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# Effect of Magnetic Iron and Potassium Humate on Growth, Yield and Fruit Quality of pomegranate Trees in Siwa Oasis, Egypt

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## ABSTRACT

This study is to evaluate the effect of magnetic iron (100 and 200g/tree) and potassium humate (25 and 50 g/tree) treatments on growth yield and fruit quality of Manfalouty pomegranate trees under Siwa Oasis – Matrouh Governorate conditions (saline soil and water), during two successive seasons 2015and 2016. There was significant improve by the different magnetic iron and potassium humate treatments on the growth, tree productivity and fruit quality. The analysis of the data collected during the study recorded that there were statistically significant increases in vegetative growth, fruit yield and fruit quality with different doses of magnetic iron and potassium humate treatments. The results also indicated that potassium humate at 25, 50g/tree was superiority and more effective in increasing the growth yield and fruit quality of Manfalouty pomegranate trees compared to magnetic iron at 100, 200g/tree and as compared with control in both studied seasons. Finely, from recorded data it can be concluded that when the most effective treatments i.e. was compared with the control these treatments can be descending as follows; magnetic iron at 200g/tree + potassium humate at 50g/tree followed by magnetic iron at 200g / tree + potassium humate at 25g / tree, magnetic iron at 100g / tree + potassium humate at 50g / tree and then by magnetic iron at 100g / tree + potassium humate at 25g / tree. In addition the response of the different growth , yield and fruit quality parameters of Manfalouty pomegranate for the abovementioned four treatments can be descending as follows; vegetative growth > yield > fruit quality.

***Key words:*** Manfalouty pomegranate, Magnetic iron, potassium humate, Vegetative growth, Yield, Fruit quality.

## Introduction

Pomegranate (*Punica granatum* L.) is a well-known table fruit of tropical and subtropical regions of the world. It belongs to genera *Punica* and family Punicaceae. In Egypt The cultivated area nowadays, acreage is rapidly increasing under the new reclaimed lands. The total cultivated area is about 71252.5 feddans produced about 219663 tons (according to Ministry of Agriculture and Land Reclamation (Annual Report 2015).

About three million feddans of arable land too saline for agriculture and hundreds of thousands feddans of agriculture productive land are lost annually for food production due to salinization (FAO, 2008). Salinity stress depresses plant growth and development at different physiological levels. The mechanism by which salt stress damage plants are still a discussing matter due to very complex nature of the salt stress in plants (Zhu, 2001). Pomegranate growth, yield and water use efficiency significantly affected by salinity and drought stresses were applied in combination (Mojtaba *et al* 2015). Saline water in irrigation reduces the length of stem, length and number of the internodes, leaf area and root development in pomegranate (Amri *et al* 2011). Salinity stress is a major abiotic stress adversely reduced growth and productivity of date palm (Erskine *et al*., 2004). Salinity stress induces an impact growth and productivity of date palm, and decreases the net photosynthesis and chlorophyll levels of date palm (Abdoulhadi *et al*., 2012). (Amro *et al*, 2014 and El-Khawaga, 2013) showed that potassium and EM foliar application under saline stress enhance leaf chlorophyll content, fruit set

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percentage, retained fruit percentage, yield, fruit quality and leaf minerals content of "Hayany","Sewy" and "Zaghloul" cultivars date palm.

Humic acid (polymeric polyhydroxy acid) is the most significant component of organic substances in aquatic systems. Humic acid is highly beneficial to both plant and soil; it is Important for increasing microbial activity, it is considered as a plant growth bio-stimulate, an effective soil enhancer; it promotes nutrient uptake as chelating agent and improves vegetative characteristics, nutritional status and leaf pigments (Eissa *et al*, 2007). Potassium humate increases production and quality of a crop, plant tolerance to drought stress, salinity, heat, cold, disease and pests (Jalilm. *et al*, 2013). Also, humate highly beneficial for both plant and soil; it maintains proper plant growth as well as it increases nutrient uptake, tolerance to drought and availability of soil nutrients particularly in calcareous soil and low organic matter of soil (Ismail *et al.,* 2007). Therefore, applying biofertilizers such as Humic acids (HA) which considered the main fractions of humic substances (HS) and the most active components of soil and compost organic matter (Ferrara and Brunetti, 2010), could be useful for increasing the productivity and quality of Superior seedless grape. HA have been shown to stimulate plant growth and consequently yield by acting on mechanisms involved in: cell respiration, photosynthesis, protein synthesis, water and nutrient uptake, enzyme activities (Aseri, 2008 on pomegranate (*Punica granatum* L.); Chen *et al.*, 2004; Nardi *et al.*, 1996 and Concheri *et al.*, 1994). Picual olive trees sprayed with humic acid as foliar application on tree at (0.5 %) at the begging of fruit set obtained the highest yield (kg/tree) as while as average fruit size, weight, and pulp/pit ratio also fruit oil percentage rather than low concentration of humic acid. (Hagagg *et al*,2013).Humic acid treatments (foliar and soil applications) markedly increased the growth parameters (shoot length, number of leaves / shoot and leaf area), yield and fruit physical and chemical properties (fruit firmness, juice SSC and SSC / acidity ratio) of 'Canino' apricot (Fathy *et al*, 2010 and Eissa 2003).Therefore, uses of humic acid improve nutrient availability especially microelements in calcareous soils since it promotes nutrient uptake as chelating agent. Furthermore, humic materials may increase root growth in a similar manner to auxins (Tatini, *et al*., 1991 and Khattab *et al.*, 2012). Enhanced growth of pomegranate by using biofertilizers (Aseri *et al*, 2008).

Using magnetic iron ($Fe_3O4$), is one of the most important factors affecting plant growth. It has a black or brownish-red color and it is one of two natural row rocks in the world that is naturally magnetic (Mansour, 2007).Magnetite (Magnetite iron ore), Diatoms as a source of Silicon and some biofertilizer like (Azolla and Cyanobacteria) are the most important factors affecting plant growth, especially under salt conditions. Application of magnetic iron increased vegetative growth and yield on pepper plant grow under saline irrigation conditions, (Taha *et al.* (2011). Also, magnetic iron increased plant growth and leaf mineral content on cauliflower and on Roselle plants (*Hibiscus Sabdariffal*), (Yasser *et al.* (2011). Moreover, some studies reported that, magnetic field had a positive effect on the number of flowers and total yield, (Matsudo *et al.* 1993) on strawberry; (Podlesny *et al*. (2005) on pea. In addition, application of a magnetic field to irrigation water was shown to increase plant nutrient content, (Moon and Chung (2000). Eman, *et al*., (2010) indicated that, applied of 1000 g magnetite at December induced the highest values of vegetative growth , yield , and leaf mineral content of Le-Conte pear trees (shoot length, diameter, number of leaves and leaf area). The lower rates of magnetite were significantly increased growth, yield, fruit quality and leaf mineral content of Superior cv. grapevines as compared to the other treatments (Ismail, *et al.,* 2010). Soil application of natural elements compound (including magnetite) significantly improved growth, yield, and leaf mineral content of Navel orange trees Ibrahim, (2011 and Hoda, *et al* 2013 on Valencia orange trees on Valencia Orange Trees (*Citrus Sinensis* L.).

The present study was therefore, undertaken to study the effects of application of Magnetic iron and potassium humate as well as combinations on Manfalouty pomegranate growth, yield and fruit quality grown under saline water conditions located at Siwa Oasis, Egypt.

## Material and Methods

This study was carried out during 2015and 2016 seasons on fifty four Manfalouty pomegranate trees grown in khamisa research station farm at Siwa Oasis – Matrouh Governorate – Egypt. The trees are planted in sandy soil at 3x3 m apart and using drip irrigation system from underground water source. The experiment was arranged in a completely randomized block design. Every treatment was

replicated three times, two trees per each. Trees received the recommended horticulture management included the control. In this respect, the mineral fertilization treatments were added as a percent of the recommended rate by Ministry of Agric.i.e. 2Kg / tree of ammonium sulphate (20.6N) as a source of nitrogen and 1.0 Kg/tree of potassium sulphate (48%K2O) as a source of potassium per tree were added as soil application in three equal doses at February, April and June. 1.0 Kg/tree calcium superphosphate (15.5%P2O2) was added with15m3/feddan organic (sheep manure) in December of both seasons. Soil and water used irrigation were analyzed according to the method of Wilde *et al.,* (1985) and the data are presented in Table1.

**Table 1:** Some physical and chemical analysis of the experiment soil and irrigation water at khamisa research station.

| Soil depth (cm) | | Soil particles distribution (%) | | | Texture | $CaCO_3$ % | EC (dS/m) | pH |
|---|---|---|---|---|---|---|---|---|
| | | Sand | Silt | Clay | | | | |
| 0-30 | | 81.2 | 8.57 | 10.23 | Sand loamy | 56.99 | 9.56 | 7.7 |
| 30-60 | | 80.08 | 10.59 | 9.33 | Sand loamy | 52.48 | 10.35 | 7.9 |
| | | Soluble cations and anions melcL-1) in soil past extraction | | | | | | |
| | | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | $K^{+}$ | $SO_4^{-}$ | $Cl^{-}$ | $HCO_3$ | $CO_3$ |
| 0-30 | | 30.5 | 17.2 | 57.2 | 1.3 | 26.2 | 61.5 | 2.8 | - |
| 30-60 | | 26.8 | 15.8 | 49.5 | 0.7 | 23.5 | 59 | 3.5 | - |
| EC, pH and Soluble cations and anions in water of irrigation ($mmol_c$ $L^{-1}$) | | | | | | | | | |
| EC (dS/m) $dSm^{-1}$ | pH | Soluble Cations ($melcL^{-1}$) | | | | Soluble Anions ($melcL^{-1}$) | | | |
| | | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | $K^{+}$ | $SO_4$ | Cl | $HCO_3^{-}$ | $CO_3^{-}$ |
| 7.85 | 7.7 | 20.5 | 8.5 | 32.95 | 0.35 | 11.8 | 57.5 | 9.5 | - |

The experiment was designed to study the effect of magnetic iron and humic acid as well as combinations on Manfalouty pomegranate. For achieving the previous goal the following nine treatments were carried out:

1- Control.
2- Magnetic iron at 100g/tree/year.
3- Magnetic iron at 200g/tree/year.
4- Potassium humate at 25g/tree/year.
5- Potassium humate at 50g/tree/year.
6- Magnetic iron at 100g/tree + potassium humate at 25g/tree.
7- Magnetic iron at 100g/tree + potassium humate at 50g/tree.
8- Magnetic iron at 200g/tree + potassium humate at 25g/tree.
9- Magnetic iron at 200g/tree + potassium humate at 50g/tree.

All treatments were addition three times annually at growth start, just after fruit setting and one month later. Four branches from four directions of each tree were chosen and labeled in March during the two seasons. The number of new shoots, leaf area ($cm^2$) according to Ahmed and Morsy (1999), total chlorophyll contents by using Minolta chlorophyll meter SPAD- 502 was estimated on the selected branches. At the harvest time in both seasons, yield/tree (kg) and yield/feddan (ton) was estimated.

Five fruits per each labeled branch from four directions of each tree were randomly selected for carrying out the number of fruit /tree and fruit quality which includes the following parameters: fruit weight (g), fruit length (cm) and fruit diameter(cm) fruit volume ($cm^3$) according to A.O.A.C. (2000). Also, fruit peel (%), fruit grain (%), weight of 100 grains (g) and juice (%). Total soluble solids (TSS) content was tested by using a hand refractometer, total acidity as percentage of Citric acid acid in fresh weight, tss/acid ratio and total sugars of fruit was estimated according to A.O.A.C. (2000). Vitamin C was determined by the titration with dichlorophenol indophenol blue dye and expressed as mg vitamin C /100 ml juice. Tannins content was measured in the juice by the method described by Winton and Winton, (1945). Also, total anthocyanin content in fruit juice was determined as described by Hsia *et al.,* (1965).

All the obtained data during both 2015 and 2016 experimental seasons were subjected to analysis of variances (ANOVA) according to Snedecor and Cochran (1982).

## Results and Discussion

### 1. Tree growth:

Results in (Table, 1) showed that all treatments increased all the Manfalouty pomegranate trees vegetative growth characters (shoot length, number of leaves per shoot, leaf area and total chlorophyll) compared with the control. The results also indicated that potassium humate at 25 and 50g/tree was more effective in increasing the shoot length, number of leaves per shoot, leaf area and total chlorophyll compared to magnetic iron and as compared with control in both studied seasons. Furthermore, results in the same table (Table,1) mentioned that combination treatments between magnetic iron and potassium humate were gave more significant effect with superiority for magnetic iron at 200g/tree + potassium humate at 50g/tree followed by magnetic iron at 200g/tree + potassium humate at 25g/tree , magnetic at 100g/tree + potassium humate at 50g/tree and then by magnetic at 100g/tree + potassium humate at 25g/tree as compared with control and other treatments in both seasons of this study and then than of any one alone on vegetative growth characters (shoot length, number of leaves per shoot, leaf area and total chlorophyll) of Manfalouty pomegranate trees. Vegetative growth attributes, were increased with various significance levels as a result of applying magnetic iron and potassium humate to improve salinity stress risistance,then to enhance growth ,yield and fruit quality .These results are harmony with those obtained by, Eissa (2003); Eissa *et al*, (2007); Ismail *et al*, (2007); Ismail, *et al.,* (2010); Fathy *et al*, (2010) ; Taha *et al.* (2011); Ibrahim, (2011); Hoda, *et al* (2013) on Valencia orange trees on Valencia Orange Trees (*Citrus Sinensis* L.)

**Table 1:** Effect of Magnetite and potassium humate on vegetative growth parameters of Manfalouty pomegranate trees during 2015 and 2016 seasons.

| Treatments | Shoot length (cm) | | No. of leaves/shoot | | Leaf area ($cm^2$) | | Total chlorophyll | |
|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| Control | 18.88 | 19.67 | 15.07 | 18.16 | 2.54 | 2.61 | 33.92 | 35.70 |
| Magnetite at 100g/tree | 19.66 | 24.41 | 15.50 | 19.70 | 2.92 | 3.03 | 35.59 | 39.41 |
| Magnetite at 200g/tree | 23.78 | 27.70 | 16.01 | 20.32 | 3.30 | 3.45 | 36.04 | 42.01 |
| Potassium humate at 25g/tree | 28.88 | 32.55 | 16.90 | 20.87 | 3.64 | 3.72 | 39.39 | 45.04 |
| Potassium humate 50g/tree | 29.51 | 33.70 | 17.59 | 22.06 | 4.24 | 4.06 | 39.14 | 45.54 |
| Magnetite at 100g/tree + potassium humate at 25g/tree | 30.59 | 35.68 | 18.59 | 22.21 | 4.70 | 4.48 | 40.23 | 46.50 |
| Magnetite at 100g/tree + potassium humate at 50g/tree | 32.22 | 35.69 | 19.25 | 23.06 | 4.72 | 4.81 | 40.85 | 46.51 |
| Magnetite at 200g/tree+ potassium humate at 25g/tree | 33.87 | 36.28 | 19.73 | 23.77 | 4.95 | 4.88 | 42.47 | 47.53 |
| Magnetite at 200g/tree+ potassium humate at 50g/tree | 34.01 | 37.50 | 20.72 | 24.26 | 5.02 | 4.92 | 42.86 | 48.55 |
| LSD at 0.5% | 1.876 | 1.858 | 1.085 | 1.085 | 0.526 | 0.208 | 1.386 | 0.795 |

Furthermore, Mohammed *et al*., (2010) and Abd El-Monem *et al*., (2011) who indicated that there are many benefits to crop growth resulted from addition magnetic iron including improved soil structure, increased soil organic matter, improved water properties and become more energy and vigor and this known as "Magneto biology', improving water holding capacity and cation exchange capacity, Improved crop nutrition from macro and micro elements. Moreover, the magnetic process separate all chlorine, toxic and harmful gases from soil, increased salt movement and solubility of nutrients increasing water retention by soil and this help on plant growth, moderation of soil temperature. Improving plant nutrition by humic acid which stimulating the absorption of mineral elements through stimulating root growth and increases the rate of absorption of mineral ions on root surfaces and their penetration into the cells of the plant tissue, so plants show more active metabolism and increase respiratory activity.

**2. Fruit yield:**

Results in (Table, 2) showed the effect of different treatment on number of fruit/tree, fruit weight, yield (kg/tree) and yield (ton/feddan).It is clear from the obtained data that all treatments increased the entire Manfalouty pomegranate trees fruit yield characters i.e., number of fruit/tree, fruit weight, yield (kg/tree) and yield (ton/feddan) as compared with the control. On the other hand, results also indicated that potassium humate at 25g or 50g/tree was more effective and surpassed in increasing all fruit yield characters compared to magnetic iron at 100g or 200g/tree and compared with control in both studied seasons 2015 and 2016. Moreover, results in the same table2 illustrated that the highest values of all Manfalouty pomegranate fruit yield parameters with surpassed other treatments in both seasons were obtained with combination treatments between magnetic iron at 200g/tree + potassium humate at 50g/tree followed by magnetic iron at 200g/tree + potassium humate at 25g/tree , magnetic at 100g/tree + potassium humate at 50g/tree and then by magnetic at 100g/tree + potassium humate at 25g/tree as compared with control and other treatments in both seasons of this study and then than of any one alone on fruit yield characters i.e., number of fruit/tree, fruit weight, yield (kg/tree) and yield (ton/feddan) of Manfalouty pomegranate trees.

**Table 2:** Effect of Magnetite and potassium humate on fruit yield parameters of Manfalouty pomegranate trees during 2015 and 2016 seasons.

| Treatments | No. of fruit/tree | | Fruit weight (g) | | Yield (kg/tree) | | Yield (ton/feddan) | |
|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| Control | 25.72 | 25.84 | 293.46 | 283.86 | 7.54 | 7.57 | 3.51 | 3.53 |
| Magnetite at 100g/tree | 26.55 | 27.54 | 320.46 | 307.30 | 8.51 | 8.83 | 3.96 | 4.11 |
| Magnetite at 200g/tree | 29.14 | 28.79 | 337.93 | 339.44 | 9.84 | 9.72 | 4.59 | 4.53 |
| Potassium humate at 25g/tree | 32.06 | 29.74 | 358.70 | 358.70 | 11.49 | 10.66 | 5.36 | 4.97 |
| Potassium humate 50g/tree | 34.99 | 31.12 | 365.43 | 374.83 | 12.79 | 11.36 | 5.97 | 5.29 |
| Magnetite at 100g/tree + potassium humate at 25g/tree | 36.14 | 32.58 | 382.70 | 385.61 | 13.82 | 12.46 | 6.44 | 5.81 |
| Magnetite at 100g/tree + potassium humate at 50g/tree | 36.93 | 34.86 | 386.80 | 390.79 | 14.28 | 13.48 | 6.66 | 6.28 |
| Magnetite at 200g/tree+ potassium humate at 25g/tree | 37.86 | 35.94 | 399.06 | 407.33 | 15.10 | 14.33 | 7.04 | 6.68 |
| Magnetite at 200g/tree+ potassium humate at 50g/tree | 38.50 | 37.40 | 406.63 | 427.17 | 15.65 | 15.20 | 7.30 | 7.09 |
| LSD at 0.5% | 2.360 | 1.275 | 13.25 | 12.79 | 1.107 | 0.648 | 0.517 | 0.302 |

These results are harmony with those obtained by Eissa (2003); Eissa *et al*, (2007); Ismail *et al*, (2007); Ismail, *et al.,* (2010); Fathy *et al*, (2010) ; Taha *et al.* (2011); Ibrahim, (2011); Jalilm. *et. al*, (2013) Hoda, *et al* (2013) on Valencia orange trees on Valencia Orange Trees (*Citrus Sinensis* L.). Furthermore, Mohammed *et al*., (2010) and Abd El-Monem *et al*., (2011) who indicated that there are many benefits to crop growth resulted from addition magnetic iron including improved soil structure, increased soil organic matter, improved water properties and become more energy and vigor and this known as "Magneto biology', improving water holding capacity and cation exchange capacity, Improved crop nutrition from macro and micro elements. Moreover, the magnetic process separate all chlorine, toxic and harmful gases from soil, increased salt movement and solubility of nutrients increasing water retention by soil and this help on plant growth, moderation of soil temperature. Improving plant nutrition by humic acid which stimulating the absorption of mineral elements through stimulating root growth and increases the rate of absorption of mineral ions on root surfaces and their penetration into the cells of the plant tissue, so plants show more active metabolism and increase respiratory activity.

**3. Fruit quality:**

*A -Fruit physical properties:*

*Fruit Length, diameter and volume:*

The effect of the different treatments on fruit length, diameter and volume is presented in (Table, 3). A significant increase in fruit length, width and volume of Manfalouty pomegranate trees was obtained in both seasons by all addition magnetic iron and potassium humate alone or combination compared to the control. Regarding, In both seasons 2015 and 2016, the highest fruit length, diameter and volume were obtained by soil addition magnetic iron at 200g/tree + potassium humate at 50g/tree followed by magnetic iron at 200g/tree + potassium humate at 25g/tree, magnetic at 100g/tree + potassium humate at 50g/tree and then by magnetic at 100g/tree + potassium humate at 25g/tree comparison to control or other treatments (Table 3). In general, results also indicated that potassium humate at 25g or 50g/tree was more positive effective in increasing all fruit length, diameter and volume compared to magnetic iron at 100g or 200g/tree and as compared with control in both studied seasons.

**Table 3:** Effect of Magnetite and potassium humate on fruit length, width and volume of Manfalouty pomegranate trees during 2015 and 2016 seasons.

| Treatments | Fruit length (cm) | | Fruit diameter (cm) | | Fruit volume ($cm^3$) | |
|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| Control | 6.59 | 6.73 | 7.65 | 7.48 | 262.39 | 263.45 |
| Magnetite at 100g/tree | 6.85 | 7.25 | 8.10 | 7.76 | 275.51 | 283.50 |
| Magnetite at 200g/tree | 7.14 | 7.53 | 8.76 | 8.27 | 283.00 | 292.63 |
| Potassium humate at 25g/tree | 7.66 | 7.74 | 8.91 | 8.64 | 288.14 | 309.79 |
| Potassium humate 50g/tree | 7.94 | 7.93 | 8.92 | 8.94 | 291.50 | 320.95 |
| Magnetite at 100g/tree + potassium humate at 25g/tree | 7.83 | 8.15 | 9.12 | 9.31 | 291.94 | 336.92 |
| Magnetite at 100g/tree + potassium humate at 50g/tree | 7.99 | 8.45 | 9.32 | 9.68 | 298.77 | 342.00 |
| Magnetite at 200g/tree+ potassium humate at 25g/tree | 8.30 | 8.77 | 9.68 | 10.33 | 325.18 | 353.39 |
| Magnetite at 200g/tree+ potassium humate at 50g/tree | 8.49 | 8.92 | 9.84 | 10.68 | 333.25 | 361.76 |
| LSD at 0.5% | 0.296 | 0.236 | 0.336 | 0.255 | 10.17 | 9.435 |

*Fruit Peel % and Fruit Grain %:*

Data in (Table,4) indicated that the fruit peel percentage had the highest values with untreated trees(control) while, the lowest values were obtained from trees treated with magnetic iron at 100g or 200g/tree and potassium humate at25g or 50g/tree treatment and the mixture between them in the first and second seasons. Meanwhile, fruit grain percentage reached to the maximum values as by using magnetic iron at 100g or 200g/tree and potassium humate 25g or 50g/tree treatment and the mixture between them, while the lowest values were obtained from untreated trees in both seasons. In this respect, combination treatments between magnetic iron and potassium humate were gave more significant effect with superiority for magnetic iron at 200g/tree + potassium humate at 50g/tree followed by magnetic iron at 200g/tree + potassium humate at 25g/tree, magnetic at 100g/tree + potassium humate at 50g/tree and then by magnetic at 100g/tree + potassium humate at 25g/tree as compared with control and other treatments in both seasons of this study. These findings are in line with earlier reported by Rahemi and Atahosseini (2004) on pomegranate. Jalilm. *et. al*, (2013) they recorded that Potassium humate increases production and quality of a crop, plant tolerance to drought stress, salinity, heat, cold, disease and pests

*Weight of 100grains (g) and Fruit Juice %:*

Data in (Table, 4) recorded that, weight of 100grain recorded the significantly increased with all Magnetic iron and potassium humate id treatments and the combination between them in both seasons with superiority for magnetic iron at 200g/tree + potassium humate at 50g/tree compared to control and other treatments. Meanwhile, fruit juice percentage was more affected significantly by using magnetic iron at 100g or 200g/tree and potassium humate at25g or 50g/tree treatment and the mixture between them as compared with control. On the other hand, combination treatments between magnetic iron and potassium humate were gave more significant effect with superiority for magnetic iron at 200g/tree + potassium humate at 50g/tree followed by magnetic iron at 200g/tree + potassium humate at 25g/tree, magnetic at 100g/tree + potassium humate at 50g/tree and then by magnetic at 100g/tree + potassium humate at 25g/tree as compared with control and other treatments in both seasons of this study. These results are in harmony with those obtained by of Fathy *et al*, (2010) on 'Canino' apricot and Ismail, *et al.,* (2010) on Superior cv. grapevines. Jalilm. *et al*, (2013) they recorded that Potassium humate increases production and quality of a crop, plant tolerance to drought stress, salinity, heat, cold, disease and pests

**Table 4:** Effect of Magnetite and potassium humate on fruit physical properties of Manfalouty pomegranate trees during 2015 and 2016 seasons.

| Treatments | Fruit peel (%) | | Fruit grain (%) | | Weight of 100grains(g) | | Juice (%) | |
|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| Control | 47.15 | 48.90 | 52.89 | 47.76 | 25.72 | 25.69 | 32.54 | 32.88 |
| Magnetite at 100g/tree | 45.33 | 40.70 | 54.67 | 59.29 | 26.80 | 27.31 | 36.84 | 36.77 |
| Magnetite at 200g/tree | 45.01 | 40.03 | 54.99 | 59.99 | 27.40 | 28.76 | 36.72 | 36.96 |
| Potassium humate at 25g/tree | 39.97 | 36.96 | 60.00 | 63.40 | 29.15 | 29.91 | 38.07 | 37.85 |
| Potassium humate 50g/tree | 39.77 | 36.60 | 60.11 | 63.04 | 29.07 | 30.83 | 40.60 | 38.73 |
| Magnetite at 100g/tree + potassium humate at 25g/tree | 39.17 | 34.36 | 60.83 | 65.65 | 29.87 | 31.76 | 40.79 | 39.37 |
| Magnetite at 100g/tree + potassium humate at 50g/tree | 38.43 | 33.61 | 61.64 | 66.39 | 31.44 | 34.53 | 41.42 | 39.83 |
| Magnetite at 200g/tree+ potassium humate at 25g/tree | 38.36 | 33.55 | 61.57 | 66.45 | 33.24 | 36.25 | 41.35 | 41.35 |
| Magnetite at 200g/tree+ potassium humate at 50g/tree | 37.97 | 32.60 | 62.03 | 67.40 | 34.20 | 37.55 | 42.02 | 43.17 |
| LSD at 0.5% | 1.127 | 4.152 | 1.103 | 3.940 | 1.530 | 1.341 | 2.246 | 0.933 |

**B -Fruit chemical properties:**

*TSS, Acidity, TSS/acidity ratio and Total sugars (%):*

It is noticed from (Table,5) that, all treatments tended to increase fruit TSS (%),TSS/acidity ratio and Total sugars (%) and to decrease fruit acidity (%) as compared to control treatment. In more details and regarding fruit TSS percentage, TSS/Acid ratio and total sugars percentage the highest values were obtained by the use of magnetic iron at 200g / tree + potassium humate at 50g / tree followed by magnetic iron at 200g/tree + potassium humate at 25g / tree, magnetic at 100g / tree + potassium humate at 50g / tree and then by magnetic at 100g / tree + potassium humate at 25g / tree as compared with control and other treatments during two seasons. As for acidity %, data in Table (5) revealed that, all treatments reduced acidity, whereas, the lowest values were obtained by use of magnetic iron at 200g / tree + potassium humate at 50g / tree compared to control and other treatments during two seasons. Moreover, results also indicated that potassium humate at 25g or 50g/tree was more effective in increasing all fruit TSS percentage, TSS/Acid ratio and total sugars percentage as compared to magnetic iron at 100g or 200g/tree and compared with control in both studied seasons.

*Vitamin C (mg/100ml), Tannins Content % and Total Anthocyanin (mg/100ml):*

Results in (Table, 6) show that, soil addition magnetic iron and potassium humate to Manfalouty pomegranate trees with the mixture had significant effect on vitamin C, tannins content and anthocyanin contents in pomegranate fruits in both seasons. Regarding fruit vitamin C, tannins content and anthocyanin contents the highest values were recorded by the use of magnetic iron at 200g/tree + potassium humate at 50g/tree followed by magnetic iron at 200g/tree + potassium humate at 25g/tree, magnetic at 100g/tree + potassium humate at 50g/tree and then by magnetic at 100g/tree + potassium humate at 25g/tree as compared with control and other treatments during two seasons. In this regard, data from the same table mentioned that potassium humate at25g or 50g/tree was more effective in increasing all fruit vitamin C, tannins content and anthocyanin contents as compared with magnetic iron at 100g or 200g/tree and compared with control in both studied seasons 2015 and 2016.

**Table 5:** Effect of Magnetite and potassium humate on fruit chemical properties of Manfalouty pomegranate trees during 2015 and 2016 seasons.

| Treatments | TSS (%) | | Acidity (%) | | TSS/acidity ratio | | Total sugars (%) | |
|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| Control | 15.43 | 15.94 | 2.84 | 2.91 | 5.44 | 5.49 | 10.56 | 11.58 |
| Magnetite at 100g/tree | 16.32 | 16.76 | 2.78 | 2.81 | 5.97 | 5.97 | 10.77 | 11.71 |
| Magnetite at 200g/tree | 16.51 | 17.30 | 2.29 | 2.67 | 7.58 | 6.48 | 11.39 | 11.73 |
| Potassium humate at 25g/tree | 17.06 | 17.75 | 1.46 | 2.01 | 11.72 | 9.16 | 11.82 | 12.35 |
| Potassium humate 50g/tree | 17.39 | 18.11 | 1.51 | 1.78 | 11.54 | 10.25 | 11.96 | 12.70 |
| Magnetite at 100g/tree + potassium humate at 25g/tree | 17.18 | 18.00 | 1.42 | 1.78 | 12.10 | 10.15 | 12.26 | 12.82 |
| Magnetite at 100g/tree + potassium humate at 50g/tree | 17.72 | 18.21 | 1.37 | 1.46 | 12.96 | 12.52 | 12.68 | 13.28 |
| Magnetite at 200g/tree+ potassium humate at 25g/tree | 17.85 | 18.56 | 1.35 | 1.29 | 13.23 | 14.40 | 12.88 | 13.71 |
| Magnetite at 200g/tree+ potassium humate at 50g/tree | 17.61 | 18.76 | 1.32 | 1.22 | 13.31 | 15.38 | 13.36 | 14.13 |
| LSD at 0.5% | 0.598 | 0.435 | 0.350 | 0.159 | 1.314 | 1.182 | 0.519 | 0.421 |

**Table 6:** Effect of Magnetite and potassium humate on fruit chemical properties of Manfalouty pomegranate trees during 2015 and 2016 seasons.

| Treatments | V.C (mg/100ml juice) | | Tannins (%) | | Anthocyanin (mg/100ml) | |
|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| Control | 11.88 | 11.93 | 2.27 | 2.25 | 13.89 | 14.52 |
| Magnetite at 100g/tree | 13.06 | 12.45 | 2.28 | 2.27f | 15.45 | 15.39 |
| Magnetite at 200g/tree | 13.74 | 12.70 | 2.28 | 2.28 | 15.95 | 15.71 |
| Potassium humate at 25g/tree | 14.41 | 13.84 | 2.32 | 2.29 | 16.53 | 15.72 |
| Potassium humate 50g/tree | 14.91 | 15.35 | 2.33 | 2.31 | 16.93 | 16.29 |
| Magnetite at 100g/tree + potassium humate at 25g/tree | 15.10 | 16.45 | 2.38 | 2.33 | 17.36 | 15.94 |
| Magnetite at 100g/tree + potassium humate at 50g/tree | 15.99 | 16.22 | 2.39 | 2.37 | 17.78 | 16.74 |
| Magnetite at 200g/tree+ potassium humate at 25g/tree | 16.35 | 16.80 | 2.45 | 2.42 | 18.10 | 16.93 |
| Magnetite at 200g/tree+ potassium humate at 50g/tree | 16.78 | 16.86 | 2.46 | 2.45 | 18.17 | 17.26 |
| LSD at 0.5% | 0.780 | 0.828 | 0.061 | 0.027 | 0.794 | 0.749 |

These results are harmony with those obtained by, Eissa (2003); Eissa *et al*, (2007); Ismail *et al*, (2007); Ismail, *et al.,* (2010); Fathy *et al*, (2010) ; Taha *et al.* (2011); Ibrahim, (2011); Hoda, *et al* (2013) on Valencia orange trees on Valencia Orange Trees (*Citrus Sinensis* L.). Jalilm. *et. al*, (2013)

they recorded that Potassium humate increases production and quality of a crop, plant tolerance to drought stress, salinity, heat, cold, disease and pests

Furthermore, Mohammed *et al*., (2010) and Abd El-Monem *et al*., (2011) whom indicated that there are many benefits to crop growth resulted from addition natural mineral product like magnetic iron ore including improved soil structure, increased soil organic matter, improved water properties and become more energy and vigor and this known as "Magneto biology" improving water holding capacity and cation exchange capacity, Improved crop nutrition from macro and micro elements. Moreover, the magnetic process separate all chlorine, toxic and harmful gases from soil, increased salt movement and solubility of nutrients increasing water retention by soil and this help on plant growth, moderation of soil temperature. Improving plant nutrition by humic acid which stimulating the absorption of mineral elements through stimulating root growth and increases the rate of absorption of mineral ions on root surfaces and their penetration into the cells of the plant tissue, so plants show more active metabolism and increase respiratory activity.

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