EFFECT OF LIQUID ORGANIC FERTILIZATION TECHNEQES ON YIELD AND CHEMICAL COMPOSITION OF PEAR AND APRICOT TREES GROWN ON SANDY SOLS AT SOUTH TAHRIR PROVINCE

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ABSTRACT5:

Two field trials were carried out on sandy soils cultivated with pears (cv. Le-conte) and apricots (cv. Canino) during two successive seasons of 2003-2004 to study the effect of applying liquid organic fertilizer contain a minimum of 2.9% humic acid, added as foliar spray on leaves (Sp), mixed with soil around the trees (So) and a combined treatment of spray on leaves + mixed with soil (Sp+So), in addition to a control treatment. These applied treatments were repeated three times, i.e., at beginning of growth, June and August.

Data obtained indicated that the treatment of (So+Sp) gave the highest values of vegetative growth parameters of pears and apricots (length of current shoots, No. of current shoots, No, of leaves on the current shoots, No. of nodes on the current shoots and leaf area) as compared with the other treatments. On the other hand, the effect of the applied treatments on apricot fruit characteristics was insignificant for all treatments, except of the fruit weight at the treatment of (Sp), which gave a significant increase as compared to the other ones.

Data revealed also that the available contents of NO_3-N, P, K, Fe, Mn, and Zn in soil were higher as a result of applying the treatment of (Sp+So), followed by (So) and (Sp) techniques. Available contents of NO_3-N and P were relatively higher after two weeks from application at the second time of June. Whereas, the relatively higher available of Fe, Mn and Zn were obtained at third time of August.

The positive effect of the superior treatment of (Sp+So) was extended to the grown trees, however, the results showed relatively higher contents of N, P, K, Fe, Mn and Zn concentrations in leaf tissues, followed by (So) and (Sp) treatments. Thus, the beneficial effects of the applied treatments could be arranged as follows: (Sp+So) > So > Sp > control. It is noteworthy to mention that at the second time of June, all the studied macro and micronutrients of N, P, K, Fe, Mn and Zn showed the highest concentrations in leaf tissues as compared with the third time of August.

Keywords: Humic acid, Sand soil, Available & Uptake nutrients, Pear and Apricot trees.

INTRODUCTION

Humic acid (HA) reportedly enhanced the growth of numerous crops. Root dehydrogenate activity and root mass growth was significantly increase by humic acid. Humic acid increased tissue concentrations of Mg, Mn and S, while it decreased those of N, Ca and Cu, but had no influence on the concentrations of P, K, Fe and Zn. **Li-Nan *et al.* (1999)** reported that applied of liquid fertilizer (consisting of humic acid, N, P, K, Ca, Mg, S, Fe & Co and applied twice on 10 May and 1 September) on apple cv. starkrimsn trees in USA led to increase

fruit weight by 81.3 and 29.2% and fruit soluble solids content by 4.9 and 11.6%, respectively. **Zhu and Zhu (2000)** reported that applied of different concentrations of Opal HA-202 liquid fertilizer (consisting of humic acid, sodium humat, N, P, K, Ca, Mg, S, Fe & microelements) as foliar spray on 10-year old pears trees (cv. Huahua) after petal fall with a total of 4 times at intervals of 10 days were increased the fruit size by 21.8-29.2 %, soluble solids content by 1.6-2.4 % and yield by 21.6-28.6 %.

Ten years old trees of apple (cv. nagano fujiz) were sprayed with different concentrations of Komix (an organic humic acid as liquid fertilizer) at different stages. Application of 250 times solution of Komix promoted shoot growth, increased chlorophyll content, enhanced photosynthesis, increased fruit weight and improved fruit quality. Komix increased also fruit weight by 45 g and the soluble solids content by 0.8% **(Guo *et al.*, 2000). Silva *et al.* (1999)** pointed out that humic compounds increased plant height, dry matter production and crude protein content, with significant differences in some cases between humic compounds extracted from different raw materials and the 2 higher application rates giving the best growth. **Abou Hussien *et al.* (2002)** reported that the adsorbed amounts of humic acid on the fine clay-fraction were larger than those adsorbed by the coarse fraction and those amounts increased by adding humic acid. The adsorbed amounts of Fe and Zn increased higher HA-concentrations in the complex.

The aim of this study is to evaluate the effect of applying liquid organic fertilizer (contain a minimum of 2.9% humic acid) techniques, added as foliar spray on leaves (Sp), mixed with soil around the trees (So) and (Sp+So) on vegetative growth, some available nutrient contents in soil or their concentrations in leaf tissues, fruit characteristics and yields of pears and apricots trees.

MATERIALS AND METHODS:

To achieve the aforementioned objectives, two field trials were carried out during two successive seasons of 2003-2004 on young trees of pears (cv. Le-conte grafted on Pyrus commuins rootstock) and apricots (cv.canino grafted on Balady apricots rootstock). These trees were grown on sandy soils with 4X5 m apart under drip irrigation system at the Experimental Orchard of Ali Mubark Horticulture Research Station, South of Tahrir Province.

The tested trees were nearly vigor and subjected to the same horticulture practices. The applied techniques were carried out through four treatments, as follows:

1. Liquid organic fertilizer contains a minimum of 2.9 % humic acid (LOF), added as foliar spray (Sp) on tree leaves, with a concentration of 5 ml LOF/liter and a rate of 4 liter/fed.
2. LOF, added as soil application (So), with a concentration of 5 ml LOF/liter and a rate of 4 liter/fed.
3. Combined treatment of (Sp + So).
4. Control treatment (un-treated trees or soils).

Humic acid content in liquid organic fertilizer was determined using $BaCl_2$ precipitation method as described by Fataftah *et al.* (2001). The different constituents of the applied liquid organic fertilizer were determined and illustrated in Table (1).

Table (1): Main characteristics of the used liquid organic fertilizer.

Component	Value
Humic acid (%)	2.9
Total solid (g/L)	390.135
Organic matter/total solid (%)	42.51
Total humic acids/total solid (g/L)	165.84
Organic carbon (%)	24.64
C/N ratio	2.46
pH	8.18
EC (dS/m)	59.3
Total nitrogen (N %)*	10
Total phosphorus (P_2O_5 %)*	10
Total potassium (K_2O %)*	10
Total calcium (Ca %)**	0.06
Total magnesium (Mg %)**	0.05
Total boron (B mg/L) **	70
Total chloride (Cl mg/L)*	5000
Total iron (Fe mg/L) **	900
Total manganese (Mn mg/L)**	90
Total zinc (Zn mg/L) **	90
Total copper (Cu mg/L) **	90

* Soluble in distill water ** Digest by H_2SO_4

These treatments were repeated in three periods, i.e., beginning of growth, June and August months. Each treatment comprised 9 trees and shared with three replicates in a complete randomized block design (18 trees for each of pear and apricot trees).

Data were recorded for the studied two seasons on vegetative growth parameters and fruit yields of pear and apricot trees, i.e., length of current shoots length, number of leaves per current shoots, number of nodes per current shoots, diameter of basal current shoots, leaf area, increment growth of rootstock & scion zone, characteristics and yield of apricot fruits (cv. Canino) in season of 2003. Tree leaves were taken after two weeks from the treatment to measure leaf area and to determine some macro and micronutrients uptake by tree leaves such as N, P, K, Fe, Mn and Zn **(Chapman and Pratt, 1961).**

Representative soil samples were taken from the experimental field after and before initiating the experiment and subjected to the different soil analysis. Some hydrophysical, chemical and fertility characteristics of the experimental soils are shown in Table (2).

Soil particle size distribution was done without $CaCO_3$ removal using the pipette method using sodium hexametaphosphate as a dispersed agent, as described by the procedure outlined by **Piper (1950).** Water holding capacity, $CaCO_3$ content, pH and organic matter content were determined according to the methods described by **Black *et al.* (1965).** Soil salinity and soluble ions were determined in the soil paste extract, as described by the methods undertaken by **Page *et al*. (1982).**

Some available macronutrients (NO_3-N, P and K) in soil were extracted by 1% potassium sulphate, 0.5 M sodium bicarbonate and 1 N ammonium acetate, respectively **(Soltanpour and Schwab, 1977),** and their contents were

determined according to **Jackson (1973).** Available micronutrients of Fe, Mn, Zn, and Cu in soil extracted using ammonium bicarbonate DTPA solution according to the methods described by **Lindsay and Norvell (1978)** and their contents in soil were measured by using the Atomic Absorption Spectrophotometer. Results obtained were statistically analyzed according to **Steel and Torrie (1960).**

Table (2): Some hydrophysical, chemical and fertility characteristics of the experimental soils.

Soil characteristics	Pears	Apricots	Soil characteristics	Pears	Apricots
Particle size distribution %			*Soil paste extract:*		
Coarse sand	73.50	73.10	ECe in dS/m	1.59	1.85
Fine sand	21.28	23.03	*Soluble ions (meq / l) :*		
Silt	3.10	2.00	Ca^{2+}	8.64	10.04
Clay	2.12	1.87	Mg^{2+}	6.40	6.24
Texture class	Sandy	Sandy	Na^{+}	1.88	2.00
Some available macro and micronutrients (mg/kg):			K^{+}	0.56	0.64
NO_3-N	3.28 L	1.82 L	CO_3^{2-}	0.00	0.00
P	5.30 M	7.00 M	HCO_3^{-}	2.20	2.04
K	36.40 L	38.50 L	Cl^{-}	6.60	6.36
Fe	2.77 L	3.76 M	SO_4^{2-}	6.68	9.52
Mn	0.49 L	0.41 L	pH (1:2.5 soil water susp.)	7.62	7.70
Zn	0.56 L	0.60 L	$CaCO_3$ %	0.95	1.06
Cu	0.34 M	0.33 M	Organic matter %	0.12	0.13
Soil moisture constants %					
Field capacity	8.70	9.00	Water holding capacity	15.20	15.90
Wilting point	3.59	4.10	Available water range	5.11	4.90

L = Low and M = Medium

RESULTS AND DISCUSSION:

I. Effect of the applied techniques on vegetative growth of the studied fruit trees:

a. Pears:

Data in Table (3) revealed that the applied techniques of (Sp+So) gave the highest and significant increase of shoot length, number of leaves, number of nodes, shoot diameter and leaf area of pears (cv. Le-conte) than the other treatments during the two successive seasons under study. These findings are in harmony with the results obtained by **Abadia (1984)** who found that the high plant growth parameters were observed when the humic substances were used, may be due to modifications in the soil-root interface that make the nutrients more available to the plants.

b. Apricots:

Table (4) showed clearly that the all applied techniques increased significantly length of current shoots, number of leaves, number of nodes, diameter of shoots and leaf area of apricots (cv. Canino), where the treatment of foliar spray only was more effective in the first season for length of current shoots, diameter of current shoots and leaf area, while soil application only gave the highest number of leaves.

Table 3, 4

II. Effect of the applied techniques on growth of rootstock and scion:

a. Pears:

Data in Table (5) showed that all applied techniques of application increased the growth of rootstock and scion of pears (cv. Le-conte) over the control treatment, with superiority for a technique (Sp+So), which gave the highest and significant increase than other treatments.

b. Apricots:

Data in Table (5) indicated that applying the different techniques on apricots (cv. Canino) exhibited insignificant differences between all treatments.

Table (5): Effect of liquid organic fertilizer on growth of rootstock and scion of pears and apricots during the studied experiment.

Treatment (T)	Scion (cm)		Rootstock		Increment of scion (cm)	Increment of rootstock (cm)
	Beginning of experiment	End of experiment	Beginning of experiment	End of experiment		
Pears						
Control	3.50	7.47	4.50	8.30	3.97	3.80
Sp.	3.60	7.80	4.50	9.57	4.20	5.07
So.	3.90	8.00	4.20	9.63	4.10	5.43
Sp + So	3.00	7.93	3.60	9.37	4.93	5.77
LSD at 5%	Ns	0.40	Ns	0.39	0.52	0.78
Apricots						
Control	1.3	4.33	1.90	5.00	3.03	3.10
Sp.	1.6	4.60	2.03	5.30	3.00	3.27
So.	1.6	4.70	1.90	5.17	3.10	3.27
Sp + So	1.2	4.53	1.90	5.03	3.33	3.13
LSD at 5%	NS	0.12	NS	0.27	NS	NS

I: June II: August Sp.: foliar spray So: Soil application

III. Effect of the applied techniques on characteristics of apricot fruits:

Data in Table (6) indicated that the characteristic of apricot fruits showed insignificant differences between all applied treatments, except of the fruit weight that exhibited the highest and significant increase at the foliar spray technique than the other studied treatments.

IV. Effect of the applied techniques on some available macro and micronutrients in soil:

a. Pears:

The effect of different applied techniques on the available contents of NO_3-N, P and K in soil are shown in Table (7), and revealed that there were significant differences between all the treatments under study. Also, the (Sp+So) technique considerably surpassed all other techniques, followed by mixed with soil and foliar spray technique in both seasons under investigation. The results showed relatively high increases in available contents of NO_3-N, P and K at the second period of application (June) as compared to those at the third one (August) for both studied seasons. The results also showed clearly an interaction effect between the applied techniques and the data obtained, as shown with P available in soil. Briefly, all techniques gave higher content of

Table 6,7

available of P than the control treatment at the second period (June), but foliar spray technique and control treatment were similar at the third period (August). These findings are confirmed by the results obtained by **Heng (1989)** who reported that humic substances played an important role in decreasing the phosphate fixing capacity of soil.

Data presented in Table (7) showed that available Fe, Mn and Zn in soil under different applied techniques gave the relatively higher values as compared to the control treatment, with significant differences among these techniques. Application of (Sp+So) was the superior technique as compared to the other ones. It was followed by the soil application and foliar spray. Also, data show that available Fe content in soil under (Sp+So) and soil application was rather similar, since the difference was not statistically significant. It was noticed that the relatively higher contents of Fe, Mn and Zn obtained at third period of application (August). In addition, the interaction between the applied techniques and data obtained showed that in first season available Fe in the second and third periods were similar only where foliar spray technique was used, but in the second season available of Fe was superior in the second period as compared to the third one. It was clearly noticed that available of Mn at a combined technique of (Sp+So) recorded the same result of soil technique. Also, available of Zn in the second season under foliar spray technique and untreated (control) were nearly similar, especially at the third period.

b. Apricots:

Data presented in Table (8) showed the available NO_3-N, P and K in soil under different applied techniques. There were significant differences among the applied techniques, with superiority for a technique of (Sp+So) followed by the soil application and foliar spray which gave the lowest value and similar to the control treatment. There were 12, 5 and 6% increases (on average) in available contents of NO_3-N, P and K, respectively, at second period over the third one.

Data of available iron, manganese and zinc in soil (Table 8) revealed that the highest average value of available Fe in soil was obtained under (Sp+So) technique, followed by the soil technique and foliar spray. It is noteworthy that both (Sp+So) and soil techniques were similar in their effects, and the two techniques gave relatively higher contents of available Mn and Zn in soil over the foliar spray technique. There were 6, 51 and 38% increases (on average) in available contents of Fe, Mn and Zn, respectively, at the third period (August) over the second one.

V. <u>Effect of the applied techniques on macro and micronutrients concentrations in tree leaves:</u>

a. Pears:

Data in Table (9) indicated that N, P and K concentrations in leaves of pear trees were affected significantly by different applied techniques in both studied seasons. (Sp+So) technique gave the highest N, P and K concentrations, followed by foliar spray and soil application. Thus, the applied treatments could be arranged as follows: combined treatment of (Sp+So) > foliar spray > soil application > the control treatment. At the second period N, P and K concentrations showed the highest as compared with the third one. Nitrogen concentration in leaves of pear trees as affected by the applied (Sp+So) and foliar spray did not differ significantly in third period (August). The data also showed that the P concentrations at (Sp+So), soil and foliar spray techniques

Table 8, 9

were similar in their effects in third period. K concentrations at soil and foliar spray techniques were rather similar, since their differences were not statistically significant, particularly evident with the second period.

Data of Fe, Mn and Zn concentrations in leaves of pear trees are presented in Table (9), and showed that the effects of the different applied techniques on micronutrients concentrations in tree leaves were significant. The (Sp+So) technique was considerable surpassed all other ones, followed by soil application, foliar spray and lastly the control treatment. It could also be noticed that, the applied techniques increased the Fe, Mn and Zn concentrations after the third period as compared with the second one.

b. Apricots:

Data of macronutrients (N, P and K) concentrations in leaves of apricot trees (Table 10) showed that the highest N-concentration was observed with the (Sp+So) technique, where its increase reached 70 % over the control treatment. The soil application treatment gave the lowest N-concentration (30%). Thus, the beneficial effect of the applied techniques on N-concentration could be categorized into the order of (Sp+So) > foliar spray > soil application > control treatment. Data also showed that the highest P and K-concentrations were observed with the (Sp+So) technique. Thus, the beneficial pattern was illustrated as follows:

(Sp+So) > foliar spray = soil application > control treatment

There were 13, 12 and 18 % increases (on average) for N, P and K concentrations, respectively, at the second period over the third one.

Iron, manganese and zinc concentrations in leaves of apricot trees were significantly affected as a result of applying the different used techniques, Table (10). The highest Fe, Mn and Zn concentrations were observed with (Sp+So) technique, where the Fe, Mn and Zn concentrations were increased by 45, 29 and 59% over the control treatment, respectively. As for the soil technique, the corresponding increases were 19, 22 and 35%, respectively. The increases in the case of foliar spray technique reached 11, 13 and 26% over the control treatment for Fe, Mn and Zn concentrations, respectively. In general, adding the liquid organic fertilizer at the second period gave the greatest positive effect that are represented by different increases of 18, 10 and 10% (on average) over the second period for Fe, Mn and Zn concentrations in leaves of apricot trees, respectively.

VI. <u>Overall assessment of results</u>:

The aforementioned results could be concluded that liquid organic fertilizer plays an important role for nutrients availability in soil. Regarding available NO_3-N, P and K in soil under pears or apricots trees, the three applied techniques could be arranged according to their positive effects as follows statistically: (Sp+So) > soil application > foliar spray, particularly after two weeks from application of LOF at the second period (June). Regarding available Fe, Mn and Zn in soil under pears or apricots trees, the three techniques could be arranged as follows statistically: (Sp+So) > soil application > foliar spray, particularly after two weeks from application of LOF at third period (August). Regarding N, P and K concentrations in leaves of pears or qapricots trees, the three techniques could be arranged as follows statistically: (Sp+So) > foliar spray > soil application, particularly after two weeks from application of LOF at the second period (June). Regarding Fe, Mn and Zn-concentrations in leaves of pears or apricots trees, (Sp+So) > soil application > foliar spray, particularly after two weeks from application of LOF at third period (August).

Table 10

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تأثير تقنيات ا لتسميد ا لعضوى ا لسا ئل على الانتاجيه والتركيب ا لكيميائى لاشجار الكمثرى والمشمش الناميه فى أراضى رمليه فى مديرية جنوب التحرير

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أجريت تجربتين حقليتين على أرض رملية منزرعة بأشجار الكمثرى صنف(cv. Le-conte) والمشمش صنف(cv. Canino) بمزرعه على مبارك التابعه لمحطة مديرية جنوب التحرير خلال موسمين زراعيين متتاليين (٢٠٠٣- ٢٠٠٤)، بهدف دراسه تأثير تقنيات التسميد العضوى فى صورة إضافه أرضيه، الرش على الاوراق، (إضافه أرضيه + الرش على الاوراق)، بجانب معاملة الكنترول(عدم اضافه)، وذلك خلال ثلاثه مواعيد مختلفه هى بداية النمو الخضرى، وخلال شهرى يونيو، أغسطس.

وقد أظهرت نتائج الدراسه أن معامله (الرش على الأوراق + الإضافه الارضيه) قد أدت الى زياده معنوية فى قياسات النمو الخضرى (طول الافرع، عدد الاوراق، عدد السلاميات، ومساحه الورقه) لكل من صنفى الكمثرى والمشمش تحت الدراسة، وكانت الزياده معنويه فى جميع المعاملات التى تم تطبيقها. كما تلاحظ عدم وجود تأثير معنوى للمعاملات على الصفات الثمريه لصنف المشمش، فيما عدا وزن الثمار لمعامله الرش على الأوراق فقد أظهرت فروقا معنوية عن باقى المعاملات تحت الدراسة.

كما أظهرت نتائج الدراسه ايضأ أن معاملة (الرش على الأوراق + الإضافة أرضى) قد أدت الى زياده فى تيسر كل من النترات والفوسفور والبوتاسيوم والحديد والمنجنيز والزنك فى الارض. وكانت الكمية الميسرة من النترات والفوسفور أكثر إرتفاعا عند الإضافه الثالثه فى شهر أغسطس.

وقد إمتد الأثر الإيجابى لمعاملة (الرش على الأوراق + الإضافة أرضى) إلى الأشجار النامية، حيث أدت الى زياده فى تركيز النتروجين والفوسفور والبوتاسيوم والحديد والمنجنيز والزنك فى انسجة اوراق أشجار الكمثرى والمشمش، يليها معاملة الإضافه الارضيه ثم الرش وذلك بالمقارنة بمعاملة الكنترول. كما أوضحت النتائج أن الإضافه فى الفترة الثانيه (يونيو) أدت الى زياده فى تركيز جميع العناصر الكبرى والصغرى تحت الدراسة (النتروجين، الفوسفور، البوتاسيوم، الحديد، المنجنيز، الزنك) بالمقارنه بالفترة الثالثه (أغسطس).