J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 2 (3): 327 - 340, 2011

RESPONSE OF LE-CONTE PEAR TREES GROWN UNDER EGYPTIAN CODITION TO SOME FOLIAR APPLICATIONS AND SOIL SPRAYING WITH AGAR SOLUTION.

Mohamed, A. A. A.; Zeinab M. A. Khalil**; A. F. E. El-Rmah* and M. A. El-Akabawy ****

*** Horticulture Res. Inst., Agric. Res. Centre, Giza, Egypt.**

**** Plant Nutrition Dept., Soil, Water and Environ. Res. Inst., Agric. Res. Centre, Giza, Egypt.**

ABSTRACT

The present investigation was carried out during two successive seasons of 2008 and 2009 at El-Kassasin Research Station (sandy loam soil) under drip irrigation system, on Le-Conte pear trees.

The work aimed at studying the effectiveness of foliar application treatments with soluble K_2SO_4 (SOP), putrescine, chelated micronutrients (Fe + Zn + Mn) solely or in combination and soil spray treatment with Agar solution (as soil conditioner) in improving pear vegetative growth, fruit yield and its quality.

The obtained results showed a pronounced enhancement in the studied vegetative growth characters (No.of leaves and leaf area), chlorophyll (A), chlorophyll (B) and carotene contents as a result of foliar spray treatments. Moreover, these treatments corrected the nutritional status of trees leading to significant increases in fruit yield and an improvement in fruit quality characters (fruit weight, size, firmness, total soluble solids (TSS), acidity, and TSS/acidity ratio).

The best results were obtained with the treatment of combination between "potassium + putrescine + micronutrients" which achieved percentage increases over control; 24.5% in fruit yield, 12.6% in fruit weight and 13.4% in fruit size.

This investigation also showed a promising result concerning using Agar solution, as a soil conditioner. Such treatment exhibited positive responses in all the studied growth parameters and fruit yield. Yet, it might need more time than two seasons in order to have remarkable beneficial effects; as a soil conditioner, being used under drip irrigation system.

INTRODUCTION

In Egypt, Le-Conte pear is the most important pear cultivar. Its trees growth , productivity and fruit quality are greatly influenced by many factors.

Among these factors, is micronutrient deficiency, especially in newly reclaimed soils. It could be considered one of the limiting factors for many fruit trees productivity. In this connection, several investigators have emphasized the great importance and significant influences of foliar application of micronutrients on deciduous fruit trees under soil conditions of Egypt (Awad and Atawia , 1995 a & b; Kabeel *et al.* 1998; Fawzy and Abdel-Moneim, 2004 and El-Sheikh *et al.* 2007).

In addition, the practical use of the diamine putrescine (as a foliar spray solution) had an outstanding influence on yield as well as on physical and chemical properties of many fruits and field crops specially when was sprayed in combination with micronutrients. Such influence was reported by Smith (1985) and Abu El-Fotoh *et al.* (2006) on wheat and rice crops**,** Abd El-

Magid *et al.* (2007) on cotton and Sayed *et al.* (2008) on orange trees. Altman and Bachrach (1981); Slocum *et al.* (1984); Smith (1985) and Kaur-Sawhney *et al.* (1987) reported that putrescine has a crucial role in protecting cell membranes against the stress injuries caused by cold, salinity, wilting, herbicides and pollution.

It is commonly accepted that potassium soil application enhances fruit yields and its fruit quality specially in poor coarse textured soils (Kilany and Kilany, 1991 and Attala, 1997) on Anna apple. However, it is interesting to mention, under Egyptian conditions, that usage of soluble potassium sulphate as foliar application exhibited significant results in increasing yields and improving fruit quality of many fruit crops **(**Khamis *et al.* 1994) on peach and pears; (El-Sherif *et al.* 2000) on guava and (Naiema, 2003) on Anna apple.

Few decades ago, considerable attention was focused on using natural polysaccharides as effective agents in stabilizing soil organic matter and clay aggregates. Many researchers have used them as soil conditioners (Wallace, 1986 a & b; Mitchell, 1986 and Ben-Hur and Letey, 1989). Recently, El-Aggory *et al.* (2002) successfully used the biopolymer Agar solution as a spray on sandy soils of Egypt. They concluded that Agar could significantly increase peanut yield.

This work was conducted to study the effect of foliar spraying with chelated micronutrients (Fe, Zn and Mn), putrescine (PUT) and soluble k (SOP), either solely or in combination as well as soil spray treatment with Agar solution, on Le-Conte pear growth , its fruit yield and quality, under Egyptian conditions.

MATERIALS AND METHODS

This investigation was implemented during consecutive seasons of 2008 and 2009 on healthy Le-Conte pear trees of about 6 years old, budded on *Pyrus communis* rootstock and planted at 5x5m apart. Trees were grown on sandy loam soil under drip irrigation system at El-Kassasin Horticulture Experimental Research Station (30° ′11 N, 31° ′18 E), Ismailia Governorate, Egypt. All the studied trees were equally subjected to the same N, P, and K fertilization practices. N was added as ammonium Nitrate (33.5 % N) at a rate of 450 N g /tree/year, P was added as superphosphate (15.5% P_2O_5) at a rate of 80 P_2O_5 g/tree/year and K was added as potassium sulphate (48 % K_2O) at a rate of 900 K_2O g/tree/year.

In January, organic manure fertilizer + a mixture of whole dose of P-fertilizer, half dose of K-fertilizer and 210 g N of N-fertilizer were applied for each tree. The second half of K- fertilization was applied in May. While, the rest of N-fertilizer was applied at 8 equal doses from mid February to mid September.

Some properties of the experimental soil are shown in Table (1).

Table (1): Some chemical properties of the experimental soil.

pH	EC dsm^{-1}	$CaCO_3$ %	OM %	Available macronutrients mg/kg			Available micronutrients mg/kg			
1:2.5	1:5			N	P	K	Fe	Zn	Mn	Cu
7.90	3.50	6.25	0.50	58.6	9.50	190.5	3.2	0.35	7.2	0.4

A split plot design was used to distribute two main plots for soil treatments and eight subplots for foliar spray treatments. The two soil treatments were either sprayed with Agar solution or without Agar. Agar was added as 1g /L, soil of each tree received 4L at the beginning of the season.

Foliar spray treatments were performed 3 times/season; at the end of February and March, and mid of April. Each treatment was replicated three times and each replicate was represented by three trees.

The foliar spray treatments were :

1- Control; sprayed with water.

2- Potassium sulphate solution SOP"K" [soluble K_2SO_4, 50 % K]; applied as 2.0 g/L.

3-Putrescine (PUT) [1,4-diaminobutane dihydrochloride];applied as 10µmole /L.

4-Micronutrients solution; containing (Fe + Zn + Mn) (MIC); 0.2g of each/L in chelated EDTA form.

5- PUT + K 6- MIC + PUT

7- MIC + K 8- MIC + PUT + K

The treated trees were checked up for the following characters:

Vegetative growth:

No. of leaves/shoot: (recorded at the season end; in August).

Leaf area: after harvest time, twenty mature leaves [the third one from the base of the tagged, non fruiting, shoots] were collected for estimating leaf area using area meter (model cl-203, USA).

Chemical analyses:

Leaf chlorophyll (A&B) and carotene contents as mg/g f.w. of mature leaf tissue were estimated according to Metzner *et al.* (1965).

Leaf nutrient contents: thirty leaves from each replicate, were dried at 70º, ground and digested by a mixture of H_2SO_4 and $HClO_4$, to determine mineral nutrients. N was determined by micro-kjeldahl as described by A.O.A.C. (1980). P was detected spectrophotometrically using molybdate-stannus chloride method and K by flame photometer according to Chapman and Pratt (1978). Fe, Mn, Zn and Cu were determined by Atomic Absorption (model GBC 932).

Fruit yield per tree: fruits were harvested at maturity stage (the end of August). Fruit yield (kg) per tree was recorded.

Fruit quality properties: representative fruit samples were taken from the **tested trees (15 fruits/replicate) for the following determinations:**

Physical properties: including average fruit weight (gm) , average fruit size (cm^3) and Fruit firmness ($lb/inch^2$); being measured by using penetrometer (pressure tester).

Chemical properties:

a- Total soluble solids (TSS); measured by using a carlreiss refractometer.

b- Percentage of total acidity; determined as malic acid (g/100g fresh weight) according to (A.O.A.C., 1980).

c- Nutrient contents; N, P, K, Fe, Mn, Zn and Cu in the digested solution of pear fruits of the second year, were determined by methods as previously mentioned.

The obtained data were statistically analysed for the split plot design according to (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

Response of pear to the foliar spray treatments:
Vegetative growth and chemical composition.

Regardless of the effect of soil spraying with Agar, data in Table (2) show clearly that foliar application of K, PUT or MIC solutions, applied solely or in combination, resulted in significant growth increases and markedly enhanced the studied vegetative growth characters namely; No. of leaves/shoot and leaf area. Also, they significantly increased chlorophyll (A), chlorophyll (B) and carotene contents, as compared to control treatment.

It is interesting to note that the overwhelming responses of the previously mentioned parameters were obtained when the three treatments were sprayed in combination; "MIC + PUT + K". The foliar treatments of the dual combinations came at the second rank, followed the order of "PUT + K ≥ "MIC + PUT "≥ MIC + K". And finely the three individual sprays showed a descending order of PUT > MIC ≥ K.

In general , the responses of the studied characters had the same trend at both seasons. The means of increase percentage achieved by the " MIC+ PUT+ K " treatment over control, for the two seasons, in number of leaves / shoot, leaf area, chlorophyll (A), chlorophyll (B) and carotene contents were 39.0, 26.8, 39.3, 46.8 and 43.4 %, respectively.

The putrescine individual treatment achieved percentage increments of about 17.2 , 12.4, 27.7, 4.6, 15.3 % for the respective characters over control. While the same increase parentages due to "MIC" treatment were about 10.0, 7.2, 15.4, 8.9, 8.4 %, respectively.

Concerning the positive effect of "PUT" on growth characters of pear, the obtained results, in this study, are in agreement with those obtained by Sayed *et al.* (2008). They pointed out the role of PUT in improving several fruit tree growth. The enhancement effect of PUT on growth of pear could be attributed to its implication in the synthesis of macro-molecules which are known to increase nucleic acids and stimulate various processes associated with the syntheses of protein (Willadino *et al.* 1996). It might act as plant growth substances (Bagni and Torrigiani (1992), or promote cell division (Smith, 1985).

Regarding micronutrients effect, it is well known that in arid or semiarid soils, being characterized by higher pH, lower organic matter and higher Ca-carbonate content, nutritional imbalance and micronutrient unavailability could prevail. Therefore, foliar application of micronutrients (Fe, Zn, Mn, ….) either separately or in conjunction could result in significant enhancing in the nutritional status of many higher plants, and consequently the vegetative growth characters (El-Kassas *et al.* 1987). Our results are in agreement with those findings of many reporters in Egypt; Mohsen *et al.* (1992) and Sayed (1998) on Balady mandarin and orange, Eissa (1997), Morales *et al.* (2000) and Fawzy (2007) on le Conte pear.

The obtained data showed that K- spraying resulted in percentage increases, in the studied vegetative growth characters and chlorophyll and carotene contents ranged from 3.7 to 7.4 %.

2

Knowing that macro-nutrients including "K" should be applied to soils, yet The responses exhibited by the vegetative growth characters and chemical composition, in the current study, resulted from foliar K-treatment could be related to the insufficiency of K in the cultivated soil. Our results resemble those reported by (Sharma *et al.* 1992; El-Sherif *et al.* 2000 and Dutta, 2004) on guava and (Doroshenko *et al.* 2005) on apple grown on similar soil.

Leaf nutrient contents

Table (3) and Table (4) show that the mean values of the mineral nutrient's concentrations of N, P, K, Fe, Mn, Zn and Cu were increased in pear leaves under all treatments, foliar and soil-spraying, comparing to control.

The obtained results suggest that foliar application of the combined treatment; " MIC+ PUT + K " gave promising results in correcting the nutritional status of pear trees under the experimental conditions.

These results are in harmony with those obtained by Fowzy *et al.* (2007) on pear trees, who attributed the improvement of pear yield to the promoted higher synthesis of metabolites. Similar results were reported by Ahmed *et al.* (1997) and Sayed *et al.* (2008).

Table (3): Macronutrient contents in Le-Conte pear leaves as affected by foliar application of K, PUT and MIC, and soil spraying with Agar solution.

Year	2008								
Character	N (%)			P (%)			K (%)		
Treatment	Agar		Mean (B)	Agar		Mean (B)	Agar		Mean (B)
	Without	With		Without	With		Without	With	
Control	1.092	1.729	1.411	0.193	0.204	0.199	1.08	1.30	1.23
SOP"K"	1.458	2.092	1.775	0.203	0.253	0.228	1.40	1.50	1.45
Put	1.274	2.184	1.729	0.237	0.261	0.249	1.28	1.45	1.37
Mic	1.274	2.002	1.638	0.231	0.245	0.238	1.25	1.40	1.33
Put + K	1.638	2.092	1.865	0.228	0.264	0.251	1.48	1.50	1.49
Mic + Put	1.729	2.184	1.957	0.227	0.248	0.238	1.30	1.48	1.39
Mic + K	1.638	2.002	1.820	0.234	0.250	0.242	1.33	1.48	1.41
Mic+Put+K	1.820	2.184	2.002	0.238	0.268	0.2353	1.45	1.50	1.48
Mean (A)	1.490	2.059	-	0.220	0.249	-	1.32	1.44	-
Year	2009								
Control	1.184	1.547	1.365	0.248	0.272	0.260	1.15	1.35	1.25
SOP"K"	1.456	2.093	1.775	0.280	0.288	0.284	1.45	1.50	1.48
Put	1.547	1.729	1.638	0.328	0.348	0.338	1.30	1.35	1.33
Mic	1.638	2.093	1.866	0.329	0.356	0.343	1.25	1.35	1.30
Put + K	1.820	2.002	1.911	0.340	0.350	0.345	1.48	1.50	1.49
Mic + Put	1.729	2.002	1.866	0.342	0.358	0.350	1.28	1.40	1.34
Mic + K	1.820	2.204	2.012	0.340	0.348	0.344	1.46	1.50	1.48
Mic+Put+K	2.002	2.184	2.093	0.338	0.358	0.348	1.48	1.50	1.49
Mean (A)	1.649	1.982	-	0.318	0.335	-	1.36	1.43	-

Table (4): Micronutrient contents in Le-Conte pear leaves as affected by foliar application of K , PUT and MIC, and soil spraying with Agar solution.

Year	2008											
Character	Fe mg/kg			Mn mg/kg			Zn mg/kg			Cu mg/kg		
Treatment	Agar		Mean	Agar		Mean	Agar		Mean	Agar		Mean
	Without	With	(B)	Without	With	(B)	Without	With	(B)	Without	With	(B)
Control	477	503	490	58	86	72	32	42	37	13	19	16
SOP"K"	581	603	592	61	95	78	53	48	50.5	19	21	20
Put	543	529	536	72	98	85	54	58	56	15	16	15.5
Mic	575	631	603	82	102	92	39	46	42.5	12	18	15
Put + K	595	614	605	66	92	79	51	54	52.5	10	15	12.5
Mic + Put	577	593	585	70	104	87	30	43	36.5	14	20	17
Mic + K	590	624	607	71	103	87	37	47	42	10	22	16
Mic+Put+K	641	643	642	78	118	98	36	49	42.5	12	16	14
Mean (A)	573	589	-	70	100	-	41.5	48.4	-	13.1	18.3	-
Year	**2009**											
Control	426	443	435	81	109	95	32	35	33.5	13	17	15
SOP"K"	479	508	494	87	117	102	34	38	36	16	19	17.5
Put	436	579	458	106	119	113	36	39	37.5	15	18	16.5
Mic	528	585	557	93	164	129	37	47	42	17	19	18
Put + K	513	578	546	95	137	116	33	43	38	18	19	18.5
Mic + Put	476	575	527	104	165	135	40	61	50.5	17	20	18.5
Mic + K	487	597	542	86	180	133	39	68	53.5	20	21	20.5
Mic+Put+K	446	522	484	155	173	164	52	69	60.5	19	21	20.0
Mean (A)	474	536	-	101	146	-	37.9	50	-	16.9	19.3	-

Fruit yield and quality:

Concerning the fruit yield (kg/tree), data in Table (5) show that, in both seasons, all the foliar treatments gave significant responses in comparison with the control treatment.

The mean increase percentages of yield, for both seasons, over control treatment, were as follows: 24.5% for (MIC+PUT+K), 23.7% for (K+PUT), 14.2% for (MIC+PUT), 12.4% for (PUT), 11.3% for (MIC+K), 9.8% for (K) and 8.0% for (MIC).

Nevertheless, it is of importance to note that the yield increases which were obtained due to these treatments at the second season were more higher than those of the same treatments at the first season. This could be probably due to the residual effects of the first season treatments.

The same trend generally holds true for fruit weight and fruit size (Table 5).

Such significant increases of fruit yield, resulted from the foliar treatments, were achieved as a logical beneficial effect of these treatments on the vegetative growth.

In this regard, Smith (1985) attributed the efficiency of PUT to its role in stimulating biosynthetic interactions, cell division and fruit set. Moreover, Martin-Tanguy *et al.* (1982), Crisosto *et al.* (1988) and Kaur-Sawhney *et al.* (1990) indicated that putrescine and polyamines seem to play a regulatory role in morphogenetic preceding fruit set through the formation of the flowers and enhancing pollen germination and fertilization. Putrescine efficiency on

increasing pear yield and fruit size was reported by Crisosto *et al.* (1988) and Franco-Mora *et al.* (2005).

Table (5): Effect of foliar application of K, PUT and MIC and soil spraying with Agar solution on fruit yield and some fruit physical properties of Le-Conte pear.

Year	2008											
Character	Fruit yield /tree (kg)			Fruit weight (g)			Fruit size (cm^3)			Fruit firmness ($lb/inch^2$)		
Treatment	Agar		Mean	Agar		Mean	Agar		Mean	Agar		Mean
	Without	With	(B)	Without	With	(B)	Without	With	(B)	Without	With	(B)
Control	39.43	40.36	39.89	142.07	144.65	143.36	163.97	158.00	160.99	19.12	19.55	19.34
SOP"K"	42.33	42.91	42.62	150.32	150.98	150.65	170.41	170.39	170.40	16.39	16.63	16.51
Put	42.78	43.08	42.93	152.90	153.38	153.14	170.41	170.70	170.56	18.06	17.99	18.03
Mic	40.81	40.99	40.90	146.79	147.70	147.25	157.86	158.29	158.07	18.19	19.08	19.00
Put + K	46.27	49.21	47.74	157.07	157.62	157.35	177.14	178.17	177.66	17.68	17.39	17.60
Mic + Put	44.28	44.46	44.37	155.13	155.45	155.29	174.19	174.69	174.44	17.57	17.63	16.41
Mic + K	42.13	43.51	42.82	154.06	153.96	154.01	173.73	175.14	174.43	16.66	16.16	17.23
Mic+Put+K	48.12	48.66	48.39	160.41	160.14	160.27	179.70	180.28	179.99	17.51	16.96	17.23
Mean (A)	43.27	44.15	-	152.35	152.99	-	170.93	170.71	-	17.74	17.69	-
L.S.$D_{0.05}$ A	N.S			0.38			N.S			N.S		
L.S.$D_{0.05}$ B	1.90			1.44			4.23			0.71		
L.S.$D_{0.05}$ AxB	2.69			2.03			5.99			1.00		
Year	2009											
Control	37.42	38.76	38.09	141.74	144.65	143.19	158.01	156.87	157.44	19.42	19.39	19.41
SOP"K"	42.23	43.62	42.92	149.51	150.36	149.93	170.77	171.51	171.14	17.22	16.89	17.05
Put	44.06	45.32	44.69	152.66	153.29	152.97	171.0.	172.09	171.56	17.57	18.14	17.86
Mic	42.80	43.67	43.24	146.94	147.42	147.18	158.89	160.25	159.57	18.42	18.72	18.57
Put + K	48.79	48.73	48.76	156.52	157.33	156.92	177.08	178.24	177.66	17.32	17.41	17.36
Mic + Put	44.33	45.23	44.64	154.42	155.65	155.04	174.08	174.98	174.53	17.80	17.31	17.56
Mic + K	43.50	44.28	43.89	153.86	154.45	154.16	175.70	176.47	176.09	15.75	16.20	15.98
Mic+Put+K	48.18	49.26	48.72	161.97	162.53	162.25	179.91	181.87	180.89	16.67	15.41	16.04
Mean (A)	43.89	44.86	-	152.20	153.21	-	170.66	171.54	-	17.52	17.44	-
L.S.$D_{0.05}$ A	N.S			1.17			N.S			N.S		
L.S.$D_{0.05}$ B	1.89			1.78			2.27			0.83		
L.S.$D_{0.05}$ AxB	2.68			2.51			3.21			1.18		

The stimulated effects of K-foliar application, on fruit yield, were reported by Khamis *et al.* (1994); Wani *et al.* (1997); El-Sherif *et al.* (2000) and Dutta (2004). They emphasized that K-foliar application has a significant effect on increasing fruit yield and size of apple, pear and guava.

Concerning micronutrients spraying effects, some workers demonstrated that they have great enhancing responses on pear fruit yield and its quality; being grown on soils of low micronutrients content, low O.M and high pH (Awad and Atawia, 1995; Eissa, 1997 and Wojcik and Popinska**,** 2009).

Fruit quality :

Fruit physical properties:

In this regard, the average fruit weight (g), fruit size (cm^3**)** and fruit firmness (L/b^2) were all responded significantly to foliar spray treatments. Data presented in Table (5) reveal clearly that, all treatments gave markedly

higher values of fruit weight and size, but obviously lower desirable values of fruit firmness; comparing to control.

The favorable response of fruit physical properties took the same trend of fruit yield. Thus, the treatment of "MIC + PUT+ K" gave the best fruit physical properties.

Fruit chemical properties :

Data presented in Table (6) display fruit TSS (%), Fruit acidity (%) and TSS/Acidity ratio, in response to the spray treatments. The obtained data reveal that all foliar treatments could achieve significant improvement effect comparing to control. Not only such foliar treatments affected fruit size and its weight but also their mineral contents, Table (7 and 8).

The improvement in both physical and chemical fruit properties exhibited the same trend of the previously shown fruit yield.

The obtained data of physical and chemical fruit quality are in accordance with those obtained by many investigators. El-Kassas *et al.* (1987) reported that micronutrients foliar spray on mandarin tree elevated fruit TSS %, and reduced total acidity of fruits.

Table (6): Effect of foliar application of K, PUT and MIC and soil spraying with Agar solution on some fruit chemical properties of Le-Cont pear.

Year	2008								
Character	Fruit T.S.S.(%)			Fruit acidity (%)			T.S.S./ acidity RATIO		
Treatment	Agar		Mean (B)	Agar		Mean (B)	Agar		Mean (B)
	Without	With		Without	With		Without	With	
Control	10.66	10.31	10.49	0.253	0.267	0.260	42.07	38.75	40.41
SOP"K"	11.38	11.34	11.36	0.207	0.210	0.208	55.05	55.03	5.04
Put	11.07	11.19	11.13	0.220	0.227	0.223	50.42	49.36	49.89
Mic	11.99	12.07	12.04	0.227	0.230	0.228	53.02	52.24	52.63
Put + K	12.82	12.99	12.91	0.213	0.210	0.212	60.26	61.94	61.10
Mic + Put	12.81	12.93	12.87	0.243	0.237	0.240	51.89	54.65	53.27
Mic + K	1195	12.40	12.18	0.233	0.237	0.235	51.35	52.41	51.88
Mic+Put+K	14.02	14.63	14.33	0.203	0.200	0.202	66.99	73.15	70.07
Mean (A)	12.09	12.23	-	0.225	0.227	-	5388	54.69	-
$L.S.D_{0.05}$ A	N.S			N.S			N.S		
$L.S.D_{0.05}$ B	0.28			0.010			2.69		
$L.S.D_{0.05}$ AxB	0.40			0.014			3.81		
Year	**2009**								
Control	10.24	10.07	10.16	0.287	0.293	0.290	35.78	34.34	35.06
SOP"K"	11.09	11.09	11.09	0.273	0.267	0.270	4071	41.63	41.17
Put	10.99	11.32	11.15	0.277	0.267	0.272	39.76	42.68	41.22
Mic	12.40	12.61	12.28	0.273	0.277	0.275	45.61	43.96	44.79
Put + K	11.53	11.83	11.68	0.267	0.257	0.262	43.22	46.19	44.71
Mic + Put	1267	12.89	12.78	0.253	0.240	0.247	50. 01	53.77	51.89
Mic + K	13.02	12.98	13.00	0.247	0.233	0.240	53.11	56.64	54.88
Mic+Put+K	14.28	14.14	14.21	0.207	0.207	0.207	68.08	68.56	68.32
Mean (A)	12.03	12.06	-	0.260	0.255	-	47.04	48.47	-
$L.S.D_{0.05}$ A	N.S			N.S			N.S		
$L.S.D_{0.05}$ B	0.46			0.015			3.69		
$L.S.D_{0.05}$ AxB	0.65			0.021			5.22		

Table (7): Macronutrient contents in Le-Conte pear fruits as affected by foliar application of K, PUT, and MIC, and soil spraying with Agar solution.

Year	2008								
Character	N (%)			P (%)			K (%)		
Treatment	Agar		Mean	Agar		Mean	Agar		Mean
	Without	With	(B)	Without	With	(B)	Without	With	(B)
Control	0.455	0.546	0.501	0.114	0.136	0.125	0.70	0.75	0.73
SOP"K"	0.546	0.637	0.592	0.140	0.161	0.151	0.80	0.90	0.85
Put	0.628	0.728	0.678	0.147	0.167	0.157	0.78	0.85	0.82
Mic	0.548	0.625	0.586	0.165	0.179	0.172	0.70	0.85	0.78
Put + K	0.638	0.728	0.683	0.158	0.173	0.166	0.85	1.05	0.95
Mic + Put	0.637	0.728	0.683	0.177	0.186	0.182	0.75	0.80	0.78
Mic + K	0.625	0.728	0.677	0.179	0.189	0.184	0.80	0.90	0.85
Mic+Put+K	0.720	0.819	0.770	0.187	0.189	0.188	0.85	1.05	0.95
Mean (A)	0.599	0.692	-	0.158	0.173	-	0.78	0.89	-

Table (8): Micronutrient contents in Le-Conte pear fruits as affected by foliar application of K, PUT, and MIC, and soil spraying with Agar solution.

Year	Fe g/kg			Mn g/kg			Zn g/kg			Cu g/kg		
Character	Agar		Mean	Agar		Mean	Agar		Mean	Agar		Mean
Treatment	Without	With	(B)	Without	With	(B)	Without	With	(B)	Without	With	(B)
Control	61	68	64.5	9	12	12.0	13	22	17.5	4	5	4.5
SOP"K"	63	70	66.5	11	13	11.0	16	27	21.5	5	8	6.5
Put	65	70	67.5	10	12	12.5	23	29	26.0	4	5	4.5
Mic	68	70	69.0	10	12	11.0	25	31	28.0	5	6	5.5
Put + K	67	73	70.0	12	13	12.5	21	23	22.0	6	6	6.0
Mic + Put	66	74	70.0	10	11	10.5	28	30	29.0	5	5	5.0
Mic + K	73	82	77.5	11	12	11.5	29	32	30.5	6	9	7.5
Mic+Put+K	76	85	80.5	10	13	11.5	26	34	30.0	8	10	9.0
Mean (A)	67.4	74.0	-	10.4	12.3	-	22.6	28.5	-	5.4	6.8	-

Lofty *et al.* (1990) and El-Sherif *et al.* (2000) showed that spraying potassium sulphate (1, 1.5 or 2%) increased TSS and reduced acidity of guava fruits.

Abd El-Dayem (2001) observed that putrescine spray increased the transport of K and enhanced its translocation into the growing tips, and led to better fruit chemical properties. Similar results also were reported by Sayed *et al.* (2008).

Response of Le-Conte pear to soil spraying with Agar solution :

The effects of soil spray treatment with Agar solution are shown in Table (2). It is noticeable that it has a slight positive response in the studied vegetative growth characters and also in the chemical composition of pear leaves.

Table (5) and (6) also, cleared up that pear fruit yield components and quality characters of fruit all positively but not significantly responded to this soil conditioner treatment. This finding could be interpreted as such soil conditioner treatment, might need more time exceeding two seasons to let it reach the root zone of pear trees; through the drip irrigation system.

However, the higher responses obtained in mineral contents of leaves (Table 3 and 4) and fruits (Table 7 and 8) denote the great promising role of Agar solution spray treatment as a soil conditioner in improving fruit yield and quality of pear trees.

In this regard, El-Aggory *et al.* (2002) conducted several experiments using Agar solution as a soil conditioner, and concluded that using the natural biopolymer Agar, was very promising in sandy and calcareous soils. They attributed such response to its stabilizing and jellifying power which causing retention of micronutrients and water around the plants and protecting them against leaching besides, being biologically undegradable.

REFERENCES

Abd El-Dayem, H.M.M. (2001). Interactions between phytohormones and mineral nutrients (A review article). Agric. Botony Dep., Fac. Agric. Moshtohor, Zagazig Univ. February, pp 5-10.

Abd El-Magid, A.A.; H.G. Abu El-Fotoh; A. Ataya Manal ; M.A. El-Akabawy and O. Monged Nadia (2007). A trial towards the improvement of cotton and sugar-beet yields under salinity stress by using foliar spraying with putrescine and some Micronutrients: Egypt. J. Appl. Sci. 22 (2)A: 450-457.

Abu El-Fotoh, H.G.; A.A. Abd El-Magid; A. Ataya Manal; M.A. El-Akabawy and O. Monged Nadia (2006). The effectiveness of putrescine and micronutrients treatments in improving the yield of wheat and rice crops under soil salinity conditions. Egypt. J. Appl. Sci., 21 (A): 321-328.

Ahmed, F.F; A.M. AKL; F.M.E. Morsey and M.A. Ragab (1997). The beneficial effects of biofertilizers on Roumi Red grapevines. (1) The effect on growth and vine nutritional status. Ann. Agric. Sci. Moshtohor 35(11): 489-495.

Altman, A. and M. Bachrach (1981). Improvement of polyamine in plants growth and senescence. In: "Advances In Polyamine Research", (G.M. Caldarea; V.Zappia and M. Bachrach, eds.), pp, 365-375. Raven Press, New York.

Altman, A.; R. Friedman; D. Amir and N. Levin (1982). Polyamine effects and metabolism in plants under stress conditions. In : "Plant Growth Substances" (Wareing, P.F., ed.), Academic Press, London, pp, 483-494.

A.O.A.C.(1985). "Official Methods of Analysis". A.O.A.C. 14th ed., Benjamin Franklin Station Washington D.C, USA pp, 494-510.

Attala, E.S. (1997). Effect of potassium fertilization on Anna trees grown in sandy soils of Egypt. Egypt. J. Agric Res., 75(4): 1069-1080.

Awad, S.M. and A.R. Atawia (1995a). Effect of foliar sprays with some micronutrients on Le-Conte pear trees (1). Tree growth, flowering and leaf mineral contents. Annuals Agric. Sci., Ain Shams Univ., Cairo. 40 (1): 359-367.

Awad, S.M. and A.R. Atawia (1995 b). Effect of foliar sprays with some micronutrients on Le-Conte pear trees (2). Tree fruiting and fruit quality. Ann. Agric. Sci., Cairo. 40 (1): 369-377.

Bagni, M. and P. Torrigiani (1992). Polyamines: A new class of plant growth substances. In: "Progress in Plant Growth Regulation", (Karssen, C. M.; L.C. Van Loon and D. Vrangdenhill, eds.). Kluwer Acad. Publ. Dordecht. pp, 254-275.

Ben-Hur; M and J. Letey (1989). Effect of polysaccharide, clay dispersion and impact energy on water infiltration. Soil Sci. Soc. Am. J., 53: 233-238.

Chapman, H.O. and P.E. Pratt (1978). "Method of Analysis for Soils, Plant and Water". Univ. Calif. Agric. Sci. Priced Publication, 4034, p, 50.

Crisosto C.H; D. Sugar and P.B. Lombard (1988). Effect of putrescine sprays at anthesis on "Comice" pear yield components. Adv. in Hort. Sci., 2 (1) 27-29.

Crisosto, C, H.; P.B. Lombard; D. Sugar and V. S. Polito (1988). Putrescine influences ovule senescence, fertilization time and fruit set in "Com ice" pears. J. Amer. Soc. Hort. Sci., 113: 708-711.

Doroshenko, T.N.; V.I. Ostapenko; L.G. Ryazanova; I.V. Dubravina**,** and S.S. Chumakov (2005). Formation of the quality of apple fruits under the effect of the foliar application of potassium. Russian. Agric. Sci. (5): 29-32.

Dutta, P. (2004). Foliar potassium spray in improving the quality of Sardar guava (*Psidium Guajava L*.) Orissa- J. Hort., 32 (1): 103-104.

Eissa, M.A. (1997). Tree growth, fruiting and fruit quality of "Le-Conte" pear in response to foliar spray with some micronutrients. Annals of Agric. Sci. Moshtohor 35: 949-964.

El-Aggory Eglal M.; S.M.A. El-Rasoul and R.I. Kenany (2002). The biopolymer, Agar Agar, as a soil conditioner. Part II : Field trials. Egypt. J. Agric. Res. 80(1): 13-27.

El-Kassas, S.E.; M.H. Mahmoud and S.M. El-Shazly (1987). Effect of certain micronutrients on the yield and fruit quality of Balady mandarin. J. Agric Sci. 18: 4.

El-Sheikh, M.H.; S.A.A. Khafaga and N.S. Zaied (2007). Effect of foliar application with some micronutrients on leaf mineral content, yield and fruit quality of "Florida prince and Desert Red" peach trees. Res. J. Agric. and Biol. Sci. 3 (4): 309-315.

El-Sherif, A.A; W.T. Saeed, and V.F. Nouman (2000). Effect of foliar application of potassium and zinc on behaviour of Montakhab El-Kanater guava trees. Bull. Fac. Agric.,Cairo Univ., 51 (1) : 73-84.

Fawzy, M. I.F. and A.A. Abd El-Moneim Eman (2004). The effect of foliar application of some trace elements and active dry yeast on vegetative growth, yield, fruit quality and leaf chemical composition of flame seedless grapevines grown in calcareous soil conditions. Minufiya, J. Agric. Res., 29 (2) : 463-478.

Fawzy, M.I.F.; M.M.M. Abd El-Migeed and A.S.E. Abd-Allah (2007). Response of Le-Conte pear trees to foliar application of some micronutrients and humic acid. Egypt. J. Appl. Sci., 22 (11): 199-210.

Franco-Mora, O; K. Tanabe; F. Tamura and A. Ltai (2005). Effects of putrescine application on fruit set in "Housui" Japanese pear (*Pyrus pyrifolia Nakai*). Scientia – Horticulturae, 104 (3): 265-273.

Kabeel, H.H.; Mokhtar and M.M. Aly (1998). Effect of foliar application for different macro and micronutrients on yield, fruit quality and leaf mineral composition of Le-Conte pear. J. Agric. Sci. Mansoura Univ., 23(7): 3317-3325.

Kaur-Sawhney, R.; G. Kandpal; B. McGonigle and A.W. Galston (1990). Further experiments on spermidine –mediated floral formation in thin-layer explants of Wiscosin 38 tobacco. Planta, 18: 212 -217.

Kaur-Sawhney, R; A. Altman and A. W. Galston (1987). Dual mechanisms in polyamines mediated control of ribonuclease activity in oat leaf protoplasts. Plant Physiol., 62: 158-160.

Khamis, M.A; A.H. Gomaa; M.M. Saraf and E.A. Kandil (1994). Comparative studies on mineral fertilization of some deciduous fruit rootstocks: 111. potassium fertilization. Bull. Fac. Agric. Cairo Univ., 45(4): 877-894.

Kilany, A. E. and O.A. Kilany (1991). Effect of potassium and boron nutrients on growth, yield and fruit quality of Anna apple trees. Bull. Fac. Agric. Cairo Univ., 42(2): 415-428.

Lofty, H.O.; S. Ikram and M. El–Said (1990). Effect of potassium sulphate foliar application on guava trees. Agric. Res. Rev. 68(5): 949-955.

Martin-Tanguy, J; E. Perdnzet and C. Martin (1982). Hydroxycinnamic acid amides in fertile and cytoplasmic male strile lines of maize. Phytochem., 21: 1939-1945.

Metzner, H.; H. Rau and H. Singer (1965). Untersuchungen Zur Synchronier barkeit einzelner pigmenten an den Mutanten von *Chlorella*.Planta, 65: 186 (c.f. Zeinab Khalil , 2006: Physiological studies on using nitrogen fixing *Bacillus polymyxa* as a biofertilizer for wheat plant in sandy soil. PH. D. Thesis, Fac. Sci. Cairo Univ., Egypt).

Mitchell, A. R. (1986). Polyacrylamide application in irrigation water to increase infiltration. Soil Sci., 141: 353-358.

Mohsen, A.M.; S.M. El-Hefnawi; S.A. Mehana and A.N. Sharaf (1992). Growth of Balady orange trees response to some nutrient elements sprays 1-foliar growth. Zagazig. J. Agric. Res. 19 (1): 427-434.

Morales, F; R. Belkhodja; A. Abadia and J. Abadia (2000). Photosystem II-efficiency and mechanisms of energy dissipation in iron-deficient, field–grown pear trees (*Pyrus communis L*.). Photosynthesis- Research, 63(1): 9-21.

Naiema, M.S.M. (2003). Effect of different doses of nitrogen and potassium on leaf mineral content. Fruit set, yield and fruit quality of Anna apple trees grown in a calcareous soil. Alex. J. Agric. Res. 48(1): 85-92.

Sayed, R.A. (1998): Studies of foliar application of some micronutrients on Balady mandarin grown on new reclaimed land. Ph. D. Thesis. Fac. Agric., Cairo Univ., Egypt.

Sayed, R.A.; M. Hasan Amira; M.A.M. El-Akabawy and O. Monged Nadia (2008). The effects of some Micronutrients and putrescine on Growth and Fruiting of Navel orange in New Land. Egypt. J. Appl. Agric. Res. 1(2): 225-236.

Sharma, R.K.; Ram Kumar and S. Thakur (1992). Effect of foliar feeding of potassium, calcium and zinc on yield and quality of guava. Indian J. Horti. 48 (4): 312-314.

Slocum, R.D.; R. Kaur-Sawhney and A.W. Galston (1984). The physiology and biochemistry of polyamines in plants. Arch. Biochem. Biophys., 235, 283-303.

Smith, T.A. (1985). "Polyamines". Annu. Rev. Plant Physiol., 39: 117-143.

Snedecor, G. W. and W.G. Cochran (1980). "Statistical methods". 7th ed., Lowa State Univ. Press, Ames Iowa, U.S.A. pp, 507.

Tiburcio, A.F. ; J. L. Campos; Y. Figureras and R.T. Besford (1993). Recent advances in the understanding of polyamine functions during plant development. Plant Growth Regul., 12:331-340.

Wallace, A. and G.A. Wallace (1986 a). Additive and synergistic effects on plant growth from polymers and organic matter applied to soil simultaneously. Soil Sci., 141: 334-342.
Wallace, A. and G.A. Wallace (1986 b). Effect of polymeric soil conditioners on emergence of tomato seedlings. Soil Sci.. 141: 334-342.
Wari, W.M.; I. Khajwall, and A.A. Sofi (1997). Mode of fertilizer application and age of leaves on nutrient composition in "Bartlett" pear (*Pyrus communis*). Indian J. Agric. Sci., 67(5): 201-203.
Wojcik, P. and W. Popinska (2009): Response of Lukasovka pear trees to foliar zinc sprays. J. Elemetology. 14(1): 181-188.
Willadino, L.; T. Camara; N. Boget; I. Claparol; M. Santos and J.M. Torne (1996). Polyamines and free amino acid variation in NaCl-treated embryogenic maize callus from sensitive and resistant cultivars. J. Plant Physiol., 149 (1-2): 179-185.

استجابة أشجار الكمثرى صنف الليكونت النامية تحت الظروف المصرية إلى بعض معاملات الرش الورقي ورش التربة بمحلول الآجار.

على أحمد على محمد، زينب محمود علي خليل**، عبد المنعم فتحي إسماعيل الرماح* و محمد عبد المحسن العقباوى****

*** معهد بحوث البساتين - مركز البحوث الزراعية- الجيزة.**

**** قسم بحوث تغذية النبات - معهد بحوث الأراضى والمياه والبيئة-مركز البحوث الزراعية- الجيزة.**

أجريت هذه الدراسة خلال موسمى (2008 ، 2009) فى أرض محطة بحوث القصاصين (أرض رملية طميية) ، تحت نظام الرى بالتنقيط على أشجار كمثرى الليكونت.

يهدف هذا البحث إلى دراسة كفاءة معاملة الأشجار بالرش الورقي – باستخدام محلول كبريتات البوتاسيوم الذائبة (SOP)، ومحلول البتروسين، و العناصر الصغرى (حديد – زنك – منجنيز فى صورة مخلبية)-بصورة منفردة أو مشتركة، علاوة على المعاملة بالرش بمحلول الآجار على التربة (كمصلح للتربة) على تحسين النمو الخضري للأشجار و المحصول الثمرى وجودته.

أظهرت النتائج المتحصل عليها أن هناك زيادة واضحة فى صفات النمو الخضرى تحت الدراسة (عدد الأوراق / فرع و مساحة الورقة)، ومحتواها من الكلورفيل أ ، ب والكاروتين) نتيجة لمعاملات الرش الورقى وذلك مقارنة بمعاملة الكنترول، كماأدت هذه المعاملات الى تحسن الحالة الغذائية للأشجارممانتج عنه زيادة معنوية فى كمية محصول ثمار الكمثرى/ شجرة وكذلك حدث تحسن فى صفات الثمرة النوعية المتمثلة فى وزنها و حجمها و بعض الصفات الطبيعية و الكيميائية .

كانت أفضل النتائج المتحصل عليها ناتجة عن المعاملة المشتركة بين الثلاث مركبات للرش (البوتاسيوم + البتروسين + العناصر الصغرى) حيث حققت زيادة بنسبة مئوية قدرها 24.5% فى محصول الفاكهة/شجرة ، 12.6% فى وزن الثمرة و 13.4% فحجمها ؛عن معاملة الكنترول.

وكذلك أظهرت الدراسة نتائج واعدة نتيجة معاملة رش التربة بمحلول الآجار كمصلح للتربة حيث أعطت هذه المعاملة تحسناً ظاهرا فى كل مقاييس النمو تحت الدراسة للأشجار ، وكذلك وجد زيادة فى محصول الثمار وتحسن صفاتها إلا أنه يبدو من المحتمل أن مثل هذه المعاملة وتحت ظروف التجربة والرى بالتنقيط ، تحتاج إلى مزيد من الوقت أكثر من موسمين لتكون أكثر تأثيرا وتحقق نتائج ملموسة.

قام بتحكيم البحث

أ.د / زكريا مسعد الصيرفى	**كلية الزراعة – جامعة المنصورة**
أ.د / ابو بكر الصديق محمد عبد الله	**مركز البحوث الزراعية**

Table (2): Effect of foliar application of K, PUT and MIC, and soil spraying with Agar solution on some vegetative growth characters and chemical composition.

Year	2008														
Character	No. of leaves/shoot			Leaf area (cm^2)			Chl (A) mg/g f. wt.			Chl (B) mg/g f. wt			Carotene mg/g f.wt		
Treatment	Agar		Mean	Agar		Mean	Agar		Mean	Agar		Mean	Agar		Mean
	Without	With	(B)	Without	With	(B)	Without	With	(B)	Without	With	(B)	Without	With	(B)
Control	13.91	14.84	14.37	24.64	25.07	24.86	0.602	0.598	0.600	0.475	0.501	0.488	0.511	0.502	0.506
SOP"K"	15.45	15.44	15.44	26.78	26.13	26.46	0.606	0.618	0.612	0.481	0.515	0.498	0.492	0.518	0.505
Put	15.95	16.45	16.20	28.04	29.21	28.63	0.638	0.658	0.648	0.509	0.526	0.518	0.582	0.568	0.575
Mic	15.16	15.71	15.43	26.00	26.64	26.64	0.631	0.651	0.641	0.559	0.543	0.551	0.526	0.543	0.535
Put + K	17.92	18.12	18.02	28.85	29.08	28.96	0.698	0.714	0.706	0.625	0.614	0.620	0.619	0.665	0.642
Mic + Put	17.93	18.18	18.06	28.17	29.58	28.88	0.694	0.688	0.691	0.599	0.634	0.617	0.594	0.636	0.615
Mic + K	17.08	17.50	17.29	26.75	28.00	27.38	0.648	0.681	0.664	0.589	0.609	0.599	0.612	0.675	0.644
Mic+Put+K	19.84	20.33	20.09	30.58	31.87	31.23	0.717	0.729	0.723	0.685	0.715	0.700	0.662	0.722	0.692
Mean (A)	16.65	17.07	-	27.48	28.20	-	0.651	0.667	-	0.565	0.582	-	0.575	0.604	-
$L.S.D_{0.05}$ A	N.S			N.S			N.S			N.S			0.014		
$L.S.D_{0.05}$ B	0.33			1.95			0.017			0.021			0.023		
$L.S.D_{0.05}$ AxB	0.47			2.76			0.024			0.029			0.032		
Year	**2009**														
Control	14.39	14.87	14.63	25.20	25.15	25.18	0.484	0.522	0.503	0.493	0.491	0.492	0.511	0.527	0.519
SOP"K"	15.32	15.51	15.42	25.49	25.82	25.16	0.589	0.604	0.597	0.483	0.546	0.515	0.569	0.593	0.581
Put	17.92	17.67	17.79	27.56	28.00	27.78	0.619	0.663	0.641	0.492	0.521	0.507	0.589	0.622	0.606
Mic	16.62	16.35	16.49	26.86	27.12	26.99	0.609	0.639	0.624	0.493	0.541	0.517	0.560	0.594	0.577
Put + K	18.40	18.69	18.55	30.47	30.93	30.70	0.739	0.769	0.754	0.671	0.693	0.682	0.723	0.753	0.738
Mic + Put	18.24	18.62	18.43	29.82	30.67	30.25	0.694	0.756	0.725	0.636	0.658	0.647	0.671	0.723	0.697
Mic + K	18.49	18.95	18.72	26.79	27.90	27.35	0.700	0.703	0.702	0.598	0.30	0.614	0.746	0.759	0.753
Mic+Put+K	19.70	20.78	20.24	31.72	32.78	32.25	0.787	0.802	0.795	0.725	0.752	0.739	0.755	0.797	0.776
Mean (A)	17.39	17.68	-	27.99	28.55	-	0.653	0.682	-	0.573	0.604	-	0.641	0.671	-
$L.S.D_{0.05}$ A	N.S			N.S			0.026			0.007			N.S		
$L.S.D_{0.05}$ B	1.22			0.87			0.021			0.032			0.036		
$L.S.D_{0.05}$ AxB	1.73			1.23			0.029			0.045			0.051		