Using Potassium Sulphur as Well as Organic And Biofertilization for Alleviating The Adverse Effects of Salinity on Growth and Fruiting of Valencia Orange Trees.

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Abstract: During 2010/ 2011 and 2011/ 2012 seasons, the effects of single and combined applications of compost , K, S , yeast, Minia Azotene and EM1 on counteracting the adverse effects of soil and water irrigation salinity on fruiting of Valencia orange trees were investigated. Single and combined applications of Compost, potassium, sulphur, yeast, Minia Azotene and EM_1 were very effective in alleviating the adverse effects of salinity on growth and fruiting of Valencia orange trees in terms of enhancing the leaf area, all nutrients and plant pigments in the leaves, yield as well as physical and chemical characteristics of the fruits in relative to the check treatment. The promotion was associated with using K, S besides organic fertilization with yeast, Minia Azotene and EM_1. Organic fertilization with compost besides biofertilization with EM1 was essential for alleviating the inferior effects of soil and water irrigation salinity on growth and fruiting of Valencia orange trees.

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Keywords: Potassium, Sulphur, compost, yeast, Minia Azotene, EM_1, fruiting and Valencia orange trees.

1. Introduction

Organic fertilization as well as using biofertilizers, K and S were very effective in counteracting the adverse effects of salinity on growth, nutritional status and fruiting of fruit crops . This is attributed to the beneficial effects of compost and biofertilizers on enhancing soil fertility and the availability of all nutrients (**Nijjar, 1985 and Kannaiyan, 2002**), yeast on increasing photosynthesis as well as its own higher content from natural hormones like IAA, cytokinins and GA_3, B vitamins, amino acids, organic acids and antioxidants **Abou- Zaid , 1984**), potassium on enhancing at least 60 different enzymes, root growth, drought and salinity resistance, translocation of sugars and reducing respiration, water less through regulating eth opening and closing of stomata that is essential for photosynthesis, water and nutrient transport and plant cooling, energy losses and different disorders(**Mengel , 1984 and Diab, 1998**), and sulphur on decreasing soil pH, and soil salinity and increasing the availability of all nutrients, protrein biosynthesis and the activity of sulphur bacteria (**Mengel , 1984; Nijjar , 1985 and Miller *et al.*, 1990**).

Application of biofertilizers (**Ahmed *et al.*, 2007; Abdo, 2008 and Mahfouz, 2011**); EM_1 (**Higa , 1991; Formowitz *et al.*, 2007 and Ibrahim , 2012**), yeast (**Ahmed, 2001; Moustafa and El- Hosseiny , 2001; Abd El- Motty- Elham *et al.*, 2010 and Ahmed- Samah, 2011**), compost (**Abd El- Naby, 2000; Abd El- Naby and Gomaa, 2000; and Mahmoud – Sara , 2008), K (Ebrahiem, *et al.*, 1993; Hassan- El Sayada, 2004 and Hussein , 2006**) and S (**Zeerban *et al.*, 2000 and El- Desouky *et al.*, 2002**) effectively alleviating the inferior effects of salinity on growth and fruiting of fruit crops in terms of enhancing growth characters, nutritional status, yield as well as physical and chemical characteristics of the fruits.

The target of this study was elucidating the effects of K, S as well as organic fertilization with compost and biofertilization with Minia Azotene, EM_1 and yeast on alleviating the adverse effects of soil and water irrigation salinity on growth and fruiting of Valencia orange trees.

2. Material and Methods

This study was conducted during 2010/ 2011 and 20111 2012 seasons on forty eight 8 years old Valencia orange trees onto sour orange citrus rootstock. The selected trees are grown in a private orchard situated at Tanpool village about 80 km far from Cairo, Alex.- Cairo Desert Road where the soil texture is saline sandy (had higher salinity, since E.C. = 31.42 mmhos/ 1 cm 25 ^{o}C), well drained and with water table depth not less than two meters deep. The uniform in vigour trees are planted at 4 x 6 meters apart. Drip irrigation system with four droppers / tree was adopted. Well water containing 1100 ppm salinity was used (Table 1).

Table (1): Analysis of the tested soil

Parameter	Values
Sand %	79.5
Silt %	15.5
Clay %	5.0
Texture	Sandy
pH (1: 2.5 extract)	8.0
O.M. %	0.20
$CaCO_3$ %	6.1
E.C. (1: 2.5 extract) mmhos / 1 cm/ 25oC	31.42
Total N %	0.08
Available P (ppm / Olsen)	2.5
Available K(ppm, ammonium acetate)	160
CO_3 (meq/ 1 L)	11
HCO_3 (meq/ 1 L)	15
Cl (meq/ 1 L)	300
SO_4(meq/ 1 L)	74.0
Ca (meq/ 1 L)	40
Mg (meq/ 1 L)	80
Na(meq/ 1 L)	250
K (meq/ 1 L)	29

The selected Valencia orange trees were subjected to the normal horticultural practices as recommended in commercial orchards.

The experiment included fourteen treatments from two factors (A & B). The first factor (A) contained the following four treatments from compost, potassium and sulphur.

a_1) untreated trees, a_2) application of compost at 25 kg/ tree, a_3) application of potassium sulphate at 500 g/ tree and a_4) application of sulphur at 50 g/ tree while the second factor (B) comprised from the following four treatments from EM_1 , Minia Azotene biofertilizers and yeast:

b_1)untreated trees, b_2) application of yeast at 25 g / tree , b_3) application of Minia Azotene biofertilizer at 25 ml/ tree and b_4) application of EM_1 at 25 ml/ tree. Each treatment was replicated three times, one tree per each, potassium, sulphate, sulphur, yeast, Minia Azotene biofertilizer and EM_1 were applied once at growth start (1^{st} week of March). The organic fertilizer namely compost (2.0 % N) was added once at the last week of January.

The liquid stock culture of EM_1 contained a mixture of lactic acid bacteria, *Lactobacillus planetarium*, *Candida utilis* and *Streptomyces albus*. It is available in a dormant state and requires activation before application. Activation involves the addition of 20 litres of water and 2 kg of pure cane sugar to one litre of dormant EM_1. The mixture was poured into a clean air tight plastic container with no air left in the container. The container was stored away from direct sunlight at ambient temperatures for 8 to 10 days. The gas was released from every day until fermentation completed.

The pure yeast powder was activated by using sources of carbon and nitrogen with ratio of 6: 1. Each ml of activated yeast contained about 12000 yeast cells **(Barnett *et al.* 1990).** Such technique allowed yeast cells to grow multiplied efficiently during conductive aerobic and nutritional conditions to produce de novo beneficial bioconstituents i.e. phytohormones, carbohydrates, proteins, amino acids, fatty acids; vitamins, enzymes, minerals ... etc, hence allowed such constituents to release out of yeast tissues in readily form. Such techniques for yeast preparation based on 1) nutritional media of glucose and casein as favourable sources of Cl N and other essential elements (P, K, Mg, Fe, Mn, Cu, B and Mo, Na and Cl) in suitable balance (**Barnett *et al.*, 1990)** and 2) air pumping and adjusting incubation temperature. The media then subjected to two cycles of freezing and thawing for disruption of yeast tissues and releasing their bioconstituents directly before using.(Table 2).

Table (2): Chemical analysis of the used yeast extract (according to Abou- Zaid, 1984).

Characters	Values
a- Amino acids (mg/ 100 d d.w)	
Arginine	: 1.99
Histidine	: 2.63
Isoleucine	: 2.31
Leucine	: 3.09
Lycine	: 2.95
Methionine	: 0.72
Phenyl alanine	: 2.01
Threonine	: 2.09
Tryptophan	: 0.45
Valine	: 2.19
Glutamic acid	: 2.00
Serine	: 1.59
Aspartic acid	: 1.33
Cystine	:0.23
Proline	: 1.53
Tyrosine	: 1.49
b- Carbohydrates (mg/ 100 g d.w)	
Carbohydrates %	: 23.2
Glucose %	: 13.33
c- Vitamins (mg/ 100 g d.w)	
B1	: 2.23
B2	: 1.33
B6	: 1.25
B12	: 0.15
Thiamin	: 2.71
Riboflavin	: 4.96
Ensitol	: 0.26
Biotin	: 0.09
Nicotinic acid	: 39.88
Panthothenic acid	: 19.56
Pamino benzoic acid	: 9.23
Folic acid	: 4.36
Pyridoxine	: 2.90
d- N %	: 7.3
e- Fats %	: 3.5
f- Ash %	: 6.7

Rundomized complete block design in split plot management was adopted. The four compost, potassium and sulphur treatments and the four yeast, Minia Azotene biofertilizer and EM_1 treatments occupied the main and subplots, respectively.

During both seasons, the following parameters were recorded, leaf area (cm^2) (**Ahmed and Morsy, 1999**), nutrients namely N, P, K, Mg, Ca, Zn, Fe , Mn and Cu (**Cottenie, *et al.*, 1982; and Summer, 1985**), plant pigments namely chlorophylls a & b , total chlorophylls and total carotenoids as mg/ 1.0 g F.W (**Hiscox and Isralstam, 1979)**, number of fruits per trees , yield / tree (kg.), averages fruit weight (g.) and dimensions (height and diameter, cm), fruit peel weight %, fruit peel thickness (cm.) , T.S.A.%, total acidity % (as, citric acid / 100 ml juice) total, reducing and non reducing sugars (**A.O.A.C., 1995**) using **Lane & Eynon method (1965)** as well as vitamin C content (as mg/ 100 ml juice) (**A.O.A.C., 1995**).

Statistical analysis was done using new L.S.D. test at 5% (**Mead *et al.*, 1993**).

3. Results and Discussions

1- Leaf area and its contents of different nutrients and plant pigments:

It is clear from the data in tables from 3 to 6 that single application of compost, potassium or sulphur significantly was accompanied with stimulating the leaf area and its content of N, P, K, Mg, Ca, Zn, Fe , Mn, Cu chlorophylls a & b , total chlorophylls and total carotenoids rather than non application. Using compost was significantly superior than using K and S. Using K and S occupied the second and third positions in this respect, respectively. Soil addition of yeast, Minia Azotene and EM_1 was significantly very effective in enhancing these parameters rather than the check treatment. Application of EM_1, Minia Azotene and yeast, in descending order was significantly very essential in enhancing the leaf area and its chemical composition. Using compost besides EM_1 biofertilizer gave the maximum values. The untreated trees produced the minimum values. These results were true during both seasons.

2- Yield / tree:

Data in Table (6) clearly exhibit that yield expressed in number of fruits/tree and weight(kg.) was significantly improved in response to application of compost, K or S in relative to the check treatment. The promotion on the yield was significantly associated with using S, K and compost, in ascending order. Treating the trees with compost gave the maximum values. Application of yeast, Minia Azotene, EM_1 had an announced and significant promotion on the yield rather than non- application . Using yeast, Minia Azotene, EM_1 in ascending order gave the maximum values. The investigated interaction among all nutrients had significant effect on the yield. Supplying the trees with compost enriched with EM_1 gave the maximum values. Under such promised treated yield per tree reached 72.1 and 73.4 K during both seasons, respectively. The minimum values (32.4 and 32.0 kg during both seasons, respectively) were recorded on untreated trees. These results were true during both seasons.

3-Some physical and chemical characteristics of the of the fruits

It is evident from the data in Tables (7, 8 , 9) that using compost , K or S was significantly very effective in improving fruit quality in terms of increasing fruit weight and dimensions, T.S.S., total and reducing sugars, T.S.S./ acid and vitamin C content and reducing weight and thickness of fruit peel and total acidity % in relative to the check treatment. The best results were obtained due to using compost, K and S, in descending order. Treating the trees with yeast, Minia Azotene and EM_1 , in ascending order was significantly very effective in enhancing fruit quality rather than non- application. Using EM_1 was the most effective material compared with yeast and Minia Azotene , in this respect. The best results with regard to fruit quality were obtained with using compost enriched with EM_1. The present treatments had no significant effect on the percentage of non reducing sugars. These results were true during both seasons.

4. Discussion

Salinity either in soil or in water irrigation caused an adverse effects on growth and fruiting of fruit crops. This is attributed to its negative action on the uptake of water and nutrients as well as its collapsing effect on the biosynthesis of plant pigment and all organic foods (**Kovda, 1964**).

The positive action of compost on fruiting of Valencia orange trees might be attributed to its essential role on improving the biological activity, water holding capacity of the soil, soil fertility, soil organic matter, fixation of N, B vitamins and natural growth hormones as well as reducing sol erosion, soil salinity and soil pH (**Nijjar, 1985 and Miller *et al,* 1990**).

These results are in harmony with those obtained by **Abd El- Naby (2000); Abd El- Naby and Gomaa (2000); El Sawy (2005); Ahmed *et al.,* (2007) and Mahmoud – Sara (2008)**.

The great benefits of potassium on growth and fruiting of Valencia orange trees might be attributed to its positive action on enhancing at least 60 different enzymes, root growth, drought and salinity resistance, translocation of sugars and reducing respiration and water less through regulating the opening and closing of stomata that is essential for photosynthesis, water and nutrient transport and plant cooling, energy losses and different disorders(**Mengel , 1984 and Dibb, 1998**).

The promoting effect of K on growth and fruiting of Valencia orange trees was supported by the results of **Ebrahiem *et al.,* (1993); Hassan- Al Sayada (2004) and Hussein (2006)**.

The beneficial effects of sulphur on fruiting of Valencia orange trees might be attributed to its favourable effects on decreasing soil pH and soil salinity as well as increasing uptake of all nutrients, protein biosynthesis and the activity of sulphur bacteria (**Mengel , 1984; Nijjar , 1985 and Miller *et al.*, 1990**).

The results of **Zeerban *et al.* (2000) and El-Desouky *et al.* (2002)** supported the benefits of S on growth and fruiting of different fruit crops.

The previous positive action of yeast on fruiting of Valencia orange trees could be ascribed on the light of the beneficial effects of yeast on enhancing the biosynthesis of aminoeluinic acid which is necessary for the formation of plants pigments and photosynthesis through enhancing the release of CO_2. The higher own content of yeast from IAA, cytokinins GA_3 proteins, amino acids, B vitamins, glutathione and enzymes could explain the present results (**N.R.P., 1977 and Abou- Zaid, 1984**).

These results are in harmony with those obtained by **Ahmed (2001); Moustaffa and El-Hosseiny (2001); Abd El- Motty – Elham *et al* (2010) and Ahmed–Samah (2011).**

The great benefits of biofertilizers on growth and fruiting of Valencia orange trees were attributed to their positive action on enhancing microflora activity, soil fertility, N fixation and availability of all nutrients (**Kannaiyan , 2002**).

These results are in harmony with those obtained by **Ahmed *et al* (2007), Abdo (2008) and Mahfouz (2011).**

The great benefits of EM_1 on enhancing soil fertility , N fixation and the availability of most nutrients could result in improving growth and fruiting of Valencia orange trees. Similar results were announced by **Higa (1991); Formowitz *et al.* (2007) and Ibrahim (2012).**

Conclusion:

The best results with regard to yield and fruit quality of Valencia orange trees were *obtained due to treating the trees with compost* enriched with EM_1 and at the same time alleviating the adverse effects of salinity on growth and fruiting.

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11/12/2013