (82.79 mg/kg) as compared with the control (74.56 mg/kg).

The percentage increase of boron in leaves comparing to check plot may be due to the direct effects as reported by Kassem and Marzouk (2004) on mango who found that spraying Zn increased leaf K, Ca, Mg and Zn contents, while B sprays increased leaf K, Ca, Mg and B leaf contents. Also, Abd El-Megeed and Wally (2007) on 'Le-conte' pear trees sprayed with H_3BO_3 found that treatment increased leaf boron content as compared with the control treatments. The same conclusion was reported by Aly *et al*. (2014) on 'Anna' apple trees that B treatment increased leaf boron content (mg/kg) as compared with control treatment. Also, Abd El-Rahman (2019) on 'Canino' apricot trees found that a gradual increase in leaf boron (mg/kg) was observed with trees treated with boric acid at 1.5 g/l application treatment as compared with the control during both experimental seasons.

4.2 Iron (mg/kg):

Results concerning the effect of foliar application with zinc sulphate, Fe-EDTA and boric acid on the leaf iron of 'Florida prince' peach during the both 2015 and 2016 seasons are listed in Table (5). In general, the obtained results indicated that Zinc sulphate, Fe-EDTA and Boric acid foliar treatments application, significantly ($p \leq 0.05$) increased leaf iron content as compared with the control during both seasons of study. But, no significantly differences were recorded among the 0.2 % H_3BO_3 foliar in the second seasons as compared with the control during both seasons study.

A gradual increase in iron leaf was observed with trees treated 0.2 % Fe-EDTA foliar treatment (127.97 and 131.71 mg/kg, each in turn) and 0.2 % $ZnSO_4$ foliar treatment (127.27 and 128.13 mg/kg, serially), followed by 0.1 % Fe-EDTA foliar treatment (126.27 and 128.10 mg/kg, each in turn) as compared with the control (120.24 and 122.21 mg/kg, each in turn) during both 2015 and 2016 seasons. The percentage increase of iron in leaf comparing to check plot may be due to the direct effects of 'Anna' apple trees were sprayed during 2005 and 2006 seasons with Zn, Mn, Mn and Fe sulfate at 1.0% as well as Boric acid at 400 mg/L, Ascorbic at 1000 mg/L and Vitamin B complex at 100 mg/L. Spraying with $FeSO_4$, Boric and Vitamin B complex increased leaf Fe, Zn and Mn content (Salwa and Khafagy, 2008).

4.3 Zinc (mg/kg):

In concerning with influence of zinc sulphate, Fe-EDTA and boric acid foliar applications treatments on the leaf zinc of 'Florida prince' peach during the both 2015 and 2016 seasons, results in Table (5) showed that zinc sulphate, Fe-EDTA and boric acid on the leaf zinc treatments, significantly ($p \leq 0.05$) increased leaf zinc as compared with the control during both seasons of study. But, no significantly differences were recorded among the 0.2 % Fe-EDTA foliar treatment and control treatment during both experimental seasons.

The increase in leaf zinc was observed with trees treated with 0.2% $ZnSO_4$ foliar treatment (32.64 and 34.01 mg/kg, each in turn) and 0.1 % $ZnSO_4$ foliar treatment (29.03 and 30.62 ppm, serially), followed by 0.05 % $ZnSO_4$ foliar treatment (25.07 and 26.13 mg/kg, each in turn) as compared with the control (20.27 and 21.69 mg/kg, each in turn) during both seasons of study.

The percentage increase of zinc in leaf comparing to check plot may be due to the direct effects as reported by Kassem and Marzouk. (2004) on mango who found that Spraying Zn increased leaf K, Ca, Mg and Zn contents, while B sprays increased leaf K, Ca, Mg and B leaf contents. Also, Hasani *et al*. (2012) studied that effects of foliar sprays of zinc and manganese sulfates on leaf nutrients concentration of pomegranate, foliar sprays of Zn significantly increased Zn, but decreased Mn and P concentrations in the leaves.

Table (5). The influence of the foliar application of zinc, boron and iron on leaf B, Fe and Zn content of 'Florida prince' peach trees during 2015 and 2016 seasons

Treatments	B (mg/kg)		Fe (mg/kg)		Zn (mg/kg)	
	2015	2016	2015	2016	2015	2016
1- Control	73.75^{g}	74.56^{h}	120.24^{f}	122.21^{f}	20.27^{f}	21.69^{g}
2- 0.05 % $ZnSO_4$	75.85^{f}	76.70^{f}	121.41^{e}	122.45^{f}	25.07^{c}	26.13^{c}
3- 0.1 % $ZnSO_4$	76.76^{e}	78.06^{e}	124.11^{c}	126.07^{c}	29.03^{b}	30.62^{b}
4- 0.2 % $ZnSO_4$	87.99^{b}	88.85^{b}	127.27^{b}	128.13^{b}	32.64^{a}	34.01^{a}
5- 0.05% H_3BO_3	81.79^{d}	82.79^{d}	124.39^{c}	124.87^{d}	21.14^{e}	22.20^{f}
6- 0.1 % H_3BO_3	86.76^{c}	87.56^{c}	122.58^{d}	123.45^{e}	22.75^{d}	23.75^{e}
7- 0.2 % H_3BO_3	95.19^{a}	96.08^{a}	120.79^{ef}	121.32^{g}	22.69^{d}	24.73^{d}
8- 0.05 % Fe-EDTA	74.37^{g}	75.46^{g}	123.55^{cd}	124.67^{d}	20.52^{f}	20.20^{h}
9- 0.1 % Fe-EDTA	72.15^{h}	73.09^{i}	126.27^{b}	128.10^{b}	21.34^{e}	22.10^{fg}
10- 0.2 % Fe-EDTA	69.19^{i}	70.00^{j}	127.97^{a}	131.71^{a}	19.65^{g}	18.61^{i}

Means not sharing the same letter (s) within each column are significantly different at 0.05 level of probability.

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الملخص العربى

تأثير الرش ببعض العناصر الصغرى على أشجار الخوخ صنف ' فلوريدا برنس'

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أجريت هذه الدراسة خلال موسمى ٢٠١٥ و٢٠١٦ على أشجار الخوخ صنف 'فلوريدا برنس' مطعومة على أصل الخوخ نيماجارد عمرها ٥ سنوات منزرعة فى تربة رملية تروى بنظام الرى بالتنقيط بمزرعة خاصة فى منطقة النوبارية بمحافظة البحيرة – مصر. تهدف الدراسة إلى معرفة تأثير الرش ببعض العناصر الصغرى على أشجار الخوخ صنف 'فلوريدا برنس' وذلك على المحصول وجودة الثمار ومحتوى الأوراق من العناصر وكان التصميم الإحصائى المستخدم هوالقطاعات العشوائية الكاملة وأظهرت النتائج أن جميع المعاملات السمادية أدت إلى زيادة معنوية فى المحصول (كجم/شجرة) مقارنة بالكنترول. بالإضافة إلى ذلك أدى إستخدام الرش ٠,٢ % حديد مخلبى إلى زيادة معنوية فى المحصول الكلى بالكجم (٩٩,٨٥ و ١٠٤,٤٠ كجم/ شجرة) بالتوالى مقارنة بالكنترول (٣٧,٣٨ و ٣٦,٨٧ كجم/ شجرة) بالترتيب خلال موسمى الدراسة. علاوة على ذلك أدت كل معاملات الرش بكبريتات الزنك وحمض البوريك والحديد المخلبى إلى زيادة معنوية فى طول وعرض وصلابة الثمار ونسبة المواد الصلبة الذائبة الكلية والحموضة ونسبة السكريات الكلية مقارنة بمعاملة الكنترول خلال موسمى الدراسة ٢٠١٥ و ٢٠١٦.