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STUDIES ON REDUCING THE HARMFUL EFFECT OF SALINE WATER IRRIGATION ON PICUAL OLIVE TREES.

A. M. Gowda ; A. A. El- Taweel and K. B. Eassa
Olive and Fruits of semi Arid Zone Dep.,Hort.Res. Inst., A.R.C.,Cairo,Egypt.
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ABSTRACT*: The present study was carried out during two successive seasons 2009 and 2010 on15-year.old Picual olive trees grown in sandy loam soil, under drip irrigation system using saline water , in a private orchard located at Cairo- Assiut west desert road (about 180 km south Cairo)–Beni Mazar distract, Minia Governorate. The objective of this study was to investigate the utilization of natural elements compounds at three rates; sulphur at (0.5,1.0, 1.5 kg/tree), feldspar at (1,2,3 kg/tree) and magnetite at (0.5,1.0,1.5kg/tree) to reduce the harmful effect of saline irrigation water in this orchard through its effect on some soil properties, parameters growth, leaf pigments and mineral contents, flowering, fruit set, yield and fruit quality of Picual olive trees irrigated using saline water (EC=5 mmhos/cm).The experimental results revealed that treatments improved some soil chemical and physical properties. Moreover, solubility and availability some of soil nutrients were increased in the soil reflects on growth and productivity. Therefore, the greatest fibrous root density and highest vegetative growth (shoot length, number of new shoots / branch/ meter, number of leaves / shoot, leaf area and fresh and dry leaf weights) were obtained. Feldspar at 3kg/tree gave the highest vegetative growth followed by sulphur at 1.5 kg/tree and the same two treatments increased leaf pigments and leaf mineral contents. Moreover, sulphur at 1.5 kg/tree improved significantly flowering characteristics (flowering density, number of total flowers/ inflorescence and perfect flowers %) while feldspar at 3kg/tree gave higher values of fruit set. Tree yield and fruit quality increased significantly when treated by feldspar at 3 kg/tree and sulphur at 1.5 kg/tree compared to other treatments in both seasons. Application of sulphur at 1.5 kg/tree gave the highest moisture content in fruits while feldspar at 3kg/tree was the superior in regard to oil content followed by feldspar at 2kg/tree in both seasons.*

Under the conditions of this study and resembling conditions, it can recommended that feldspar at 3 kg/tree or sulphur at 1.5 kg/tree applications added in three times, January, June and August by mixing with the soil surface layer (20 cm depth) was the best treatment to improve growth and productivity of Picual olive trees irrigated with saline water (EC=5 mmhos/cm).

Key words*: Feldspar -Picual olive cultivar fruit oil, Saline water ,Magnetite, Flowering density.*

INTRODUCTION

Olive (*Olea europaea* L.) is an important fruit crops in Egypt for planting in new reclaimed lands where soil and water are poor, it resists drought and salinity conditions, it increases the land values where the soil is unsuitable for other crops .Olive plants has been described as having medium tolerance to salts (Bongi and Loreto, 1969).The total acreage under olive orchards increased to reach about 158.58 feddans according to the statistics of the Ministry of Agricultural (2009). Although olive trees can survive and grown under low soil fertility and unavailability conditions such as, salinity, many research studies have been showed that improving soil fertility and satisfying water requirements are essential factors to obtain good production. Water is the most limited factor for production where saline irrigation water inhibits the growth and yield. The injurious effects of salinity are associated with water deficit, ionic imbalance and mineral nutrition (Mass and Hoffman,1977). However, increasing olive trees productivity under desert conditions must be based on appropriate technical and economic management due to the natural resources scarcity. Furthermore, production and utilization of chemical fertilizers are considered as, air, soil and water polluting agents, in addition of the high costs of their manufacture. Thus, the application of organic fertilizer avoided these pollutions, reduced the costs of fertilization and would be safe for human, animal and environment. As results of chemical fertilizers misuse, the natural of the agriculture land is changed and exhausted. Therefore, the alternative use of natural elements compounds are improve the soil physical, chemical properties, as well as, increased water uptake and nutrient availability (Helail *et al*.,2003) ; (Eman *et al*., 2010). Natural elements compounds as feldspar, sulphur and magnetite used as a source of some nutrient minerals, this management are considered clean or organic agriculture and these compounds improving soil aggregation, structure, permeability, infiltration, EC and may overcome the harmful effect of saline water application. Moreover, Egyptian soils having alkaline pH are low in their available nutrients sulphur is frequently considered the most important amendment for soil reclamation and improvement whereas, reducing soil Ph, improving water relations and increasing availability some of nutrient elements needed for increasing growth and yield (Mostafa *et al*., 1990 ; Hening *et al*., 1991; Harhash &Abdel-Nasser, 2000 and El-Dsouky *et al*., 2002). In order to reduce the dependence on imported potash, feldspar a potash mineral, contains 11.25 % K2O and therefore it could be a potential K- source for crop production (Bader, 2006). The use of potassium feldspar or crushed granite dose give a yield response, although no greater than for conventional fertilizers (Manning,2010). Furthermore, El- Haggar, *et al*., (2004) found that initial application of natural rocks to compost caused the release of macro elements and converted them to soluble forms of P,K,Ca and Mg.

Thus, this work was carried out to investigate the effect of application of some natural elements compounds as feldspar, sulphur and magnetite on reducing the harmful effect of saline water irrigation on olive trees cv. Picual.

MATERIALS AND METHODS

The experiment took place during 2009 and 2010 growing seasons in a private farm located at Cairo- Assiut west desert road (about 180 km south Cairo)–Beni Mazar distract, Minia Governorate. The study was conducted on 15 - year- old Picual olive cultivar, grown in sandy loam soil at 6x6 m apart. Some physical and chemical properties of experimental soil are shown in Table (1 - a) according to Wilde *et al* (1985).The soil was characterized by PH :7.45,Ec:5:12 mm /cm, organic matter % : 0.03 and content cations meg/1^{-1}(Ca:21,Mg:24,Na: 8.7, K:3.3) and anions meg/1^{-1}(Cl:30,Hco_3 : 2.3, So_4: 24.7). The experimental trees were as uniform as possible in vigour and were grown under drip irrigation system using saline water. It composed of a mixture of cations & anions and PH: 7.8, Ec: 5 mm/cm as shown in (Table 1-b.) Each tree had four drip emitters (4 l h^{-1}) located 50 cm from the trunk on each side of the tree.

Table (1-a): Some initial soil physical and chemical properties in November 2008.

Character	Value
Particle size distribution	
• Sand %	71.8
• Silt%	12.0
• Clay%	16.2
• Texture	Sandy loam
Chemical analysis	
• Organic matter %	0.03
• EC(mm/cm)	5.12
• pH	7.45
Cations meq/l^{-1}	
• Ca^{2+}	21.0
• Mg^{2+}	24.0
• Na^{+}	8.7
• K^{+}	3.3
Anions meq/l^{-1}	
• Cl^{-}	30.0
• Co_3^{2-}	-
• Hco_3^{-}	2.3
• So_4^{2-}	24.7

Table (1-b): Some chemical properties of the water used for irrigation.

Character	Artesian well water
• EC(mmhos/cm)	5.0
• Total soluble solids ppm	3200
• pH	7.8
• SAR	15.64
Cations meq/l^{-1}	
• Ca^{2+}	7.6
• Mg^{2+}	3.9
• Na^{+}	37.5
• K^{+}	1.0
Anions meq/l^{-1}	
• Cl^{-}	45.3
• Co_3^{2-}	-
• Hco_3^{-}	0.4
• So_4^{2-}	0.7

The experimental design was a completely randomized block with ten treatments replicated three times; the replicate represented by two olive trees. The normal horticultural practices that used in the farm were applied to

all Picual olive trees except those dealing with feldspar, sulphur and magnetite.

In addition, other fertilization program adopted in the farm, olive tree was fertilized every year with 750 gm N /tree, as (ammonium sulphate 20.6% N), 1.300 kg calcium super phosphate (15.5% P2O5), 1.0 kg potassium sulphate (48% K2O). The olive tree was fertilized with 50 kg cattle manure every year at November in trenches (40 cm length X30cm width X20 cm depth). Feldspar, sulphur and magnetite were added and divided to three equal doses applied at January, June and August by mixing with the soil surface layer (20 cm depth) under the four drip emitters. After one week of application of these compounds, potassiomag as a liquid source for *Bacillus circulans* have high efficiency in availability of potassium in soil was added as 4 litre / feddan for all the experimental trees. Chemical analysis of the used natural element compounds was done at the Ministry of Petroleum and illustrated in Table (2).

Table (2): Chemical analysis of the used natural mineral compounds

Character (%)	Feldspar	Magnetite	Character (%)	Sulphur
SiO2	71.25	7.32	Total S	99.08
Al2O3	15.45	0.37	Na2O	0.09
TiO2	0.03	0.07	Cl^-	0.10
Fe2O3	0.12	72.35	-	-
MgO	< 0.01	0.28	-	-
MnO	0.01	2.35	-	-
CaO	0.59	12.54	-	-
Na2O	2.41	0.11	-	-
K2O	8.95	0.12	-	-
P2O5	0.13	0.47	-	-
L.O.I	0.13	2.02	-	-
	0.63			

Treatments:

This experiment included ten treatments as follows:

1. **Control (normal farm of fertilizer in the orchard).**
2. **Sulphur as rate 0.5 kg / tree.**
3. **Sulphur as rate 1.0 kg / tree.**
4. **Sulphur as rate 1.5 kg / tree.**
5. **Feldspar as rate 1.0 kg / tree.**
6. **Feldspar as rate 2.0 kg / tree.**
7. **Feldspar as rate 3.0 kg / tree.**
8. **Magnetite as rate 0.5 kg / tree.**
9. **Magnetite as rate 1.0 kg / tree.**
10. **Magnetite as rate 1.5 kg / tree.**

Measurements

I- Soil analysis: soil samples were taken from the major root zone at the end of each growing season and ready for analysis; electrical conductivity (EC), soluble ions and soil pH. Soil chemical, physical properties and nutrient availability were determined according to Chapman and Pratt (1978).

In December of each season, twenty healthy one year old shoots were randomly chosen and labeled at each direction for carrying out the following measurements.

II - growth parameters .

At the end of each growing season during first week of August the following characteristics were measured

1-Shoot characteristics as length (cm), number of new shoots / branch/ meter, number of leaves per shoot

2-Leaf characteristics as leaf area (cm2) according to(Ahmed and Morsy, 1999) using the following equilibration = 0.53 (length X width) + 1.66. Leaf fresh weight and dry weight (gm) were determined before and after drying at 70 ^{o}C until constant weight.

3-Fibrous root density were determined in each soil sample taken with a hand operated well – drilling type soil auger with a cup of 10 cm in diameter to make a core of 10 cm in diameter and 30 cm depth, in October, 2009 and 2010, (Cahoon *et al*., 1959 and described by Dawood, 2001).All samples were taken at 150 cm away from the trunk of each tree in four directions. Fibrous root were cleaned and their fresh weight was determined at two depth (0-30 and 30-60 cm), then the average root weight per core was calculated and was expressed as g/core.

III - Leaf pigments and mineral content

At the first week of August, in both seasons, 50 mature leaves per replicate were collected from the medium position of the current season′s shoots.

1-Chlorophyll A, B and carotenoids were determined in fresh leaves samples calorimetrically at wave length of 660, 640 and 440nm respectively according to (A.O.A.C., 1985).

2-Leaf mineral content: Dry weight of leaves obtained after drying at 70 ^{o}C until constant weight .The dried leaf samples were finely ground and digested for the determinations as follows :

- **Total nitrogen: was determined by modified micro - Keyldahl method as described by (Pregl, 1945).**
- **Phosphorus content: was determined colorimetrically according to Murphy and Riely (1962).**
- **Potassium content: was determined by Flame Photometer (Brown and Lilleland, 1946).**

- **Micro elements (Fe, Mn and Zn): as ppm was spectrophoto-metericaly determined using atomic absorption according to Jackson(1973).**

V - Flowering characteristics

1-Flowering density: number of inflorescence per meter on the labeled twenty shoots was calculated.
2-Number of total flowers per inflorescence.
3-Perfect flowers %: the percentage of perfect flowers to total flowers was calculated for every replicate.

VI- Fruiting

1-Percentage of fruit set: fruit set percentage at two times first after 21 days from full bloom as initial fruit set and the second 60 days after full bloom as final fruit set according to Mofeed (2002).
2- Yield: average yield per tree was calculated from each treatment.

IV- Fruit quality:

Thirty fruit per each tree were randomly selected for carrying out the fruit quality measurements:
1-Fruit length (cm).
2-Fruit diameter (cm).
3-Fruit weight (gm).
4-Flesh weight (gm).
5-Flesh diameter (cm).
6-Flesh / fruit weight (%).
7-Fruit moisture content (%).
8-Fruit oil content (%).

Statistical analysis:

The obtained data were statistically analyzed according to randomized complete block design with three replicates (Snedecor and Cochran, 1980) using MSTAT program. Least significant ranges (LSR) were used to compare between means of treatments according to Duncan (1955) at probability of 5%.

RESULTS AND DISCUSSION

1- Soil chemical-physical properties and some soil nutrient elements

With respect of the effect of adding sulphur, feldspar and magnetite with different rates, the obtained data (Table,3) revealed that sulphur or magnetite applications caused a pronounced decrease in soil pH and EC values. Moreover SAR values and Na/ Ca ratio were reduced in the soil samples. This may be due to the improvement of soil structure, consequently salt leaching through irrigation water moved downward. Also, improved soil physical properties such as; aggregation index (A.I), consequently, improved soil structure and permeability. Soil structure improvement was accompanied

with decreasing Ec and SAR values. As for soil nutrient elements, the used natural mineral compounds increased available soil K, P, Fe, Zn and Mn. The beneficial effects of sulphur, feldspar and magnetite were mainly attributed to the reduction of soil pH, EC, SAR, Na/Ca and soil aggregate index improvement which leads better soil conditions. Feldspar as a source of potassium reduced the osmotic pressure and increased water uptake which due to K influx in soil water solution, consequently, increased the availability of some macro and micronutrients. These results coincide with those obtained by Singh and Sharma (1983); Koriem (1994) and Dawood (2001) on citrus trees.

Table (3) Some chemical, physical properties and nutrient elements (ppm) of the soil as affected by sulphur, feldspar and magnetite application. (Average of 2009 and 2010).

Treatment	EC ds/m	pH	SAR	Na/ Ca	*A.I	K	P	Fe	Zn	Mn
Control	5.12	7.9	4.99	2.63	0.16	129.02	18.5	4.7	2.5	1.4
Sulphur 0.5kg	3.50	7.7	3.10	0.77	0.25	133.14	33.6	8.2	3.0	5.3
Sulphur 1kg	3.20	7.7	3.77	0.78	0.26	158.0	35.1	8.2	3.2	6.7
Sulphur 1.5kg	3.25	7.7	3.98	0.76	0.28	157.16	35.7	8.8	3.8	7.8
Feldspar 1kg	4.05	7.8	4.17	0.91	0.22	201.0	26.5	8.3	2.8	4.3
Feldspar 2kg	4.20	7.8	4.10	0.90	0.25	231.80	28.1	8.5	2.9	5.1
Feldspar 3kg	4.00	7.75	4.08	0.88	0.25	258.0	29.8	8.8	3.1	5.6
Magnetite0.5kg	4.00	7.75	4.05	0.89	0.23	159.11	30.2	8.6	3.1	5.6
Magnetite 1 kg	3.80	7.7	4.00	0.81	0.24	156.27	33.3	9.3	3.2	6.0
Magnetite1.5kg	3.80	7.7	3.80	0.77	0.24	158.30	33.3	9.9	3.3	6.7

*** A.I = Aggregate index**

2- Growth parameters

2-1. Shoot characteristics

The effect of sulphur, feldspar and magnetite on shoot growth of Picual olive cultivar are presented in Table (4).It is obvious that, shoot growth parameters (length, number of new shoots / branch/ meter and number of leaves / shoot) were significant influenced by different aforementioned application compared to the control during both seasons. Hence, the highest shoot length was obtained for trees received feldspar at 3 kg/tree (17.63 and 19.61) followed by feldspar at 2 kg/tree (15.68 and 19.09) and sulphur at 1.5 kg/tree (15.53 and 19.32) during 2009 and 2010 seasons, respectively. As for number of new shoots per branch/ meter, feldspar at 3 kg/tree has the highest values (12.38 and 14.48) followed by sulphur at 1.5 kg/tree (11.07 and 13.42), feldspar at 2 kg/tree (10.79 and13.19) and magnetite at 1.5 kg/tree (10.43 and 12.93) and the differences between the three last treatments were not significant during the first and second seasons, respectively. As for number of leaves / shoot, sulphur at 1.5 kg/tree was the superior in the first season (15.67) while in the second one the superior values were recorded with trees received feldspar at 3 kg/tree (16.33) in the second season.

Table 4

This could be possible due to increased nutrients uptake and better translocation of nutrients. Many investigators supported these findings, Milewski, (2006); El-Salhy *et al*., (2006) on grapevines by different a foremen trened applications, Abdel – Rahman *et al*., (2009) on citrus; Eman *et al*., (2010) on pear trees

2.2 Fibrous root density

Picual olive fibrous root density were significantly increased by different aforementioned applications (Table 4) compared to the control trees as a result of lowering soil pH, EC, SAR, Na/Ca and increasing soil permeability and structure improvement by adding the tested natural elemental materials as sulphur, feldspar and magnetite. The highest fibrous root density (g/core/tree) was shown with application of sulphur and feldspar compounds. Sulphur at 1.5 kg/tree had the greatest fibrous root density (2.913 and 2.953) followed by feldspar at 3 kg/tree (2.814 and 2.882) in 2009 and 2010 seasons, respectively. These results are in accordance with obtained by Dawood (2001) who mentioned that fibrous root density influenced by soil characteristics.

2.3 Leaf characteristics

Results in Table (5) showed that leaf area was affected significantly by the treatments. The highest values were recorded with treatments of feldspar at 3 kg/tree (4.88 and 4.95) and sulphur at 1.5 kg/tree (4.83 and 5.01) during 2009 and 2010 seasons, respectively and the differences between them were not significant in both seasons. The least values always resulted from the control. Concerning leaf fresh and dry weights, Table (5) show that the treatments gave an improvement in values of fresh and dry weights compared with the control. The highest values recorded with trees received sulphur at 1.5 kg / tree in both seasons while that received magnetite at 0.5 kg/ tree and control had the lowest values. Differences were not significant with most of treatments comparing with magnetite at 0.5 kg/ tree and the control. These results are in line with that reported by Abdel – Rahman *et al*., (2009) on citrus and Eman *et al*., (2010) on pear trees. Milewski, (2006) mentioned that using magnetic water and magnetite in the soil stimulate the growth of plants.

This may be due to the role of applications natural elemental materials, feldspar as source of potassium and its role in promoting and enhancing the metabolic process and regulate water balance (Manning, 2010). as well as sulphur and magnetite decrease soil pH and improve the soil properties reflects on improving growth and yield. (Mostafa *et al*., 1990)

Table 5

3- Leaf pigment and mineral contents

3.1 Chlorophyll A, B and carotenoids

The results for chlorophyll (a), (b) and carotenoids in Table (5) revealed that application of some natural elements compounds as feldspar, sulphur and magnetite significantly increased leaf pigment contents compared to control in both growing season. Generally, the higher rates of feldspar, sulphur and magnetite gave the highest values comparing the other treatments. Trees received with sulphur at 1.5 kg/tree promoted all leaf photosynthetic pigment contents and gained the highest values of chlorophyll (a) (1.75 and 1.91), (b) (1.55 and 1.65) and carotenoids (1.44 and 1.46) compared the other treatments during the two seasons. These results supported by Eman *et al.,* (2010) on pear. This could be possible because of the role of K in the synthesis of precursor of chlorophyll pigments. The higher chlorophyll content in leaves improves the transfer of radiation energy into primary chemical energy in the form of ATP and NADPH in the chloroplasts. Singh (1988) reported that sulphur application increased the activities of iron containing enzymes and promotes the synthesis of catalase and peroxidase. Further, these enzymes are capable of scavenging the free radicals produced in the plant system and thus improving the general health of the plants. Sulphur might be responsible for the formation of ferridxin (iron- sulphur protein) in plants which might have a direct impact in activating the catalase and peroxidase enzymes. Sulphur has a synergistic effect with zinc, which is essential for carbon dioxide absorption and utilization, synthesis of RNA and auxin. Zinc is also essential for chlorophyll formation, which improves the photosynthetic activity (Pandey and Sinha 1999).

3.2 Leaf mineral contents

The effect of different natural elements compounds applications on macro elements (N, P and K %) content and micro elements (Fe, Mn, and Zn ppm) content in Picual olive leaves was significant effect during the two seasons as shown in Table (6).The application of sulphur, feldspar and magnetite raised up the macro nutrients in leaves of Picual olive compared to untreated control in both seasons. The highest nitrogen and potassium percent in leaves (2.253 & 2.117 and 1.545 & 1.615, respectively) obtained for treatment of sulphur at 1.5 kg/tree while the highest values of phosphorus content (0.313 and 342) recorded for magnetite at 1.5 kg/tree treatment in the first and second seasons, respectively. Concerning micronutrient in leaves, results cleared that the application of sulphur at 1.5 kg/tree was the superior treatment which increased the micronutrients (Zn : 16.692 and 18.922 & Mn : 33.227 and 39.524) in 2009 and 2010 seasons, respectively.

Table 6

Meanwhile, the same treatment in the first season and magnetite at 1.5 kg/tree in the second season gave the highest leaf content of Fe (201.2 and 212.7, respectively) compared to other treatments. The untreated control gave the lowest values of macro and micronutrients in both seasons. Similar results were reported by Elham Abd El- Motty *et al*., (2009) on olive seedlings; Dawood (2001) on orange ; Eman *et al*., (2010) on pear trees .

The promotion in leaf mineral content due to natural elements compounds which, improving the structure of soil, reducing soil pH, solubility and availability of nutrients in soil. Sulphur increase absorption of potassium or it can react with nitrogen and potassium (Koriem, 1994 and Farag *et al*., 1990). Moreover, sulphur increases the activities of micro organisms that enhance the solubility and availability of soil nutrient that increase the uptake and translocation of them. The improvement of leaf nutrients content as a result of potassium addition may be due to its an active role in enhancing the absorption, translocation and accumulation of mineral contents in leaves (Hikal,2000).

4- Flowering characteristics

Table, (7) shows the effect of some natural elements compounds as feldspar, sulphur and magnetite on blooming characteristics (flowering density, number of total flowers/ inflorescence and sex expression as perfect flowers %)of Picual olive trees. These parameters significantly affected by the aforementioned treatments compared to the control in both seasons. As for flowering density, sulphur at 1.5 kg/tree , feldspar at 3 kg/tree and sulphur at 1 kg/tree treatments gained the highest flowering density (42.14, 41.66 and 40.30 , respectively) and no significant between these values in the first season while in the second one the highest value was(42.11) for trees received sulphur at 1.5 kg/tree. Meantime, magnetite at 0.5 kg/tree and control presented the lowest values (24.94 and 30.64 & 27.08 and 29.00) in 2009 and 2010 seasons, respectively. Concerning the number of total flowers/inflorescence, feldspar at 3 kg/tree (15.43 and 8.20) and sulphur at 1.5 kg/tree (14.73 and 8.26) treatments surpassed other treatments during the first and second seasons, respectively. Meanwhile, the lowest values (11.97 and 5.23) were obtained with untreated trees in both seasons. With the respect of percentage of perfect flowers was significantly increased with the application of sulphur at 1.5 kg/tree treatment as recorded (64.41 & 64.74) compared with other treatments. While, untreated trees gave the lowest perfect flowers % averaged (41.47 and 39.77) in both study seasons. These results agree with those of (Abdel – Rahman *et al*., 2009) on citrus. Improving flowering characteristics may be the role of treatments, which increased water uptake by regulating the stomata, excessive water loss through transpiration is prevented and thus K improves the water use efficiency.

Table 7

5- Fruiting and yield

Data in Table (7) revealed that all the tested treatments increased significantly initial & final fruit set and yield (kg/ tree) of Picual olive trees as compared with control during both seasons. In this concern application of sulphur at 1.5 kg/tree presented the highest initial fruit set (12.52 and 12.87) in 2009 and 2010 seasons, respectively. Meantime, no significant differences between sulphur at 1 & 1.5 kg/tree and feldspar at 2 & 3 kg/tree treatments. On the other hand, the untreated trees had the lowest initial fruit set (10.34 and 8.47) in both seasons. Regarding the final fruit set, significant differences were observed in both seasons by applications of the natural elemental materials. The highest percentage of final fruit set recorded for trees received sulphur at 1.5 kg/tree (2.93) in the first season while in the second one, feldspar at 3 kg/tree gave the highest percentage (2.67).In contrast, magnetite at 0.5 kg/tree gave lowest values (1.63 and 1.56)during 2009 and 2010 seasons, respectively.

Concerning yield (kg/tree) of Picual olive trees tested with the sulphur, feldspar and magnetite, the results revealed that all natural elemental materials applied had a pronounced increase of yield. Based on mean values, treatments of feldspar at 3 kg/tree, sulphur at 1.5kg/tree, magnetite at 1.5 kg/tree and feldspar at 2 kg/tree recorded an increment for yield of about 51.95%, 48.22%, 27.24% and 26.47% over the control respectively in the first season. While in the second one the same determinations recorded 41.21%, 37.78%, 37.30% and 40.73% respectively. The present results are in harmony with those of (Abdel – Rahman *et al*., 2009) on citrus ;(El- Salhy *et al*., 2006) on grapevines and (Eman *et al*., 2010) on pear trees. Using natural elemental compounds as sulphur, feldspar and magnetite caused a remarkable promotion on fruit set and yield which may be due to the improvement of soil characteristics and nutrient status and its important role in translocation compounds which increase the growth pooled in yield and fruit quality (Najjar,1985).

6- Fruit quality

6.1 Fruit length, diameter and fruit weight

The effect of tested treatments on fruit length, diameter and fruit weight of Picual olive trees is shown in Table (8). These data indicated that all treatments increased significantly fruit length, diameter and weight during both seasons. In this respect, applying feldspar at 3 kg/tree and sulphur at 1.5 kg/tree gave higher records of fruit length (2.64 &3.11 and 2.61& 3.06) and fruit diameter (1.96&2.38 and 2.01&2.36) in first and second seasons respectively, and the differences between the two last treatments were not significant in both seasons. On the other hand, fruit weight of Picual olive trees increased as a result of applications of sulphur, feldspar and magnetite and the highest fruit weights were obtained from the sulphur at 1.5 kg/tree

Table 8

treatment (6.88 and 6.98) followed by feldspar at 3 kg/tree (6.68 and 6.88) in 2009 and 2010 seasons, respectively. Whereas, untreated trees (control) had the lowest values in this respect.

6.2 Flesh weight, diameter and flesh / fruit weight

Data in Tables (8 & 9) revealed that application of feldspar at 3 kg/tree gave the heaviest flesh weight (6.182 and 6.321), while the control treatment had the lowest values (4.937 and 4.897) in 2009 and 2010 seasons respectively. Applications of sulphur at 1.5 kg/tree in the first season and feldspar at 3 kg/tree in the second one produced higher fruit flesh diameter (0.54 and 0.66) respectively, while the control treatment had lower flesh diameter (0.41 and 0.44) in both seasons. As for flesh / fruit weight percentage, application of feldspar at 3 kg/tree in the first season gave the highest percentage (92.55) followed by sulphur at 1.5 kg/tree (89.86) while in the second season the highest percentagerecorded with application of sulphur at 1.5 kg/tree (90.56) followed by sulphur at 1 kg/tree (89.84). Meanwhile, the lowest percentage recorded with magnetite at 0.5 kg/tree and control trees in both seasons.

6.3 Fruit moisture and oil contents

Fruit moisture content and fruit oil content were significantly affected by different applications of sulphur, feldspar and magnetite treatments in both seasons (Table,9). The highest percentage of fruit moisture and oil contents was obtained from adding sulphur at 1.5 kg/tree (65.48 & 66.31) and feldspar at 3 kg/tree (22.76 & 21.00) respectively while the lowest values were presented by untreated trees (51.24 & 54.11 and 9.91 & 10.35) in 2009 &2010 seasons respectively. As a general the highest fruit oil content was given in descending order by feldspar, sulphur then magnetite applications. Generally, olive fruit quality improved as a result of adding sulphur, feldspar or magnetite which may be due to some soil property improvement, soil nutrient availability and better vegetative growth.

These results are nearly in the same line with these obtained by Badr (2006) and Abdel Rahman *et al*., (2009) on Navel orange tree. Sulphur is crucial for the formation of amino acids like methionine and cystine, which are involved in protein synthesis. It also associated with the synthesis of vitamin B, such as biotine and thiamine, metabolism of carbohydrates, proteins and oils, formation of flavour imparting compounds and marketing quality of several crops (Kumar and Kumar 2008).

It could be concluded that to reduce the harmful effects of irrigation with saline water or increasing the productivity of olive trees under this conditions, feldspar at(3kg/tree) or sulphur(1.5 kg/tree) must be added in three times, January, June and August by mixing with the soil surface layer (20 cm depth).

Table 9

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دراسات على تقليل الأثر الضار للرى بالماء المالح على أشجار الزيتون صنف البيكوال

عادل محمد جودة ، عبد العزيز أحمد الطويل و كمال بشير عيسى

قسم بحوث الزيتون وفاكهه المناطق شبه الجافة- معهد بحوث البساتين- مركز البحوث الزراعية - الجيزة- مصر

الملخص العربي

أجريت هذه التجربة خلال موسمين متتاليين ٢٠٠٩ و ٢٠١٠ على أشجار زيتون صنف البيكوال عمر ١٥ سنة النامية في تربة رملية طميية تحت نظام الري بالتنقيط في مزرعة خاصة تقع على بعد ١٨٠ كم جنوب القاهرة- طريق مصر أسيوط الصحراوي الغربي -مركز بني مزار - محافظة المنيا. وكان موضوع البحث هو دراسة استخدام بعض مركبات العناصر الطبيعية فى ثلاث معدلات وهى: الكبريت (٥ ر٠ و ١ و ٥ر١ كجم/شجرة) والفلسبار(١ و ٢ و ٣ كجم/شجرة) والمجنيتايت(٥ ر٠ و ١ و ٥ر١ كجم /شجرة) وذلك لتقليل الأثر الضار للرى بالماء المالح فى هذا البستان وتأثير ذلك على بعض خصائص التربة والنمو الخضري ومحتوى الورقة من الصبغات والعناصر المعدنية والتزهير والعقد والمحصول وصفات الجودة لأشجار الزيتون صنف البيكوال والتي تروى بمياه مالحة التوصيل الكهربي لها = ٥ ملليموز / سم . وأظهرت النتائج مايلي:

١. أدت المعاملات إلي تحسن بعض خصائص التربة الكيماوية والطبيعية و زيادة ذوبان وصلاحية العناصر فى التربة وانعكس ذلك على النمو وإنتاجية الأشجار فقد زادت كثافة الجذور الشعرية ولوحظ أكبر نمو خضري (طول الفرع-عدد الأفرع الجديدة/ غصن/متر- عدد الأوراق/ فرع- مساحة الورقة- الوزن الطازج والجاف للورقة) وكانت معاملة الفلسبار ٣ كجم / شجرة الأعلى فى قيم النمو الخضري تليها المعاملة بإضافة الكبريت ٥ر١ كجم/ شجرة. كما أدت هاتين المعاملتين الى زيادة محتوى الأوراق من الصبغات والعناصر المعدنية.

٢. أدى اضافة الكبريت بمعدل ٥ر١ كجم/شجرة إلى تحسن معنوي في خصائص التزهير (كثافة الأزهار –عدد الأزهار الكلى/نورة– نسبة الأزهار الكاملة) في حين تم الحصول على أعلى القيم لعقد الثمار بإضافة الفلسبار بمعدل ٣كجم/ شجرة.

٣. زاد محصول الشجرة وتحسنت صفات الجودة معنويا بإضافة الفلسبار ٣ كجم/شجرة والكبريت ٥ر١ كجم/شجرة مقارنة بباقي المعاملات خلال موسمي الدراسة.

٤ـ أدى إضافة الكبريت ٥ر١ كجم/شجرة إلى الحصول على أعلى محتوى رطوبة بالثمار وأدى استخدام الفلسبار ٣كجم/شجرة إلى أعلى القيم في محتوى الثمار من الزيت يليها استخدام الفلسبار ٢كجم/شجرة.

٥ـ تحت ظروف هذه الدراسة والظروف المماثلة يمكن التوصية بإضافة الفلسبار بمعدل ٣كجم/شجرة أو الكبريت بمعدل ٥ر١ كجم/شجرة على ثلاث مرات من الإضافة في يناير ويونيو وأغسطس خلطا مع سطح التربة بعمق ٢٠سم حيث كانت أفضل المعاملات من حيث النمو والأنتاج أشجار الزيتون صنف البيكوال والذي يروى بمياه مالحة ذات توصيل كهربي مقدارة ٥ ملليموز / سم.

Table (4): Effect of sulphur, feldspar and magnetite on shoot length, number of new shoots / branch / meter, number of leaves/ shoot and fibrous root/ core of Picual olive trees irrigated with saline water during 2009 and 2010 seasons.

Treatments	Shoot length (cm)		Number of new shoots / branch / meter		Number of leaves/ shoot		Fibrous root/ core (gm)	
	2009	2010	2009	2010	2009	2010	2009	2010
Control	12.10 ef	10.51 g	8.92 f	9.31 d	13.27 e	12.96 d	1.97 c	2.12 c
Sulphur at 0.5 kg / tree	12.36 ef	14.73 e	9.81 e	10.70 c	13.50 de	14.29 c	2.81 a	2.81 ab
Sulphur at 1.0 kg / tree	13.57 ef	17.80 bc	10.57 bcd	12.92 b	14.75 bc	14.98 bc	2.88 a	2.92 a
Sulphur at 1.5 kg / tree	15.53 bc	19.32 c	11.07 b	13.42 b	15.67 a	15.43 b	2.91 a	2.95 a
Feldspar at 1.0 kg / tree	13.37 def	15.67 de	10.14 cde	10.70 c	14.14 cd	13.32 d	2.31 abc	2.29 bc
Feldspar at 2.0 kg / tree	15.68 b	19.09 ab	10.79 bc	13.19 b	14.91 b	14.77bc	2.56 abc	2.62 ab
Feldspar at 3.0 kg / tree	17.63 a	19.61 a	12.32 a	14.48 a	14.97 b	16.33 a	2.76 ab	2.8o ab
Magnetite at 0.5 kg / tree	11.57 f	12.18 f	9.78 e	9.59 d	12.97 e	13.51 d	2.22 bc	2.32 bc
Magnetite at 1.0 kg / tree	14.13 bcde	14.64 e	9.92 de	10.96 c	13.60 de	14.48 c	2.73 ab	2.81 ab
Magnetite at 1.5 kg / tree	15.23 bcd	16.59 cd	10.43 bcde	12.93 b	13.96 d	15.08 bc	2.81 a	2.88 a

Table (5): Effect of sulphur, feldspar and magnetite on leaf area, fresh and dry weights and leaf pigments content of Picual olive trees irrigated with saline water during 2009 and 2010 seasons.

Treatments	Leaf area (cm2)		Leaf fresh weight (gm)		Leaf dry weight (gm)		Chlorophyll A $mg.g^{-1}$ F. W.		Chlorophyll B $mg.g^{-1}$ F. W.		Carotenoids $mg.g^{-1}$ F. W.	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Control	4.01 f	4.26 f	0.097 c	0.100 b	0.040 b	0.041 c	1.52 f	1.60 d	1.42 f	1.47 f	1.32 f	1.38 bc
Sulphur at 0.5 kg / tree	4.28 de	4.43 e	0.108 abc	0.116 ab	0.043 ab	0.046 bc	1.65 c	1.83 b	1.45 e	1.51 ef	1.34 e	1.43 ab
Sulphur at 1.0 kg / tree	4.60 bc	4.78 bc	0.111 abc	0.126 a	0.056 ab	0.063 ab	1.75 a	1.85 ab	1.51 bc	1.61 abc	1.36 cd	1.44 ab
Sulphur at 1.5 kg / tree	4.83 ab	5.01 a	0.123 a	0.129 a	0.060 a	0.067 a	1.75 a	1.91 a	1.55 a	1.65 a	1.44 a	1.46 a
Feldspar at 1.0 kg / tree	4.47 cd	4.71 cd	0.103 bc	0.119 ab	0.048 ab	0.051 abc	1.62 d	1.82 bc	1.49 d	1.52 def	1.37 bc	1.42 abc
Feldspar at 2.0 kg / tree	4.76 ab	4.85 b	0.117 ab	0.125 a	0.054 ab	0.058 abc	1.74 a	1.84 b	1.52 bc	1.57 cde	1.38 b	1.45 a
Feldspar at 3.0 kg / tree	4.88 a	4.95 a	0.117 ab	0.127 a	0.059 ab	0.059 abc	1.75 a	1.88 ab	1.53 b	1.63 ab	1.43 a	1.48 a
Magnetite at 0.5 kg / tree	4.15 ef	4.42 e	0.100 bc	0.106 b	0.040 b	0.042 c	1.54 e	1.77 c	1.43 f	1.56 cde	1.34 de	1.37 c
Magnetite at 1.0 kg / tree	4.04 f	4.44 e	0.100 bc	0.111 ab	0.043 ab	0.046 bc	1.63 cd	1.82 bc	1.47 e	1.58 bcd	1.36 c	1.42 abc
Magnetite at 1.5 kg / tree	4.41 cd	4.62 d	0.112 abc	0.117 ab	0.047 ab	0.050 abc	1.69 b	1.86 ab	1.51 c	1.61 abc	1.42 a	1.45 a

Table (6): Effect of sulphur, feldspar and magnetite on some macro and micro elements of Picual olive leaves irrigated with saline water during 2009 and 2010 seasons.

Treatments	N (%)		P (%)		K (%)		Fe (ppm)		Mn(ppm)		Zn(ppm)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Control	1.137 e	1.212 c	0.195 e	0.210 c	1.286 bcd	1.300 c	100.6 i	113.3 i	18.41 c	20.12 d	10.27 c	11.84 f
Sulphur at 0.5 kg / tree	1.218 e	1.631 abc	0.207 de	0.231 c	1.284 bcd	1.419 bc	138.5 f	147.8 f	26.52 b	25.11 c	14.68 ab	14.81 cd
Sulphur at 1.0 kg / tree	1.673 cd	1.910 ab	0.253 bcde	0.300 ab	1.390 bc	1.531 ab	162.3 d	171.5 d	29.45 b	28.90 b	14.56 ab	16.86 b
Sulphur at 1.5 kg / tree	2.253 a	2.117 a	0.308 ab	0.337 a	1.545 a	1.615 a	201.2 a	205.7 b	33.23 a	39.52 a	16.69 a	18.92 a
Feldspar at 1.0 kg / tree	1.198 e	1.397 bc	0.234 cde	0.267 bc	1.279 cd	1.528 ab	104.8 h	116.8 h	28.66 b	28.76 b	12.70 bc	12.65 ef
Feldspar at 2.0 kg / tree	1.738 bcd	1.965 ab	0.263 abcd	0.296 ab	1.403 b	1.580 ab	128.6 g	135.2 g	26.85 b	26.82 bc	14.42 ab	13.53 def
Feldspar at 3.0 kg / tree	2.123 ab	2.100 a	0.284 abc	0.302 ab	1.523 a	1.612 a	177.0 b	180.4 c	27.64 b	28.36 b	14.96 ab	13.90 de
Magnetite at 0.5 kg / tree	1.440 de	1.523 abc	0.207 de	0.231 c	1.227 d	1.312 c	151.7e	166.1 e	28.09 b	28.16 bc	13.72 b	14.83 cd
Magnetite at 1.0 kg / tree	1.802 bcd	1.910 ab	0.224 de	0.255 bc	1.390 bc	1.400 bc	162.5 d	178.9 c	27.94 b	26.65 bc	14.30 ab	16.05 bc
Magnetite at 1.5 kg / tree	1.931 abc	1.982 ab	0.313 a	0.342 a	1.525 a	1.379 ab	168.6 c	212.a	27.29 b	26.82 bc	14.52 ab	16.30 bc

Table (7): Effect of sulphur, feldspar and magnetite on flowering characteristics, fruit set and yield of Picual olive trees irrigated with saline water during 2009 and 2010 seasons.

Treatments	Flowering density		Number of total flowers / inflor.		Perfect flowers %		Initial fruit set (%)		Final fruit set (%)		Yield / tree (kg)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Control	27.08 de	29.00 e	11.97 e	5.23 e	41.47 d	39.77 f	10.34 e	8.47 g	1.84 e	1.72 ef	18.21 cd	12.52 d
Sulphur at 0.5 kg / tree	31.57 cd	31.30 cde	13.75 bcd	6.69 bc	50.31 c	47.17 d	10.86 de	9.66 f	1.73 ef	1.85 ef	18.30 cd	12.87 d
Sulphur at 1.0 kg / tree	40.30 ab	36.91 b	14.40 b	7.31 b	56.35 b	51.33 b	11.85 ab	11.83 bc	2.58 c	2.28 bc	19.69 cd	16.15 b
Sulphur at 1.5 kg / tree	42.14 a	42.11 a	14.73 ab	8.26 a	64.41 a	64.74 a	12.52 a	12.87 a	2.93 a	2.16 cd	26.99 a	17.62 a
Feldspar at 1.0 kg / tree	30.45 cde	32.79 bcde	8.67 f	5.65 de	47.93 c	41.90 ef	11.48 bcd	11.01 cd	1.63 f	1.92 de	19.22 cd	14.88 c
Feldspar at 2.0 kg / tree	33.28 c	35.74 bc	13.90 bcd	6.48 bcd	51.86 bc	47.94 cd	11.81 abc	11.19 bcd	2.72 b	2.49 ab	23.03 b	17.25 a
Feldspar at 3.0 kg / tree	41.66 a	36.48 b	15.43 a	8.20 a	52.28 bc	50.60 bc	12.06 ab	11.99 b	2.82 ab	2.67 a	27.67 a	17.68 a
Magnetite at 0.5 kg / tree	24.94 e	30.64 de	13.07 d	5.81 cde	48.90 c	40.93 ef	10.31 e	9.57 f	1.63 f	1.56 f	18.26 cd	13.33 d
Magnetite at 1.0 kg / tree	32.17 cd	34.37 bcd	13.33 cd	6.56 bcd	48.57 c	43.89 e	10.90 cde	9.91 ef	1.87 e	1.68 ef	20.99 bc	14.80 c
Magnetite at 1.5 kg / tree	35.70 bc	36.80 b	14.13 bc	7.30 b	53.33 bc	50.86 bc	11.43 bcd	10.73 de	2.12 d	1.95 de	23.17 b	17.19 a

Table (8): Effect of sulphur, feldspar and magnetite on fruit length, diameter, weight and fruit flesh weight of Picual olive trees irrigated with saline water during 2009 and 2010 seasons.

Treatments	Fruit length (cm)		Fruit diameter (cm)		Fruit weight (gm)		Flesh weight (gm)	
	2009	2010	2009	2010	2009	2010	2009	2010
Control	2.42 de	2.71 e	1.72 d	1.97 e	5.60 f	5.55 f	4.937d	4.897 f
Sulphur at 0.5 kg / tree	2.37 e	2.82 d	1.83 c	2.12 d	5.86 ef	5.97 de	5.189 cd	5.294 de
Sulphur at 1.0 kg / tree	2.54 abcd	2.87 cd	1.90bc	2.21 cd	6.43 bc	6.72 ab	5.741 abc	6.037 ab
Sulphur at 1.5 kg / tree	2.61 abc	3.06 ab	2.01 a	2.36 a	6.88 a	6.98 a	5.959 ab	6.167 a
Feldspar at 1.0 kg / tree	2.45 cde	2.91 c	1.91 bc	2.24 bc	6.13 cde	6.11 cde	5.436 bcd	5.426 cd
Feldspar at 2.0 kg / tree	2.59 abc	3.0 b	1.91 bc	2.31 ab	6.43 bc	6.42 bc	5.719 abc	5.741 bc
Feldspar at 3.0 kg / tree	2.64 ab	3.11 a	1.96 ab	2.38 a	6.68 ab	6.88 a	6.182 a	6.321 a
Magnetite at 0.5 kg / tree	2.50 bcde	2.79 d	1.85 c	1.98 e	5.58 f	5.74 ef	4.906 d	5.075 ef
Magnetite at 1.0 kg / tree	2.50 bcde	2.82 d	2.02 a	2.01 e	5.88 def	6.12 cde	5.198 cd	5.435 cd
Magnetite at 1.5 kg / tree	2.67 a	2.87 cd	1.88 bc	1.99 e	6.23 cd	6.35 bcd	5.532 bc	5.669 c

Table (9): Effect of sulphur, feldspar and magnetite on fruit flesh diameter, flesh / fruit weight (%), fruit moisture and oil contents of Picual olive trees irrigated with saline water during 2009 and 2010 seasons.

Treatments	Flesh diameter (cm)		Flesh / Fruit weight (%)		Fruit moisture content (%)		Fruit oil content (%)	
	2009	2010	2009	2010	2009	2010	2009	2010
Control	0.41g	0.44 f	88.16 c	88.23 c	51.24 f	54.11 g	9.91 g	10.35 f
Sulphur at 0.5 kg / tree	0.46 ef	0.56 e	88.55 bc	88.68 bc	52.35 f	55.81 f	12.47 ef	12.56 e
Sulphur at 1.0 kg / tree	0.48 cd	0.61 bc	89.29 bc	89.84 ab	53.62 e	56.92 e	13.16 de	12.89 de
Sulphur at 1.5 kg / tree	0.54 a	0.65 a	89.86 b	90.56 a	65.48 a	66.31 a	13.81 d	14.12 c
Feldspar at 1.0 kg / tree	0.44 f	0.56 e	88.88 bc	88.81 bc	55.87 d	58.38 d	18.26 c	18.57 b
Feldspar at 2.0 kg / tree	0.50 bc	0.60 cd	88.94 bc	89.42 abc	57.76 c	58.87 d	21.50 b	19.20 b
Feldspar at 3.0 kg / tree	0.51 b	0.66 a	92.55 a	89.64 abc	62.71 b	62.93 b	22.76 a	21.00 a
Magnetite at 0.5 kg / tree	0.45 f	0.56 e	87.92 c	88.42 c	52.39 f	54.16 g	11.49 f	12.20 e
Magnetite at 1.0 kg / tree	0.47 de	0.59 d	88.40 c	88.81 bc	56.61 cd	57.29 e	12.47 Ef	12.93 de
Magnetite at 1.5 kg / tree	0.49 bc	0.63 b	88.80 bc	89.28 abc	56.67 cd	60.38 c	13.27 de	13.59 cd