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EFFECT OF FULVIC ACID, SOME MICRO-ELEMENTS AND MICRO-ORGANISMS ON YIELD AND ITS COMPONENTS, CONTENT FRUITS OF MACRO- AND MICRO- ELEMENTS CONTENT OF ZAGHLOUL DATE PALM.

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ABSTRACT

The present work was carried out in newly reclaimed land at the Experimental Station of the Faculty of Agriculture (Kalabshow and Zayan), Mansoura University, Dakahlia Governorate, Egypt. to study the effect of fulvic acid, some micro elements and microorganisms on yield and its components, fruits content of macro- and micro-element of Zaghloul date palm.

The obtained results indicated that fulvic acid applied at 83.33 ml / palm tree + microorganisms at 83.33 ml / palm conjugation with micro elements at (3.12 gm from $FeSo_4.7H_2o$ + 1.56 gm from $ZnSo_4.7H_2o$ + 1.56 gm from $MnSo_4.H_2o$) as soil application / palm (T_7) gave significant increase yield/ palm (174.16 and 169.33 kg), fruit weight (33.2٩ and 32.45 gm) and flesh weight (30.927 and 30.070 gm), whereas the yield of T_1 control (96.16 and 92.23 kg/palm), fruit weight (20.34 and 19.63 gm) and flesh weight (18.47 and 17.95 gm) in both seasons of the study, respectively.

All treatments of organic compounds extracts and microelements gave significant increase in the values of NPK and Fe, Zn and Mn in Date palm fruits as compared to control treatment in both seasons of the study .

INTRODUCTION

Date palm (Phoenix dactylifera L.) is one of the oldest fruit trees in the world. It is known as “tree of life” because of its resilience, its need for limited water inputs, its long term productivity and its multiple purpose qualities. In Egypt, dates are important traditional crops. According to FAO (2012), Egypt is considered as the first country of the top ten date producers (1,130,000 tones). Economically, Zaghloul date is the most important soft cultivar grown in Egypt. Organic fertilizers improve soil structure and enhance activities of useful soil organisms. Agricultural commodities resulted from organic cultivation are good for human health (Jayathilake *et al*., 2006). Fulvic acid is the most significant component of organic substances and highly beneficial to both plant and soil; it is important for increasing microbial activity, it is considered as a plant growth bio-stimulant, an effective soil enhancer; it promotes nutrient uptake as chelating agent and improves vegetative characteristics, nutritional status and leaf pigments (Eissa *et al.* 2007). There are a number of inoculants with possible practical application in crops where they can serve as useful components of integrated plant nutrient supply systems. Such inoculants may help in increasing crop productivity by increasing biological N fixation (BNE), availability or uptake of nutrients

through solubilization or increasing absorption, stimulation of plant growth through hormonal action or antibiosis or by decomposition of organic residues (Wani, and Lee 1995). The present study was undertaken to investigate the effect of organic, biofertilizers and microelements (Fe, Zn and Mn) on the yield, macro and micro elements content of Zaghloul date palm fruits.

MATERIALS AND METHODS

Effect of fulvic acid, some micro-elements (Fe, Zn and Mn) and micro- organisms (*Serratia sp* + *Bacillus polymyxa* + *Pseudomonas fluorescens* + *Trichoderma viride* + *Trichoderma harzianum*) on yield and its components, fruits content of macro and micro elements of date palm Zaghloul cv. The experiment carried out at the Experimental Station of the Faculty of Agriculture (Kalabshow and Zayan), Mansoura University, Dakahlia Governorate, Egypt. Female palms with similar vigor, height, pollen source and age (10 years old) were selected and subjected to the normal cultural practices applied for date palms and planted at 7×7m under furrow irrigation system. seven soil application treatments were arranged in a completely randomized design with three replicates (1 replicate = 2 palms) per treatment (i.e. 7×3×2 = 42 palm).

The treatments were as follows:

T1: Control (treated with water only).

T2: Fulvic acid only at 83.33 ml Liters/palm.

T3: Microelements only at (3.12 gm from $FeSo_4.7H_2o$ + 1.56 gm from $ZnSo_4.7H_2o$ + 1.56 gm from $MnSo_4.H_2o$) /palm.

T4: Micro-organisms only at 83.33 ml Liters/palm.

T5: T2 + T3 T6: T2 + T4 T7: T2 + T3 + T4

These treatments added in three dates:

1- After full bloom and the beginning of set stage of date fruit at 23/4/2010 and 29/4/2011 seasons.

2- At Kamri stage of date fruit at 29/6/2010 and 5/7/2011 seasons. .

3- At the beginning of date fruit color at 6/8/2010 and 11/8/2011 seasons.

These treatments were applied in circle holes around each palm trees with 50 cm depth and the distance from the palm trunk is 70 cm.

Soil samples were taken to determine the properties of experimental soil at three depths from soil surface, 0 to 30 cm, 30 to 60 cm and 60 to 90 cm. Such samples were completely mixed and subjected to mechanical and chemical analysis to measure properties of soil as in Table 1.

Table (1): Mechanical and chemical analysis to measure certain properties of soil

Depth	Mechanical analysis				Chemical analysis					Available (ppm)		
	Sand %	Silt%	Clay %	Texture %	E.C. ds/m	pH	Sp %	$CaCO_3$ %	O.M. (%)	N	P	K
0-30	69.31	20.21	10.48	**Sandy loamy soil**	1.36	7.92	42	3.92	0.88	31.9	4.2	248
30-60	66.96	21.35	11.69		1.12	8.01	45	3.25	0.63	28.7	3.7	225
60-90	65.11	22.94	11.95		1.03	8.08	49	2.07	0.57	27.2	3.2	212

Preparation of Fulvic acid:

Compost prepared from Rice straw, Farmyard manure, Rock phosphate, Bentonite and Urea were digested with 0.5N KOH for 48 h at room temperature in the ratio of 1/10 (W\V). Separation of the solute form the undigested residues were then carried out by filtration by 100 Mesh screen. The supernatant was acidified at pH 2 with concentrated H_2SO_4 and left settling for 24 h in the dark in order to allow humic acid flocculation. Fulvic acid was collected by filtration. (Vallini *et al.,* 1990).

Table (2): analysis of fulvic acid

Trait	Value
PH	2.8
E.C (ds/m)	8.68
Organic-C (%)	2.81
Available-N (PPM)	210
Available -P(PPM)	7.4
Total-K(%)	2.26

Preparation of Micro organisms inoculants :

Serratia sp, grown on pepton – glycerol media (Grimont and Grimont, 1984), *Pseudomonas fluorescens* grown on king's media (Alef, 1995), *Bacillus polymyxa* grown on nutrient broth media (Dowson, 1957) and *Trichoderma* species grown on Potato dextrose media (ATTC,1992)were incubated for 2-3 days at 28 °C to maintain populations of $3x10^8$ colony forming unit ml^{-1} (CFU\ml). All microbial strains were kindly provided from Dept. of Microbiology, Soils, Water and Environment Research Institute (SWERI), Agriculture Research Center (ARC).

The following measurements were carried out:

1- **Yield /palm (Kg/palm) and its components**: At the harvesting, the yield counted as accumulation from six times of harvest, where each harvest was weighted. The simple of Date palm fruits (1oo fruits) were taken to determine its components.

2- **Macro elements content in date palm fruits at harvest:** The middle harvest (third) during the mid of September in both seasons, where the Date palms were harvested for six times, the simple of Date palm fruits (10 fruits) were taken and dried at 70c° to determine the macro and micro elements as follow: yield of tested studied palms was recorded in Kg / palm.

2.1 Total nitrogen %: Determined using micro-kjeldahl procedure according to the method described by Pregle (1945).

3.2 Phosphorus %: it was measured as described by Jackson (1967).

4.3 Potassium %: it was measured according to Black (1965).

5. Micro-elements content in date palm fruits at harvest: Iron, Zinc and Manganese elements were determined using Atomic-absorption (Analyst 200, Perkin Elmer, Inc., MA, USA), as described by Chapman and Pratt (1982).

The data of experiment was statistical analysis of variance according to Snedecor and Cochran (1980) and New LSD at 5 % level as mentioned by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Data in Table (3) illustrate effect of some organic compounds extract and microelements as soil application on yield and its components of Date palm trees during 2010 and 2011 seasons. All tested treatments gave significant increase on yield / palm, fruit weight and flesh in both seasons of the study compared with control treatment (treated with water only)

Application of fulvic acid at 83.33 ml / palm tree + treated palm tree with microorganisms at 83.33 ml / palm conjugation with micro elements at (3.12 gm from $FeSo_4.7H_2o$ + 1.56 gm from $ZnSo_4.7H_2o$ + 1.56 gm from $MnSo_4.H_2o$) as soil application / palm/ (T_7) gave significant increase yield/ palm (174.16 and 169.33 kg), fruit weight (33.29 and 32.45 gm) and flesh weight (30.93and 30.07 gm) in both seasons (2010-2011) of the study, respectively. While (T_6) application of fulvic acid at 83.33 ml / palm + treated palm tree with microorganisms at 83.33 ml / palm tree came in the second rank on yield (161.50 and 156.05 kg/palm), fruit weight (28.39and 30.75 gm) and flesh weight (26.15 and 28.48 gm) in 2010-and 2011seasons, respectively. On the contrary, the yield from T_1 control recorded in this respect (96.16 and 92.23 kg/palm), fruit weight (20.34and 19.63 gm) and flesh weight (18.47and 17.95 gm) in both seasons of the study, respectively. All other treatments gave value in between the previous treatments.

Table (3): Effect of organic substance, micro-elements and micro-organisms on yield traits during 2010 and 2011 seasons

Treatments	Yield and its components		
	Yield / palm (kg/palm)	Fruit weight (g)	Flesh weight (g)
	2010 season		
T1	96.16	20.34	18.47
T2	105.66	23.92	21.92
T3	101.55	21.59	19.63
T4	117.39	25.93	23.84
T5	132.94	26.37	24.20
T6	161.50	28.39	26.15
T7	174.16	33.29	30.93
New LSD at 0.05 level	6.57	0.56	0.58
	2011 season		
T1	92.33	19.63	17.95
T2	101.00	22.04	19.80
T3	97.67	20.48	18.45
T4	112.83	23.05	20.95
T5	129.83	29.34	27.19
T6	156.05	30.75	28.48
T7	169.33	32.45	30.07
New LSD at 0.05 level	4.976	1.10	1.034

Improving yield of date palm can be achieved through better cultural practices such as soil application of organic compounds extracts, which contained some plant nutrition, some of these nutrition are known as micronutrients i.e., Zn, Fe and Mn or amino acids and humic acid that are essential for producing healthy date trees as well as increasing the productivity of trees (Tan 2003). In addition, fulvic acid is highly beneficial to both plant and soil; it is important for increasing microbial activity, it is considered as a plant growth bio-stimulant, an effective soil enhancer; it promotes nutrient uptake as chelating agent and improves vegetative characteristics, nutritional status, leaf pigments and increasing fruit yield of date palm (Eissa *et al.* 2007).

These results are confirmed with those of Kaloosh (1993) studied on fertilization of Date palm trees by compost and reported that increasing the level of the compost from 0 to 25 kg/ tree increased the yield from 16.7 to 35.4 kg/tree. Also found that the application of 20 to 25 kg of tested compost/tree doubled the yield of the Date palm trees.

Mostafa *et al*. (2009) carried out an experiment on 15-year-old Thompson seedless grapevines (*Vitis vinifera*, L.) grown in clay soil in Belkas district, Dakahlia Governorate, Egypt in 2003 and 2004 seasons. They studied the effect of some natural organic nutrients including compost tea and chicken manure extracts at different concentration (1:10, 1:20 and 1:30) on yield/vine. They found that the highest yield values relatively were obtained from vines that sprayed with mixed from compost tea and chicken manure extract at rate of 1:10 x 1:10 w/v. Such yield was 19.82 and 20.41 Kg/vine in the 2003 and 2004 seasons, respectively.

Marzouk and Kassem (2011) on Zaghloul palm cultivar**,** revealed that fruit weight, flesh weight, length, diameter and dry weight were increased by the application of organic manures either alone or in combination with mineral NPK as compared to the mineral N..

Fruits content of macro element

1-Nitrogen percentage

Data in Table (4) showed that effect of organic compound extracts and microelements on fruit content of nitrogen during 2010 and 2011 seasons. All treatments of organic compounds extracts and microelements gave significant increase in the values of nitrogen content of fruits in both seasons of the study compared with control, whereas T_7 (treated of date palm with 83.33 ml / palm fulvic acid plus the mixture of 3.12 gm $FeSO_4.7H_2o$ +1.56 gm of $ZnSO_4.7H_2o$ +1.56 gm $MnSO_4.H_2o$ and 83.33 ml/palm microorganisms as soil application) recorded the highest values (5.177 and 5.573%, in 2010 and 2011 seasons, respectively) without significant differences between (T_5) application of 83.33 ml/ palm fulvic acid as soil application + mixture of 3.12 gm $FeSO_4.7H_2o$ +1.56 gm of $ZnSO_4.7H_2o$ +1.56 gm $MnSO_4.H_2o$ / palm as soil application (5.097 and 5.487 % in the 1st and 2nd seasons, respectively. While the lowest values in this respect was obtained with control treatment (treated date palm with water only) and recorded 4.190 and 4.510 % in the 1st and 2nd seasons, respectively.

Phosphorus percentage

Data given in Table (4) indicated that P% significantly increased in fruits by application of organic compound extracts and some microelements in 2010 and 2011 seasons. All treatments of organic compounds extracts and microelements as soil application gave

significant increase in fruit phosphorus content values in the two seasons of the study compared with control treatment, whereas T_7 gave the highest values of fruit phosphorus content (0.765 and 0.704 % in 1st and 2nd seasons , respectively), followed by T_5 treated of palm with 83.33 ml/ palm fulvic acid as soil application + mixture of 3.12 gm $FeSO_4.7H_2o$ +1.56 gm of $ZnSO_4.7H_2o$ +1.56 gm $MnSO_4.H_2o$ / palm as soil application (0.737 and 0.678 % in the 1st and 2nd seasons, respectively. On the contrary, control treatment gave the lowest values of fruit phosphorus content compared with other treatments in the two seasons of the study (0.620 and 0.571 % in the 1st and 2nd seasons, respectively).

Potassium percentage

Data tabulated in Table (4) cleared the effect of organic, microelements and microorganism as soil application on fruit potassium content of date palm during 2010 and 2011 seasons. Treated of date palm with organic compound extracts and some microelements had significant effect on potassium content in fruits in both season.

Table (4): Effect of organic, microelements and microorganisms on N,P and K contents in fruits during 2010 and 2011 seasons

Treatments	Microelements content (%)		
	N	P	K
	2010 season		
T1	4.190	0.620	5.097
T2	4.440	0.653	5.390
T3	4.700	0.685	5.670
T4	4.427	0.657	5.457
T5	5.097	0.737	6.120
T6	4.823	0.711	5.820
T7	5.177	0.765	6.283
New LSD at 0.05 level	**0.100**	**0.013**	**0.093**
	2011 season		
T1	4.510	0.571	4.743
T2	4.777	0.601	5.013
T3	5.060	0.631	5.273
T4	4.767	0.605	5.073
T5	5.487	0.678	5.690
T6	5.193	0.655	5.410
T7	5.573	0.704	5.847
New LSD at 0.05 level	**0.111**	**0.012**	**0.083**

All treatments recorded significant increase in fruit content of potassium in both seasons of the study as compared with control treatment, whereas T_7 treatment(treated of date palm with 83.33 ml / palm fulvic acid plus the mixture of 3.12 gm $FeSO_4.7H_2o$ +1.56 gm of $ZnSO_4.7H_2o$ +1.56 gm $MnSO_4.H_2o$ and 83.33 ml/palm microorganisms as soil application) gave the highest increase of potassium fruit content (6.283 and 5.847 % in

two seasons, respectively) comparing with the rest treatments. T_5 came in the second rank (6.120 and 5.690 % in both seasons 2010-2011, respectively). On the other hand, the control treatment gave the lowest values of potassium compared to other treatments in two seasons of the study (5.097 and 4.743 % in 2010 and 2011 seasons, respectively).

The important role of organic compounds extracts in soil may exhibit through enhancement of the nutrient elements availability by reducing soil pH, increasing the exchangeable capacity and reducing their losses by leaching as well as the ability of organic chelating agents to protect the nutrient elements against the conversion to unavailable forms.

These results are in agreement with there reported by Ahmed *et al.* (1997) studied the effect of amending a foliar applied spray containing (N, P, K, Mg, Zn, Fe, Mn, Cu and B) with glycerol (0.05%) or active dry yeast (0.1%) on its efficiency were investigated on grapes cv. Red Roumy in Egypt. They indicated that all the treatments improved nutritional status of vines.

Fruits micro-elements contents

Date in Table (5) show the effect of organic compound extracts and some microelements on Fe, Zn and Mn concentration in fruits at harvest time during 2010 and 2011 seasons. Treated of date palm trees with organic extracts such as fulvic acid, microorganisms and some microelements (Fe, Zn and Mn) as soil application had significantly increased Fe, Zn and Mn concentration in fruits as compared to control treatment in both seasons.

Table (5): Effect of organic, micro-elements and micro-organisms on fruits contents of Fe, Zn and Mn during 2010 and 2011 seasons.

Treatments	Microelements content (ppm)		
	Fe	Zn	Mn
	2010 season		
T1	18.98	8.59	9.48
T2	20.03	9.07	10.02
T3	21.24	9.58	10.58
T4	20.24	9.17	10.11
T5	23.15	10.33	11.48
T6	21.73	9.84	10.85
T7	23.41	10.64	11.73
New LSD at 0.05 level	0.13	0.141	0.10
	2011 season		
T1	21.32	8.85	9.79
T2	22.50	9.34	10.30
T3	23.86	9.86	10.93
T4	22.74	9.45	10.45
T5	26.01	10.64	11.87
T6	24.41	10.14	11.21
T7	26.30	10.96	12.12
New LSD at 0.05 level	0.14	0.141	0.11

In this regard application of T_7 gave the higher values (23.42 and 26.30 ppm) for Fe , (10.64 and 10.96 ppm) for Zn (11.73 and 12.12 ppm) for Mn in the 2010 and 2011 seasons, respectively, followed by T5 (23.153 and 26.007 ppm) for Fe, (10.330 and 10.640 ppm) for Zn (11.483 and 11.867 ppm) for Mn in the 2010 and 2011 seasons, respectively. While T1 control

treatment recorded the lowest values (18.980 and 21.320 ppm) for Fe , (8.587 and 8.845ppm) for Zn (9.477 and 9.793 ppm) for Mn in the 2010 and 2011 seasons, respectively.

These results are in harmony with these reported by Abd El-Naby and Gomaa (2000) working on Maghrabi banana plants. They found that the adding of organic combined with inorganic fertilizers produced fruits with a higher content of iron.

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تأثير حمض الفولفيك وبعض العناصر الصغرى والكائنات الدقيقة على المحصول ومكوناتة ومحتوى الثمار من العناصر الكبرى والصغرى للبلح صنف الزغلول

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**** مركز بحوث الأراضى والمياة والبيئة.**

تم تنفيذ هذا العمل فى الأراضى المستصلحة حديثا فى المحطة التجريبية التابعة لكلية الزراعة- جامعة المنصورة بقلابشو وزيان - محافظة الدقهلية - مصر. وذلك لدراسة تأثير حمض الفولفيك وبعض العناصر الصغرى والكائنات الدقيقة على المحصول ومكوناتة ومحتوى الثمار من العناصر الكبرى والصغرى لأشجار نخيل البلح صنف الزغلول.

أشارت النتائج التى تم الحصول عليها أن الأضافة الأرضية من حمض الفولفيك بمعدل ٨٣,٣٣ ملليتر/ نخلة + الكائنات الحية الدقيقة بمعدل ٨٣,٣٣ ملليتر /نخلة + العناصر الصغرى بمعدل ٣,١٢جم سلفات حديدوز + ١,٥٦ جم سلفات زنك +١,٥٦ جم سلفات منجنيز (المعاملة السابعة) قد أعطت زيادة معنوية للمحصول/نخلة (١٧٤,١٦ ، ١٦٩,٣٣ كجم)، ووزن الثمرة (٣٣,٢٩ ، ٣٢,٤٥ جم)، ووزن اللحم (٣٠,٩٣، ٣٠,٠٧) بينما أعطت معاملة الكنترول (٩٦,١٦، ٩٢,٢٣ كجم) للمحصول / نخلة ، (٢٠,٣٤ ، ١٩,٦٣ جم) لوزن الثمرة ، (١٨,٤٧، ١٧,٩٥ جم) لوزن اللحم فى كلا موسمى الدراسة (٢٠١٠-٢٠١١)، على التوالى. كما أعطت أيضاً هذه المعاملة زيادة معنوية لمحتوى ثمار البلح من النيتروجين والفوسفور والبوتاسيوم والحديد ،الزنك والمنجنيز بالمقارنة بمعاملة الكنترول فى كلا موسمى الدراسة.

ومن هذه الدراسة يتبين أهمية تطبيق المركبات العضوية مثل حمض الفولفيك لتحسين ظروف التربة الرملية من الناحية الغذائية وزيادة السعة التبادلية للحفاظ على العناصر الغذائية مثل العناصر الكبرى والصغرى التى تضاف للتربة. وكذلك تشجيع تكوين مجتمعات جديدة من الكائنات الحية الدقيقة التى تلعب دوراً مهماً للنبات والتربة.

قام بتحكيم البحث

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