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# Improving Productivity and Fruit Quality of Ferehy Date Palm Cultivar under Siwa Oasis Conditions.

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THIS study was conducted during two successive seasons (2017 and 2018) at Siwa Research Station in Tigzerti farm, Desert Research Center, Siwa oasis, Matrouh Governorate, Egypt. The aim of this research was to investigate the effect of magnetic iron, licorice extract and garlic extract on productivity, fruit quality and leaf minerals content of Ferehy date palm under salinity stress. In this experiment, four treatments of magnetic iron were applied to soil in the winter [0 ($Fe_0$), 250 g ($Fe_1$), 500 g ($Fe_2$) and 750 g ($Fe_3$)], besides spraying with licorice extract and garlic extract (as natural growth stimulants), as follows: cont.: control treatment, $L_1$: licorice extract at 3g/l, $L_2$: licorice extract at 5g/l, $G_1$: garlic extract at 2% and $G_2$: garlic extract at 4%. Investigated trees were sprayed three times along each season (after fruit set, one month later from fruit set and two months later from fruit set). The obtained results revealed that magnetic iron at 750 g ($Fe_3$) was better than the other treatments of iron in all parameters. In addition, $G_2$under $Fe_3$ recorded the highest fruit set, bunch weight, yield, fruit weight and fruit flesh weight. While $G_2$ and $L_2$ under $Fe_3$ gave the highest fruit flesh %, fruit length, fruit diameter, total soluble solids, reducing sugars, non-reducing sugars, total sugars, leaf nitrogen, phosphorus , potassium, iron content and decreased total acidity and tannins content. Furthermore, it is clearly appear that EC, pH, Cl and Na in the soil were decreased, when added magnetic iron in high level ($Fe_3$) in both seasons.

**Keyword**: Date palm, Magnetic iron, Garlic extract, Licorice extract, Siwa Oasis.

## Introduction

Date palm (*Phoenix dactylifera* L) accounts for more than 1500 cultivars around the world. Date palm is one of the oldest fruit trees in the world. Moreover, it's a tree regards to the tropical and subtropical fruits zone. In addition, to its commercial and nutritional value, the date palm as a minimum water demand, tolerates harsh weather, and tolerates high levels of salinity (FAO, 1982). On the other hand, increasing soil salinity is starting to show negative impact on the date palm agro-ecosystem in arid region, especially in the Middle East. A serious attention is needed to maintain the diversity and growth of such plant in the arid regions. Salt-affected soil is a worldwide problem, however, it is more common in arid and semi-arid regions because of high evaporation rates and lack of fresh water resources that is required to leach salts. As water evaporates from the soil surface, the salts move upward to the soil surface but stay within or on the soil (Miller & Donahue, 1990). In many irrigated lands, salts dissolve in the irrigation water leading to accumulate of salts in the soil.

Siwa oasis lies in the western desert of Egypt, 300 km south of the Mediterranean coast and the closest cityis Marsa Matruh, and about 70 km east of the Libyan border. Siwa is situated in a depression about 50 km in length and 10 km wide, 20 meters below sea level. In Siwa, the date palm constitutes the main cash crop of the oasis (Battesti, 2013). These arid regions are characterized by long, hot summers, with or very little to no rainfall and low relative humidity during the ripening period. Generally, date palm tree of the oasis

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are in three types according to its fruit moisture content, i.e. dry, semi dry and soft. Ferehy is a dry cultivar grown in Siwa oasis (Hussein, et al., 2001(and adapted to the local environmental conditions. Unfortunately, approximately 50 % of the oases conducive to cultivation of date palms are confronted with soil fertility problems and hence have deficient productivity. Water and soil salinization are the main factors responsible for the low agricultural productivity of these oases. The soil quality degradation is a serious problem in Siwa oasis. Soil salinization, assessed as the increase in concentration of dissolved salts in soil, consequence of several factors including the application of saline water for irrigation (due to the shortage of fresh water resources) and inadequate drainage activities is a serious cause of this degradation (Nachtergaele et al., 2011). Moreover, a significant decline in growth is expected when the EC of irrigation water exceeds 9 dS m-1 that may reach up to 50% with water EC 18 dS m-1 (in sandy soil with very good drainage) (Alrasbi et al. 2010). Many studies proved that unsuitable soil types badly affect date palm growth, inhibit root growth, decrease productivity and fruit quality. The negative effect could be attributed to that salinity stress induces an impact growth and productivity of date palm, and decreases the net photosynthesis and chlorophyll levels of date palm (Bacha & Abo Hassan, 1983 and Alhammadi & Kurup, 2012).

Magnetic iron ($Fe_3O_4$) is a natural row rock that has very high iron content with a black or brownish-red color. Magnetite iron ore is affecting plant growth, especially under salt conditions. Magnetite may be play an important role in cations uptake capacity and has a positive effect on immobile plant nutrient uptake (Mansour, 2007). Eman et al. (2010) indicated that, applications of 1000 g magnetite at December induced the highest values of yield and leaf mineral content of Le-Conte pear trees The higher rates of magnetite significantly increased growth, yield, fruit quality and leaf mineral content (Ismail et al., 2010) on Superior grapevines (Hoda et al., 2013) on orange.

The licorice plant (*Glycyrrhizaglabra* L.) contains many chemical compounds without side effects on human and the environment. Licorice extract contains protein and amino acid (Asparagin), monosaccharide (glucose, fructose, sucrose and maltose), lignins, tannins, starch, choline, phytosterols, different types of vitamins such as B1, B2, B3, B6, C, E, biotin, folic acid, pantothenic acid, many mineral compounds (aluminum, calcium, iron, magnesium, cobalt, zinc, phosphorus, sodium, silicone, potassium and stannous) and bitter principles (Arystanovaet al., 2001). In addition, Hussein, (2008) found that spraying date palm with licorice extract at 5g/L. enhanced the fruit quality. Sheren and Eman (2015) found that spraying pear with licorice extracts gave the highest values in fruit quality parameters.

Garlic (*Allium sativum*) extract contains vitamins, minerals, flavonoids ascorbic acid, sulphur, trace of iodine, Seventeen amino acids, eight essential enzymes and more than 200 chemical compounds. Allicin that gives garlic its antibiotic properties has higher contents of volatile and sulphur compounds put both in the top due to their real and essential roles they play in fruiting process of various fruit crops (Pons, 2003). Abd El-Razek et al. (2011) reported that Canino apricot trees greatly responded to spraying garlic extract at 4% by improving productivity and fruit quality. Moreover, Ahmed et al., (2009)found that garlic extracts improve productivity and fruit quality when applied to grapevine", apple and peach.

The aim of this research was to investigate the effect of magnetic iron and licorice extract and garlic extract on productivity, fruit quality and leaf minerals content of Ferehy date palm under salinity stress.

## Materiel and Methods

This study was conducted during two successive seasons (2017 and 2018) on 60 Ferehy date palms at the Siwa Research Station in Tigzerti farm, Desert Research Center, Siwa oasis, Matrouh Governorate, Egypt. The aim of this research was to investigate the effect of magnetic iron and licorice extract and garlic extract on productivity, fruit quality and leaf minerals contentof Ferehy date palm trees under salinity stress. The palms were 10 years old, planted at 7 X 7 m apart, and grown in loamy sand soil irrigated with saline water. All palms are almost uniform in shape and received the common horticultural practices. The leaf/bunch ratio was adjusted by the end of blooming to be 10:1 in both seasons. Pollination was achieved by using pollen grains from the same parents in both seasons.The soil and irrigation water analysis data are given in Table 1 and 2.

**TABLE 1. Some physical and chemical analysis of the experiment soil atSiwa Research Station (farmed Tigzerti).**

| Particle size distribution% | | | Texture soil | EC dS/m1 | pH | Soluble cationsmeq/l | | | | Soluble anions meq/l | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sand | Silt | Clay | | | | Ca2+ | Mg2+ | Na+ | K+ | SO4- | Cl- | HCO3 | CO3 |
| 80.0 | 10.0 | 10.0 | Sand loamy | 11.36 | 7.7 | 25 | 12.25 | 75.17 | 1.2 | 25.2 | 85.52 | 2.9 | - |

**TABLE 2. Some physical and chemical analysis of the irrigation water at (Siwa Research Station (farmed Tigzerti)).**

| EC, pH and Soluble cations and anions in water of irrigation (mmolc $L^{-1}$) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **EC $dSm^{-1}$** | **pH** | **Soluble Cations (melc$L^{-1}$)** | | | | **Soluble Anions (melc$L^{-1}$)** | | | |
| | | $Ca^{+2}$ | $Mg^{+2}$ | $Na^{+}$ | $K^{+}$ | $SO_4$ | Cl | $HCO_3^-$ | $CO_3^-$ |
| 8.94 | 7.7 | 23.22 | 9.5 | 55.95 | 0.78 | 13.10 | 65.95 | 10.4 | - |

The experiment was designed as spilt plot design. Three replicates were used for each treatment and every replicate was represented by one palm in a factorial arrangement for treatments. The following factors and levels are arranged as follow, the main factor was the four magnetic iron treatments that added to the soil in the winter[0 ($Fe_0$), 250 g ($Fe_1$), 500 g ($Fe_2$) and 750 g ($F_3$)] , and the sub main factor was the spraying with licorice extract and garlic extract as natural growth stimulants), as follows: control: spraying with water as a control treatment, $L_1$: licorice extract at 3g/l, $L_2$: licorice extract at 5g/l, $G_1$: garlic extract at 2% and$G_2$: garlic extract at 4%. Investigated trees sprayed three times along each season (after fruit set, one month later from fruit set and two months later from fruit set).Preparing the licorice extracts and garlic extracts was carried out prior the begging of each spraying time. The procedure of preparing the mentioned materials could be described as follow:

*Licorice Roots Extract:*

The aqueous extract of licorice roots (*Glycyrrhizaglabra*) (Table 2) was prepared by boiling 3 g and 5 g in one liter of distilled water for 15 minutes. The solution filtered using a cotton cloth, and re-filtered through Whatman filterpaper No. 2 and completed by distilled water to one liter.

*Garlic extract*

The 2% and 4% garlic aqueous extract were prepared by blending 20 g and 40 g of fresh mature cloves in one liter of distilled water, frozen and thawed two times, and then filtered and diluted by distilled water to one liter (El-Desouky et al., 1998). Some chemical constituents of garlic cloves are shown in Table 3.

**TABLE 3. The physicochemical properties of Licorice (in dry matter)**

| | | | | | |
|---|---|---|---|---|---|
| **Reducing sugar (%)** | 3.23 | **Humidity (%)** | 5.88 | **Ca (mg/g)** | 560.0 |
| **Non-reducing sugar (%)** | 10.27 | **$GA_3$ (%)** | 0.63 | **Mg (mg/g)** | 280.0 |
| **Starch (%)** | 4.76 | **P (mg/g)** | 540.00 | **Fe (mg/g)** | 33.0 |
| **Glycyrrhizic acid (%)** | 26.00 | **K (mg/g)** | 1235.00 | **Zn (mg/g)** | 3.6 |
| Antioxidants mg/100g dry weight basis | | | | | |
| **Total phenols** | **Total flavonoids** | **saponins** | **carotenoids** | **vitamin C** | **tannins** |
| 405.02 | 114.91 | 27.99 | 11.78 | 1.20 | 47.54 |

**TABLE 4. Some chemical constituents of garlic cloves according to Arid Land Agricultural Research Unit.**

| GA3 (mg/l00gm F.W) | IAA | ABA | Ca (%) |
|---|---|---|---|
| 1.633 | Trace amount | Trace amount | 1.363 |
| $S0_4$ (%) | Mg (%) | Zn (ppm) | Mn (ppm) |
| 0.181 | 1.230 | 66.5 | 94.4 |

*The following data were recorded*

*Fruit Set, Bunch weight and Fruit Yield*

The number of scares and set of fruits in twenty five strands per palm were recorded after 4 weeks of pollination. The percentage of fruit set was calculated using the following formula:

*Fruit set %=*

Total setting of fruits number per bunch / Total scares number per bunch x 100

*Fruit yield*

At the harvesting time, bunch weight and the fruit yield per palm (kg fruits per palm)were recorded.

*Fruit quality*

Samples of 50 fruits were randomly collected at ripening stage, (late of October) from each palm for determining the fruit physical characteristics, fruit weight (g) was recorded and diameter (cm) of the fruit was measured using a micrometer caliper. After pitting, fruit flesh weight was recorded. Chemical characteristics such as total soluble solids (TSS), total sugars, reducing sugars, non-reducing sugars, tannins and acidity, were determined according to the methods of A.O.A.C (2000).

*Nutrients Content*

To determine leaf mineral content (N, P, K, and Fe), leaf samples were taken during November. Each sample was collected randomly at a constant height and at all directions of the palm.Total NPK are calorimetrically determined as described by Cottenie et al. (1982). Iron was determined by Inductively Coupled Plasma–Atomic Emission Spectrometry (ICP-AES) (Chapman and Pratt, 1961).

*Soil nutrient contents*

Before applying the treatments and at the end of experiment soil samples were taken from each treatment at major root zone (0–60 cm depth). These soil samples were dried, sieved (through 2 mm) and analyzed to determine soluble cations, soluble anions and available micronutrients in soil.

The obtained data were subjected to analysis of variance according to Clarke and Kempson **(**1997). Means were differentiated using Range test at the 0.05 level (Duncan, 1955).

## Results and Discussion

*Fruit set, bunch weight and yield/ palm*

It is evident from the results in Table 5 that fruit set, bunch weight and yield/ palm were significantly affected by all licorice and garlic extract treatments in both seasons. However, $G_2$ gave the best fruit set% (64.59%and 65.17%), bunch weight (7.82 kg and 7.86 kg), and fruit yield/ palm (96.64 kgand 97.20 kg)in the first and the second seasons, respectively.

Furthermore, fruit set %, bunch weight andfruit yield/ palmwas affected significantly bymagnetic iron in both seasons. $Fe_3$ treatment produced the highest fruit set %, bunch weight andfruit yield/ palm in both seasons. On the other side, $Fe_0$ treatment gave the lowest fruit set%, bunch weight and fruit yield/ palm in both seasons.

Moreover, the interactions between spraying licorice, garlic extract and soil adding of magnetic iron cleared that, $G_2$ with $Fe_3$ recorded the highest fruit set%, bunch weight and fruit yield/ palmin both seasons followed by $L_2$ with $Fe_3$ in both seasons In addition, control with $Fe_0$ recorded the lowest fruit set%, bunch weight and fruit yield/ palm in both seasons.

*Fruit weight (g), fruit flesh weight (g) and fruit Flesh %*

Concerning the results in Tables 6 fruit weight, fruit flesh weight and fruit flesh percentage were significantly affected by all extracts treatments in both seasons. However, $G_2$ gave the highest fruit weight and flesh weight followed with $L_2$ in both seasons. In addition, there was no significant effect between $G_2$ and $L_2$ in fruit flesh percentage in both seasons.

On the other hand, fruit weight, fruit flesh weight and fruit flesh %were affected significantly

by magnetic iron in both seasons. $Fe_3$ treatment produced the highest fruit weight (7.75g and 7.85g), fruit flesh weight (6.57g and 6.68 g) and fruit flesh percentage (84.77% and 85.09%) in the first and the second seasons respectively, followed by $Fe_2$ in both seasons. On the other side, $Fe_0$ gave the lowest fruit weight, fruit flesh weight and fruit flesh percentage in both seasons.

The interactions between spraying licorice, garlic extract and magnetic iron that added to soil indicated that, $G_2$with $Fe_3$ recorded the highest fruit weight and fruit flesh weight in both seasons. While $G_2$ and $L_2$ with $Fe_3$ gave the highest fruit flesh percentage in both seasons. In addition, the control under $Fe_0$ recorded the lowest fruit weight, fruit flesh weight and fruit flesh % in both seasons.

**TABLE 5. Effect of spraying some natural extracts (A) and adding magnetic iron (B) to the soil on fruit set%, bunch weight and fruit yield/ palm of Ferehy date palm during 2017 and 2018 seasons.**

| parameters | | Fruit set % | | bunch weight/palm (kg) | | Total fruit yield /palm(kg) | |
|---|---|---|---|---|---|---|---|
| Treatments | | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| **Effect of spraying licorice and garlic extract (A)** | | | | | | | |
| Cont. | | 58.40e | 58.70e | 6.90e | 6.92 e | 80.37e | 80.56e |
| $L_1$ | | 62.58c | 63.52c | 7.23d | 7.30 d | 84.12d | 84.95d |
| $L_2$ | | 64.27b | 65.10b | 7.75b | 7.81 b | 95.84b | 96.59b |
| $G_1$ | | 61.01d | 61.91d | 7.52c | 7.58c | 89.62c | 90.28c |
| $G_2$ | | 64.59a | 65.17a | 7.82a | 7.86a | 96.64a | 97.20a |
| **Effect of adding magnetic iron to soil (B)** | | | | | | | |
| $Fe_0$ | | 51.49d | 51.82d | 6.19d | 6.22 d | 64.42d | 64.78 d |
| $Fe_1$ | | 59.76c | 60.75c | 6.90c | 6.96c | 78.78c | 79.42 c |
| $Fe_2$ | | 66.12b | 66.67b | 7.75b | 7.80 b | 97.78b | 98.33 b |
| $Fe_3$ | | 71.32a | 72.29a | 8.95a | 9.01 a | 116.29a | 117.12 a |
| **The interaction between A&B** | | | | | | | |
| | | Fruit set % | | bunch weight/palm (kg) | | Total fruityield/palm(kg) | |
| (A) | (B) | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| Cont. | $Fe_0$ | 47.22s | 46.18s | 5.91p | 5.88r | 59.13r | 58.77r |
| | $Fe_1$ | 55.28n | 55.87n | 6.38l | 6.42n | 70.18 n | 70.62 n |
| | $Fe_2$ | 63.11i | 63.98j | 7.20 i | 7.20k | 86.36 j | 86.44 k |
| | $Fe_3$ | 68.01e | 68.77e | 8.14e | 8.19e | 105.82e | 106.43e |
| $L_1$ | $Fe_0$ | 50.25r | 51.44r | 6.11o | 6.21q | 61.10q | 62.13 q |
| | $Fe_1$ | 58.55 m | 60.07m | 6.78k | 6.82m | 74.54m | 75.02 m |
| | $Fe_2$ | 65.46h | 65.88i | 7.56h | 7.61i | 90.68i | 91.36 i |
| | $Fe_3$ | 69.77d | 70.25d | 8.47 d | 8.56d | 110.15d | 111.28d |
| $L_2$ | $Fe_0$ | 53.91o | 54.15p | 6.34m | 6.38o | 69.78o | 70.14 o |
| | $Fe_1$ | 62.33k | 63.21 k | 7.17i | 7.23j | 86.00k | 86.80 j |
| | $Fe_2$ | 67.25f | 68.18g | 8.05f | 8.13f | 104.61g | 105.69f |
| | $Fe_3$ | 73.59b | 74.88b | 9.46b | 9.52b | 122.98b | 123.72b |
| $G_1$ | $Fe_0$ | 52.31q | 53.12q | 6.23n | 6.27p | 62.30p | 62.73p |
| | $Fe_1$ | 60.01l | 61.41l | 7.01j | 7.12l | 77.11l | 78.32l |
| | $Fe_2$ | 66.78g | 67.02 h | 7.87g | 7.92h | 102.31h | 102.92h |
| | $Fe_3$ | 71.25c | 72.55c | 8.98c | 9.01c | 116.74c | 117.13c |
| $G_2$ | $Fe_0$ | 53.77p | 54.20o | 6.34m | 6.38o | 69.78o | 70.14o |
| | $Fe_1$ | 62.63j | 63.21 k | 7.17i | 7.20k | 86.08jk | 86.36k |
| | $Fe_2$ | 67.98 e | 68.30 f | 8.07f | 8.10g | 104.95f | 105.26g |
| | $Fe_3$ | 73.99a | 74.99 a | 9.67a | 9.77 a | 125.75a | 127.05a |

Means that having the same letter (s) in each column or row are not significantly different at 5% level.Cont.: spraying with water, $\mathbf{L_1}$: Licorice extract at 3g/l, $\mathbf{L_2}$: Licorice extract at 5g/l, $\mathbf{G_1}$: garlic extract at 2% and $\mathbf{G_2}$: garlic extract at 4%.$Fe_0$: without magnetic iron, $Fe_1$: magnetic iron at 250 g ,$Fe_2$: magnetic iron at 500 g and $Fe_3$: magnetic iron at 750 g.

**TABLE 6. Effect of spraying some natural extracts (A) and adding magnetic iron to the soil (B) on fruit weight, fruit flesh weight and fruit flesh% of Ferehy date palm during 2017 and 2018 seasons.**

| parameters / Treatments | | Fruit weight (g) | | Flesh weight (g) | | Fruit Flesh % | |
|---|---|---|---|---|---|---|---|
| | | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| **Effect of spraying licorice and garlic extract (A)** | | | | | | | |
| Cont. | | 5.55e | 5.62e | 4.47e | 4.52e | 80.54d | 80.42d |
| $L_1$ | | 6.00d | 6.08d | 4.92d | 4.99d | 82.00c | 82.07c |
| $L_2$ | | 6.60b | 6.70b | 5.50b | 5.59b | 83.33a | 83.43a |
| $G_1$ | | 6.28c | 6.38c | 5.18c | 5.27c | 82.48b | 82.60b |
| $G_2$ | | 6.62a | 6.75a | 5.51a | 5.65a | 83.23a | 83.70a |
| **Effect of adding magnetic iron to soil (B)** | | | | | | | |
| $Fe_0$ | | 4.20d | 4.23d | 3.24d | 3.27d | 77.14d | 77.30d |
| $Fe_1$ | | 5.77c | 5.90c | 4.72c | 4.85c | 81.80c | 82.20c |
| $Fe_2$ | | 7.11b | 7.22b | 5.92b | 6.02b | 83.26b | 83.37b |
| $Fe_3$ | | 7.75a | 7.85a | 6.57a | 6.68a | 84.77a | 85.09a |
| **The interaction between A&B** | | | | | | | |
| | | Fruit weight (g) | | Flesh weight (g) | | Fruit Flesh % | |
| **(A)** | **(B)** | **Season 2017** | **Season 2018** | **Season 2017** | **Season 2018** | **Season 2017** | **Season 2018** |
| Cont. | $Fe_0$ | 3.553q | 3.44r | 2.45r | 2.31r | 69.01p | 67.15m |
| | $Fe_1$ | 4.66m | 4.77n | 3.76n | 3.88n | 80.68l | 81.34ij |
| | $Fe_2$ | 6.66h | 6.78i | 5.51i | 5.62i | 82.73h | 82.89d-g |
| | $Fe_3$ | 7.32e | 7.46e | 6.14e | 6.28e | 83.87d | 84.18bc |
| $L_1$ | $Fe_0$ | 4.14p | 4.17q | 3.16q | 3.19q | 76.32o | 76.49l |
| | $Fe_1$ | 5.32l | 5.43m | 4.34m | 4.45m | 81.57k | 81.95 hi |
| | $Fe_2$ | 7.00g | 7.10h | 5.81h | 5.91h | 83.00g | 83.23c-g |
| | $Fe_3$ | 7.54d | 7.62d | 6.35d | 6.43d | 84.21c | 84.38b |
| $L_2$ | $Fe_0$ | 4.55n | 4.65o | 3.64o | 3.75o | 80.00m | 80.64j |
| | $Fe_1$ | 6.43 j | 6.54k | 5.28k | 5.39k | 82.11i | 82.41f-h |
| | $Fe_2$ | 7.33 e | 7.42f | 6.13ef | 6.19f | 83.62e | 83.42c-f |
| | $Fe_3$ | 8.11 b | 8.18b | 6.94b | 7.01b | 85.57a | 85.69a |
| $G_1$ | $Fe_0$ | 4.22o | 4.26p | 3.31p | 3.36p | 78.43n | 78.87k |
| | $Fe_1$ | 6.01k | 6.12l | 4.92l | 5.04l | 81.86j | 82.35g-i |
| | $Fe_2$ | 7.27f | 7.33g | 6.06g | 6.11g | 83.35f | 83.35c-e |
| | $Fe_3$ | 7.62c | 7.77c | 6.43c | 6.59c | 84.38b | 84.81b |
| $G_2$ | $Fe_0$ | 4.56n | 4.65o | 3.65o | 3.76o | 80.04m | 80.86j |
| | $Fe_1$ | 6.45i | 6.65j | 5.30j | 5.50j | 82.17i | 82.70e-h |
| | $Fe_2$ | 7.32e | 7.46e | 6.12f | 6.26e | 83.60e | 83.91b-d |
| | $Fe_3$ | 8.15a | 8.24a | 6.97a | 7.10a | 85.52a | 86.16a |

Means that having the same letter (s) in each column or row are not significantly different at 5% level.Cont.: spraying with water, **$L_1$**: Licorice extract at 3g/l, **$L_2$**: Licorice extract at 5g/l, **$G_1$**: garlic extract at 2% and **$G_2$**: garlic extract at 4%.$Fe_0$ without magnetic iron, $Fe_1$: magnetic iron at 250 g ,$Fe_2$: magnetic iron at 500 g and $Fe_3$: magnetic iron at 750 g.

*Fruit length and diameter (cm)*

Results presented in Table 7 show that fruit length and fruit diameter were significantly affected by all licorice and garlic extract treatments in both seasons. However, $L_2$ and $G_2$ gave the best fruit length and fruit diameter comparing with the control in both seasons.

Furthermore, fruit length and diameter were affected significantly by magnetic iron in both seasons. $Fe_3$treatment produced the highest fruit length (4.49 cm and 4.65 cm) and fruit diameter (1.83 cm and 1.86 cm) in the first and the second seasons respectively, followed by $Fe_2$ in both seasons. On the other side, $Fe_0$ gave the lowest fruit length (3.21 cm and 3.25 cm) and fruit diameter (1.55 cm and 1.57 cm) in the 1st and 2nd seasons, respectively.

The obtained results from the interaction between spraying licorice, garlic extract and adding magnetic iron to the soil show that, $L_2$ and $G_2$with $Fe_3$ recorded the highest fruit length and fruit diameter in both seasons followed by $G_1$with $Fe_3$ in both seasons. In addition, control under $Fe_0$ recorded the lowest fruit length and diameter in both seasons.

**TABLE 7. Effect of spraying some natural extracts (A) and adding magnetic iron to the soil (B) on fruit length and diameter of Ferehy date palm during 2017 and 2018 seasons.**

| parameters | | Fruit length (cm) | | Fruit diameter (cm) | |
|---|---|---|---|---|---|
| Treatments | | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| **Effect of spraying licorice and garlic extract (A)** | | | | | |
| Cont. | | 3.69d | 3.75e | 1.66d | 1.67d |
| $L_1$ | | 3.79c | 3.87d | 1.70c | 1.73c |
| $L_2$ | | 4.04a | 4.17b | 1.74a | 1.76a |
| $G_1$ | | 3.94b | 4.04c | 1.72b | 1.75b |
| $G_2$ | | 4.04a | 4.18a | 1.74a | 1.77a |
| **Effect of adding magnetic iron to soil (B)** | | | | | |
| $Fe_0$ | | 3.21d | 3.25d | 1.55d | 1.57d |
| $Fe_1$ | | 3.69c | 3.80c | 1.69c | 1.72 c |
| $Fe_2$ | | 4.21b | 4.32b | 1.77b | 1.80b |
| $Fe_3$ | | 4.49a | 4.65a | 1.83a | 1.86a |
| **The interaction between A&B** | | | | | |
| | | Fruit length (cm) | | Fruit diameter (cm) | |
| (A) | (B) | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| Cont. | $Fe_0$ | 3.06n | 2.98p | 1.49n | 1.42n |
| | $Fe_1$ | 3.34j | 3.41l | 1.63j | 1.67j |
| | $Fe_2$ | 4.01g | 4.15h | 1.73f | 1.76g |
| | $Fe_3$ | 4.36d | 4.48d | 1.81c | 1.84c |
| $L_1$ | $Fe_0$ | 3.21m | 3.26o | 1.53m | 1.56m |
| | $Fe_1$ | 3.37i | 3.48k | 1.68i | 1.72i |
| | $Fe_2$ | 4.12f | 4.21g | 1.76e | 1.79f |
| | $Fe_3$ | 4.47c | 4.56c | 1.82b | 1.85bc |
| $L_2$ | $Fe_0$ | 3.27k | 3.37m | 1.60k | 1.63k |
| | $Fe_1$ | 3.98g | 4.11i | 1.72g | 1.75g |
| | $Fe_2$ | 4.35d | 4.45e | 1.80c | 1.82de |
| | $Fe_3$ | 4.55a | 4.77a | 1.84a | 1.87a |
| $G_1$ | $Fe_0$ | 3.24l | 3.29n | 1.56l | 1.60l |
| | $Fe_1$ | 3.78h | 3.88j | 1.70h | 1.73h |
| | $Fe_2$ | 4.22e | 4.34f | 1.78d | 1.81e |
| | $Fe_3$ | 4.51b | 4.66b | 1.83b | 1.86ab |
| $G_2$ | $Fe_0$ | 3.27k | 3.37m | 1.60k | 1.62k |
| | $Fe_1$ | 3.99g | 4.12i | 1.72g | 1.75g |
| | $Fe_2$ | 4.35d | 4.46e | 1.80c | 1.83d |
| | $Fe_3$ | 4.56a | 4.78a | 1.85a | 1.87a |

Means that having the same letter (s) in each column or row are not significantly different at 5% level. Cont.: spraying with water, $\mathbf{L_1}$: Licorice extract at 3g/l, $\mathbf{L_2}$: Licorice extract at 5g/l, $\mathbf{G_1}$: garlic extract at 2% and $\mathbf{G_2}$: garlic extract at 4%.$Fe_0$: without magnetic iron, $Fe_1$: magnetic iron at 250 g ,$Fe_2$: magnetic iron at 500 g and $Fe_3$: magnetic iron at 750 g.

*Total soluble solids, reducing, non-reducing and total sugars content%*

Table 8 cleared that total soluble solids, reducing sugars, non-reducing sugars and total sugars were significantly affected by all licorice and garlic extract treatments in both seasons. However, $G_2$ gave the highest total soluble solids and non-reducing sugars in the first season, reducing sugars and total sugars in both seasons, with non-significant differences between them and $L_2$ in total soluble solids and non-reducing sugars in the second season only. On the other side, control gave the lowest total soluble solids, reducing, non-reducing and total sugars in both seasons.

Furthermore, total soluble solids, reducing sugars, non-reducing and total sugars were affected significantly by magnetic iron in both seasons. $Fe_3$ treatment produced the highest total soluble solids, reducing, non-reducing and total sugars in both seasons. On the other side, $Fe_0$ decreased total soluble solids, reducing, non-reducing and total sugars in both seasons.

The obtained results from the interaction between spraying licorice, garlic extract and adding magnetic iron to the soil show that, $L_2$ and $G_2$ with $Fe_3$ recorded the highest total soluble solids in both seasons and reducing, non-reducing and total sugars in second season. While, $G_2$under $Fe_3$ recorded the highest reducing, non-reducing and total sugars in the first season. In addition, control under $Fe_0$ decreased total soluble solids, reducing, non-reducing and total sugars in both seasons.

**TABLE 8. Effect of spraying some natural extracts (A) and adding magnetic iron (B) to the soil on total soluble solids, reducing sugars non-reducing and total sugars content of Ferehy date palm during 2017 and 2018 seasons.**

| parameters | Total soluble solids(TSS)% | | Reducing sugars% | | Non reducing sugars % | | Total sugars% | |
|---|---|---|---|---|---|---|---|---|
| Treatments | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| **Effect of spraying licorice and garlic extract (A)** | | | | | | | | |
| Cont. | 62.08e | 62.14d | 31.51e | 31.57e | 23.61e | 23.40d | 55.13e | 54.98e |
| $L_1$ | 62.55d | 62.69 c | 31.73d | 31.78d | 23.86d | 23.96c | 55.59d | 55.74d |
| $L_2$ | 63.20b | 63.33 a | 32.26b | 32.33b | 24.39b | 24.53a | 56.66b | 56.86b |
| $G_1$ | 62.97c | 63.04b | 32.05c | 32.16c | 24.14c | 24.30b | 56.20c | 56.47c |
| $G_2$ | 63.23a | 63.39a | 32.32a | 32.39a | 24.41a | 24.53a | 56.73a | 56.93a |
| **Effect of adding magnetic iron to soil (B)** | | | | | | | | |
| $Fe_0$ | 60.71d | 60.71d | 30.54d | 30.57d | 22.62d | 22.50d | 53.16d | 53.07 d |
| $Fe_1$ | 62.28c | 62.49c | 31.52c | 31.61c | 23.68c | 23.79c | 55.21c | 55.40c |
| $Fe_2$ | 63.53b | 63.70b | 32.53b | 32.62b | 24.59b | 24.69b | 57.13b | 57.31 b |
| $Fe_3$ | 64.70a | 64.77a | 33.30a | 33.39a | 25.44a | 25.60a | 58.74a | 58.99a |

**The interaction between A&B**

| (A) | (B) | Total soluble solids(TSS)% | | Reducing sugars% | | Non reducing sugars% | | Total sugars% | |
|---|---|---|---|---|---|---|---|---|---|
| | | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| Cont. | $Fe_0$ | 60.11q | 59.87n | 30.11r | 29.97r | 22.26s | 21.12p | 52.37s | 51.09q |
| | $Fe_1$ | 61.44l | 61.52j | 31.01n | 31.12n | 23.14o | 23.27l | 54.16o | 54.39m |
| | $Fe_2$ | 62.81h | 63.11g | 32.02i | 32.17i | 24.06j | 24.11h | 56.08j | 56.28 h |
| | $Fe_3$ | 63.94d | 64.06d | 32.90e | 33.02d | 25.00e | 25.13d | 57.91e | 58.15d |
| $L_1$ | $Fe_0$ | 60.45p | 60.56m | 30.24q | 30.29q | 22.36r | 22.45o | 52.60r | 52.74p |
| | $Fe_1$ | 61.98k | 62.06i | 31.28m | 31.32m | 23.55n | 23.65k | 54.83n | 54.98l |
| | $Fe_2$ | 63.34g | 63.55f | 32.27h | 32.31h | 24.34i | 24.47g | 56.61i | 56.78g |
| | $Fe_3$ | 64.44c | 64.58c | 33.12d | 33.19c | 25.19d | 25.26c | 58.31d | 58.46 c |
| $L_2$ | $Fe_0$ | 60.98n | 61.02l | 30.84o | 30.92o | 22.92p | 23.02m | 53.76p | 53.94n |
| | $Fe_1$ | 62.78i | 63.03g | 31.78k | 31.85k | 23.97l | 24.07i | 55.75l | 55.93 j |
| | $Fe_2$ | 63.91e | 64.05d | 32.87f | 32.92f | 24.93g | 25.05e | 57.81g | 57.97 e |
| | $Fe_3$ | 65.12a | 65.23a | 33.55b | 33.64a | 25.76b | 25.98a | 59.32b | 59.62 a |
| $G_1$ | $Fe_0$ | 60.88o | 60.91l | 30.64p | 30.75p | 22.67q | 22.90n | 53.31q | 53.66 o |
| | $Fe_1$ | 62.43j | 62.75h | 31.56 | 31.67l | 23.78m | 23.89j | 55.35m | 55.56 k |
| | $Fe_2$ | 63.68f | 63.71e | 32.65g | 32.77g | 24.67h | 24.77f | 57.32h | 57.54 f |
| | $Fe_3$ | 64.88b | 64.78b | 33.34c | 33.47b | 25.46c | 25.64b | 58.80c | 59.11b |
| $G_2$ | $Fe_0$ | 61.12m | 61.18k | 30.85o | 30.92o | 22.92p | 23.03m | 53.77p | 53.95 n |
| | $Fe_1$ | 62.79i | 63.11g | 31.98j | 32.08j | 23.98k | 24.08i | 55.97k | 56.16 i |
| | $Fe_2$ | 63.91e | 64.06d | 32.88f | 32.93e | 24.95f | 25.04e | 57.83f | 57.98 e |
| | $Fe_3$ | 65.12a | 65.24a | 33.58a | 33.63a | 25.78a | 25.99a | 59.36a | 59.62a |

Means that having the same letter (s) in each column or row are not significantly different at 5% level. Cont.: spraying with water, $L_1$: Licorice extract at 3g/l, $L_2$: Licorice extract at 5g/l, $G_1$: garlic extract at 2% and $G_2$: garlic extract at 4%.$Fe_0$: without magnetic iron, $Fe_1$: magnetic iron at 250 g, $Fe_2$: magnetic iron at 500 g and $Fe_3$: magnetic iron at 750 g.

*Total acidity and Tannins content%*

It is evident from table (9) that total acidity and tannins content were significantly affected by all licorice and garlic extract treatments in both seasons. However, $L_2$ and $G_2$ decreased total acidity and tannins content in both seasons. In addition, $G_1$decreased tannins content in the second season, while, the control increased total acidity and tannins content in both seasons.

Moreover, total acidity and tannins content were affected significantly by magnetic iron in both seasons. $Fe_3$treatment decreased total acidity (0.293% and 0.283%) and tannins content (0.694% and 0.691%) in first and second seasons, respectively. On the other side, $Fe_0$ increased total acidity (0.334 % and 0.333%) and tannins content (0.758% and 0.755%) in first and second seasons, respectively.

Furthermore, the interaction between spraying licorice, garlic extract and adding magnetic iron to the soil cleared that, $L_2$ and $G_2$under $Fe_3$ decreased total acidity and tannins content followed by $G_1$ in both seasons. In addition, control under $Fe_0$ increased total acidity and tannins content in both seasons.

**TABLE 9. Effect of spraying some natural extracts (A) and adding magnetic iron (B) to the soil on total acidity and tannins content of Ferehy date palm during 2017 and 2018 seasons.**

| parameters | | Total acidity% | | Tannins content% | |
|---|---|---|---|---|---|
| Treatments | | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| **Effect of spraying licorice and garlic extract (A)** | | | | | |
| Cont. | | 0.320a | 0.316a | 0.737a | 0.735a |
| $L_1$ | | 0.316b | 0.310b | 0.730b | 0.725b |
| $L_2$ | | 0.310d | 0.303cd | 0.717d | 0.712c |
| $G_1$ | | 0.313c | 0.305c | 0.722c | 0.715c |
| $G_2$ | | 0.309d | 0.300d | 0.715d | 0.711c |
| **Effect of adding magnetic iron to soil (B)** | | | | | |
| $Fe_0$ | | 0.334a | 0.333a | 0.758a | 0.755a |
| $Fe_1$ | | 0.320b | 0.314b | 0.730b | 0.724b |
| $Fe_2$ | | 0.307c | 0.297c | 0.714c | 0.709c |
| $Fe_3$ | | 0.293d | 0.283d | 0.694d | 0.691 d |
| **The interaction between A&B** | | | | | |
| | | Total acidity% | | Tannins content% | |
| (A) | (B) | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| Cont. | $Fe_0$ | 0.340a | 0.350a | 0.786a | 0.796a |
| | $Fe_1$ | 0.326cde | 0.323cd | 0.736de | 0.730de |
| | $Fe_2$ | 0.313ghi | 0.303ghi | 0.723gh | 0.716ghi |
| | $Fe_3$ | 0.300klm | 0.290klm | 0.703kl | 0.700 k |
| $L_1$ | $Fe_0$ | 0.336ab | 0.333b | 0.766b | 0.763b |
| | $Fe_1$ | 0.323def | 0.320de | 0.733ef | 0.726ef |
| | $Fe_2$ | 0.310hij | 0.300 hij | 0.720hi | 0.713hi |
| | $Fe_3$ | 0.296lmn | 0.286lmn | 0.700lm | 4 0.696kl |
| $L_2$ | $Fe_0$ | 0.330bcd | 0.326bcd | 0.743d | 0.736cd |
| | $Fe_1$ | 0.316fgh | 0.313 ef | 0.726fgh | 0.723efg |
| | $Fe_2$ | 0.303jkl | 0.293 jkl | 0.710jk | 0.703 jk |
| | $Fe_3$ | 0.290no | 0.280no | 0.690n | 0.686m |
| $G_1$ | $Fe_0$ | 0.333abc | 0.330bc | 0.753c | 0.743c |
| | $Fe_1$ | 0.320efg | 0.310fg | 0.730efg | 0.720fgh |
| | $Fe_2$ | 0.306ijk | 0.296ijk | 0.7133ij | 0.710 ij |
| | $Fe_3$ | 0.293mno | 0.283mno | 0.693mn | 0.690lm |
| $G_2$ | $Fe_0$ | 0.330bcd | 0.326bcd | 0.743d | 0.736cd |
| | $Fe_1$ | 0.316fgh | 0.306 fgh | 0.726fgh | 0.723efg |
| | $Fe_2$ | 0.30jkl | 0.293 jkl | 0.706jkl | 0.703 jk |
| | $Fe_3$ | 0.28o | 0.27o | 0.68n | 0.68m |

Means that having the same letter (s) in each column or row are not significantly different at 5% level. Cont.: spraying with water, $\mathbf{L_1}$: Licorice extract at 3g/l, $\mathbf{L_2}$: Licorice extract at 5g/l, $\mathbf{G_1}$: garlic extract at 2% and $\mathbf{G_2}$: garlic extract at 4%.$Fe_{0:\ without}$ magnetic iron, $Fe_{1:}$ magnetic iron at 250 g ,$Fe_{2:}$ magnetic iron at 500 g and $Fe_{3:}$ magnetic iron at 750 g.

*Leaf mineral content*

*Nitrogen, phosphorus, potassium (%) and iron (ppm)*

Results presented in Table 10, show that all extract treatments were significantly effective on leaf nitrogen, phosphorus, potassium and iron contents in both seasons. However, $G_2$ gave the highest leaf nitrogen and iron content in both seasons, while, there was insignificant difference between $L_2$ and $G_2$ in leaf phosphorus and potassium content in both seasons. In addition, control gave the lowest leaf nitrogen, phosphorus, potassium and iron content in both seasons.

Furthermore, leaf nitrogen, phosphorus, potassium and iron content were affected significantly by magnetic iron in both seasons. $Fe_3$ treatment gave the highest leaf nitrogen, phosphorus, potassium and iron content in both seasons, while, $Fe_0$ gave the lowest leaf nitrogen, phosphorus, potassium and iron content in both seasons.

The interaction between spraying licorice, garlic extract and magnetic iron that added to the soil cleared that, $L_2$ and $G_2$with $Fe_3$ gave the highest leaf nitrogen, phosphorus and potassium content followed by $G_1$ in both seasons, while, $G_2$ with $Fe_3$ gave the best leaf iron content followed by $L_2$ in both seasons. On the other hand, the control with $Fe_0$ gave the lowest leaf nitrogen, phosphorus, potassium and iron content in both seasons.

**TABLE 10. Effect of spraying some natural extracts (A) and adding magnetic iron (B) to the soil on nitrogen, phosphorus, potassium and iron content of Ferehy date palm during 2017 and 2018 seasons.**

| parameters | | N% | | P% | | K% | | Fe (ppm) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| **Effect of spraying licorice, garlic extract (A)** | | | | | | | | | |
| Cont. | | 1.56e | 1.66e | 0.33d | 0.36d | 1.78d | 1.81d | 171.22e | 172.23e |
| $L_1$ | | 1.66d | 1.78d | 0.38c | 0.41c | 2.14c | 2.17c | 173.33d | 174.62d |
| $L_2$ | | 1.71b | 1.86b | 0.42a | 0.44a | 2.20a | 2.24a | 176.40b | 177.36 b |
| $G_1$ | | 1.68c | 1.81c | 0.40b | 0.43b | 2.16b | 2.20b | 174.98c | 175.79 c |
| $G_2$ | | 1.72a | 1.88a | 0.42a | 0.45a | 2.21a | 2.25a | 176.76a | 177.80 a |
| **Effect of adding magnetic iron to soil (B)** | | | | | | | | | |
| $Fe_0$ | | 1.43d | 1.45d | 0.28d | 0.28d | 1.69d | 1.71d | 164.66d | 165.48 d |
| $Fe_1$ | | 1.69c | 1.75c | 0.36c | 0.38c | 2.10c | 2.12c | 172.34c | 173.19 c |
| $Fe_2$ | | 1.75b | 1.94b | 0.43b | 0.47b | 2.25b | 2.28b | 178.33b | 179.40 b |
| $Fe_3$ | | 1.79a | 2.06a | 0.50a | 0.53a | 2.36a | 2.42a | 182.82a | 184.17a |
| **The interaction between A&B** | | | | | | | | | |
| | | N% | | P% | | K% | | Fe(ppm) | |
| (A) | (B) | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 | Season 2017 | Season 2018 |
| Cont. | $Fe_0$ | 1.11o | 1.09o | 0.14o | 0.13p | 0.62o | 0.61n | 160.12q | 159.96s |
| | $Fe_1$ | 1.64j | 1.65k | 0.34kl | 0.35kl | 2.01k | 2.03k | 168.12m | 169.15o |
| | $Fe_2$ | 1.73g | 1.88g | 0.38h | 0.43g | 2.19h | 2.22g | 175.96i | 177.67j |
| | $Fe_3$ | 1.77cd | 2.01c | 0.48cde | 0.52bcd | 2.32cd | 2.38c | 180.67e | 182.16e |
| $L_1$ | $Fe_0$ | 1.43n | 1.45n | 0.29o | 0.30o | 1.94n | 1.97m | 163.45p | 164.78r |
| | $Fe_1$ | 1.67i | 1.71j | 0.35jk | 0.36jk | 2.06j | 2.07j | 170.53l | 171.65n |
| | $Fe_2$ | 1.74fg | 1.90f | 0.41g | 0.45f | 2.24g | 2.26f | 177.12h | 178.60i |
| | $Fe_3$ | 1.78bc | 2.05b | 0.49cd | 0.52bc | 2.34bc | 2.40bc | 182.23d | 183.44d |
| $L_2$ | $Fe_0$ | 1.55l | 1.59l | 0.32mn | 0.33mn | 1.98lm | 2.00l | 167.12n | 168.08p |
| | $Fe_1$ | 1.73g | 1.82h | 0.37hi | 0.39hi | 2.17h | 2.19h | 174.96j | 175.89l |
| | $Fe_2$ | 1.76de | 1.97d | 0.47e | 0.50d | 2.29ef | 2.33d | 179.70f | 180.23g |
| | $Fe_3$ | 1.81a | 2.08a | 0.51ab | 0.55a | 2.39a | 2.45a | 183.83b | 185.24b |
| $G_1$ | $Fe_0$ | 1.48m | 1.50 m | 0.31n | 0.32no | 1.96mn | 1.99lm | 165.23o | 166.34q |
| | $Fe_1$ | 1.70h | 1.76i | 0.36ij | 0.38ij | 2.09i | 2.12i | 172.77k | 173.00m |
| | $Fe_2$ | 1.75ef | 1.94e | 0.44f | 0.48e | 2.27f | 2.29e | 178.89g | 179.48h |
| | $Fe_3$ | 1.79b | 2.05b | 0.50bc | 0.53b | 2.35b | 2.42b | 183.02c | 184.35c |
| $G_2$ | $Fe_0$ | 1.57k | 1.60l | 0.33lm | 0.34lm | 1.99kl | 2.01kl | 167.40n | 168.26p |
| | $Fe_1$ | 1.73g | 1.83h | 0.37hi | 0.40h | 2.18h | 2.20gh | 175.30j | 176.29k |
| | $Fe_2$ | 1.77cde | 2.00c | 0.48de | 0.51cd | 2.30de | 2.34d | 180.00f | 181.00f |
| | $Fe_3$ | 1.82a | 2.09a | 0.52a | 0.56a | 2.40a | 2.47a | 184.33a | 185.67a |
| #optimum level | | N:1.50–3.50 | | P:0.11–0.80 | | K:0.70–4.00 | | Fe:18–250 | |

Means that having the same letter (s) in each column or row are not significantly different at 5% level. Cont.: spraying with water, $L_1$: Licorice extract at 3g/l, $L_2$: Licorice extract at 5g/l, $G_1$: garlic extract at 2% and $G_2$: garlic extract at 4%.$Fe_0$ without magnetic iron, $Fe_1$: magnetic iron at 250 g ,$Fe_2$: magnetic iron at 500 g and $Fe_3$: magnetic iron at 750 g.#Optimum level: was prepared utilizing from Jones et al. (1991)

*Soil nutrient contents*

*Effect of magnetic iron treatment on soil chemical properties*

Figure 1 clears that there was a noticeable gradual decrease in EC and pH in soil paste extract after using magnetic iron treatment in season 2017 and 2018 respectively. In respect to the essential elements for plants, i.e. Cl and Na, the results reveal that magnetic iron treatment affected the solubility of those elements in the soil and decreased them gradually with the increase of used magnetic iron. It appears that magnetic treatment leads to an intensive reduction of soluble Na salts. The optioned results clearly shown that EC, pH, Cl and Na in the second season decreased noticeably as a result of the positive accumulative effect of the first season treatments.

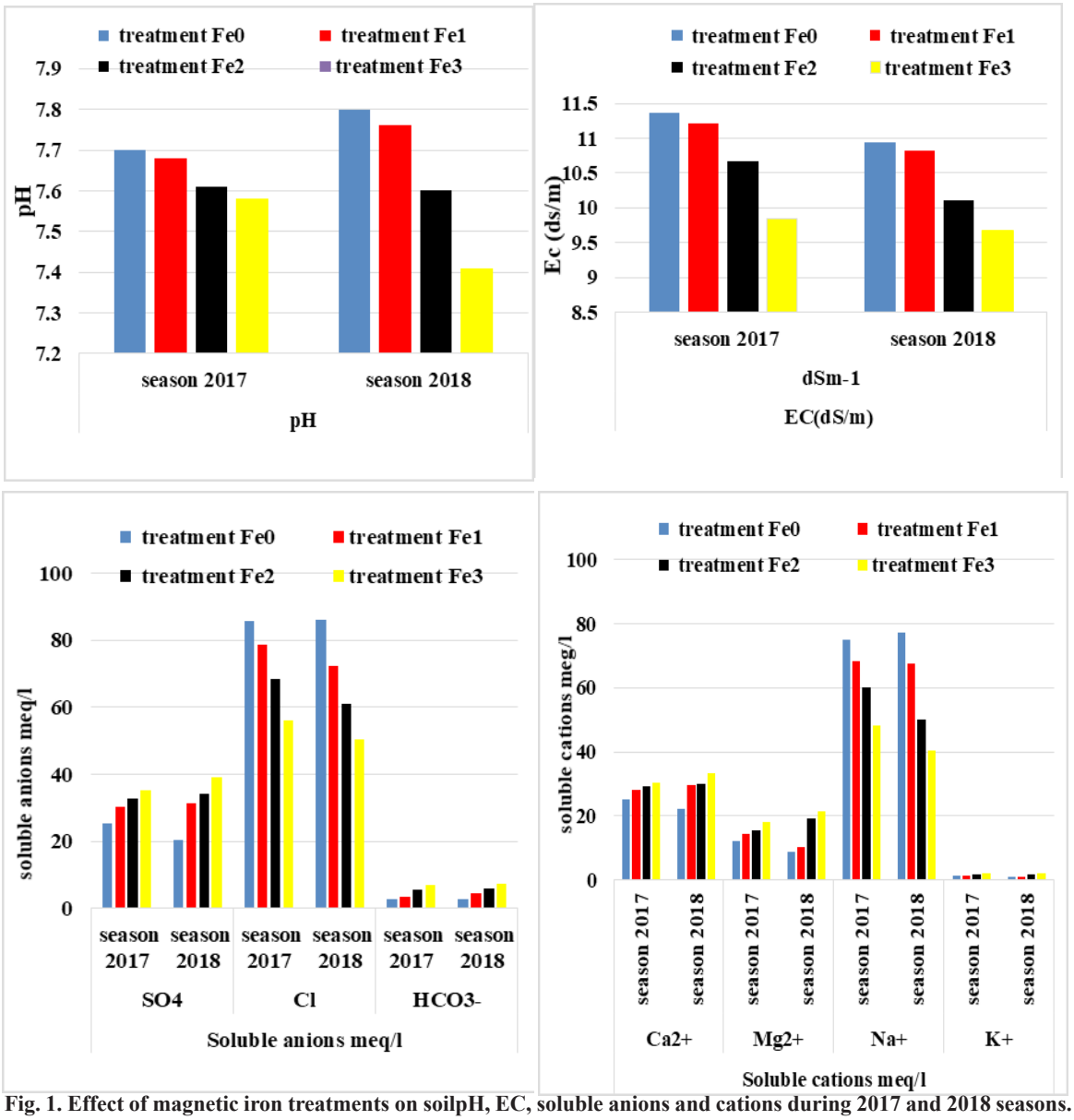


**Fig. 1. Effect of magnetic iron treatments on soilpH, EC, soluble anions and cations during 2017 and 2018 seasons.**

## Discussion

The general positive effects for adding magnetic iron tothe soil and spraying licorice and garlic extracts that observed on fruit set, yield, NPK in the leaf and some physical and chemical characteristics of Ferehy date palm cultivar and some properties of soil could be due to that magnetic field may be plays an important role in cations uptake capacity and has a positive effect on immobile plant nutrient uptake. Moreover, the magnetic process separates all chlorine which is toxic and harmful gases from the soil, increased salt movement and solubility of nutrients, increased water retention by soil and this help in plant growth, moderation of soil temperature (Mohammed et al., 2010). Moreover, the magnetic iron has a positive role in nutrients assimilation and absorption that consequently increasing fruit quality and yield. Plants have absorbed more water with magnetic iron than non-treated and that consequently enhanced the uptake of more nutrients which play an important role in improving the quality of fruit. In addition, magnetic iron improved soil structure, increased soil organic matter, improved water properties and become more energy and vigor and this known as "Magneto biology', that improved water holding capacity and cations exchange capacity, improved crop nutrition content from macro and micro

elements (Mansour, 2007, Aladjadjiyan, 2010 and Esitken & Turan, 2004). In addition, Hilal et al. (2012) mentioned that total salts removal from the soil with magnetic treatment was greater by 24.39% compared with non-mantic. Furthermore, magnetic treatment removes the excess of soluble salts and leaches the salts far away from root zone (Hilal et al., 2012 and Abou El Yazied et al., 2012). In addition, Abou El Yazied et al. (2012) showed that the reduction in soil pH is due to the effect of magnetic field on organic matter in the soil where it releases relatively greater of organic acids in the rhizosphere. In addition, magnetic treatments lead to an increase in all elements content except sodium. This is because of Na is paramagnetic elements which have a small positive susceptibility to magnetic fields, while other elements are diamagnetic which are slightly repelled by a magnetic field (Nave, 2008). Moreover, Hilal et al. (2012) recorded that there was an increase in Ca, Mg, K concentration into plants. Selim (2008) indicated that magnetic treatment has induced changes in the mobility of nutrient elements in root zone since there was the difference from one element to another according to element magnetic susceptibility. These results are harmony with those obtained by Abd El-Rahman, Amira, (2016) on grape. Ismail et al. (2010), Hoda et al. (2013) and Abobatta (2015) on Valencia orange. They cleared that salt stressed transplants when magnetic Iron added to soil as recovering substances were more effective in alleviating the adverse of salinity on vegetative growth, yield production and the fruit quality. In addition, some studies reported that magnetic field had a positive effect on the number of flowers, total yield and nutrient uptake (Abobatta 2015). In addition, the enhancement of fruit quality and yield could be due to the effective components of garlic and licorice extract (i.e., some growth regulators, antioxidants, protein, amino acid nutritive, minerals and phytohormone) (Arystanova et al., 2001). Furthermore, garlic extract improved vegetative growth, leaves content of N, P and k, fruit set, yield andfruit TSS of mango cv. FagriKalan (El-Sharony et al., 2015). Moreover, Abd El-Razek et al. (2013) on 'Le Conte' pear, Mostafa and El-Yazal (2013) on "Anna" apple trees and Leonel et al. (2015) on fig tree, found that spraying garlic extract enhanced fruit set, total number of fruits, productivity and fruit quality. Sheren and Weal (2017) on peach, Hussein (2008) on date palm, Al-Hadethi et al. (2012), Sheren and Eman (2015) and Shakir and Al-Rawi (2017) on pear reported that spraying trees with licorice improved vegetative growth, leaves content of nitrogen, potassium, iron, zinc, yield and fruit quality.

## Conclusion

Regarding the mentioned results, it can be concluded that under salinitys tress, spraying Ferehy date palm with licorice extract at 5g/l or garlic extract at 4% with adding magnetic iron at 750 g to the soil will be improve fruit quality and productivity and could be recommendeddue to their environmentally friendly treatment, high potentiality as well as the nutritive value.

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## تحسين انتاجيه وجوده ثمار نخيل البلح صنف الفريحى تحت ظروف واحه سيوه

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أجريت هذه الدراسة خلال موسمين متتاليين (٢٠١٧ و ٢٠١٨) في محطة بحوث سيوة ( بمزرعة تجزرتى)، مركز بحوث الصحراء ، واحة سيوة ، محافظة مطروح ، مصر. كان الهدف من هذا البحث هو دراسة تأثير الحديد المغناطيسي وخلاصة عرق السوس ومستخلص الثوم على إنتاجية وجودة الثمار والمحتوى المعدنى لأوراق نخيل البلح الفريحى المتاثر بالملوحه. في هذه التجربة ، تم تطبيق أربعة معاملات من الحديد المغناطيسي على التربة في فصل الشتاء[٠ ($Fe_0$) ، 250جم ($Fe_1$) ، 500جم ($Fe_2$) و ٧٥٠ جم($Fe_3$)] إلى جانب الرش باستخدام مستخلص عرق السوس ومستخلص الثوم (منشطات نمو طبيعيه) ، على النحو التالي: الرش بالماء كمعامله المقارنه ، $L_1$: مستخلص عرق السوس ٣ جم / لتر ، $L_2$:مستخلص عرق السوس ٥ جم / لتر :$G_1$ مستخلص الثوم بتركيز ٢ ٪ و : $G_2$ مستخلص الثوم بتركيز ٤ ٪. تم رش الأشجار ثلاث مرات خلال موسمى الدراسة (بعد العقد ، وبعد شهر واحد من العقد وبعد شهرين من العقد). أظهرت النتائج أن جميع المعاملات كانت فعالة في نسبه العقد ، والمحتوي المعدني للأوراق ، والمحصول ، والخصائص الفيزيائية والكيميائية للثمار والتربة. عموما ، كانت المعامله بالحديد المغناطيسي ٧٥٠ جم ($Fe_3$) أفضل من المعاملات الأخرى . بالإضافة إلى ذلك ، سجلت $G_2$ تحت $Fe_3$ أعلى نسبه عقد ، وزن السباطه ، كمية المحصول ، وزن للثمرة ووزن اللحم. بينما أعطى $G_2$ و $L_2$ تحت $Fe_3$ أعلى نسبة لحم للثمرة وطول الثمرة وقطر الثمرة والمواد الصلبة الذائبة الكلية والسكريات المختزلة والغير مختزلة والسكريات الكلية ومحتوى الاوراق من النيتروجين والفوسفور والبوتاسيوم والحديد وانخفاض الحموضة والتانينات الكلية. علاوة على ذلك، انخفضت قيمة EC و pH للتربة وكذلك انخفض كل من Cl و Na في التربة باستخدام اعلى معدل من الحديد المغناطيسى ($Fe_3$) في كلا الموسمين.