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Effect of Foliar Application of Some Nutrients on "Le-Conte" Pear Trees Grown under Calcareous Soil Conditions

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THIS INVESTIGATION was carried out during two successive seasons (2010 and 2011) on "Le-Conte" pear trees *(Pyrus communis X Pyrus pyrifolia).* The trees were 8 years old, budded on *Pyrus communis* rootstock and grown on calcareous soil under flood irrigation system in a private orchard located at Borg El-Arab region, Alexandria governorate. Twenty-four trees planted at 5 x 5m apart were selected as uniform as possible. The experiment involved the following six treatments: Control (untreated trees), Potassium sulphate at 0.1%, Copper sulphate at 0.02%, Sequestrated zinc at 0.04%, Sequestrated iron at 0.06% and Mixed nutrients mixed by the same concentration. Each treatment was applied three times during the growing season starting immediately after fruit set and at 21 days intervals.

The results showed that all treatments gave better results compared with control. Mixed nutritions gave the highest results in this trend. This treatment resulted in the best vegetative growth parameters. Leaf K, Cu, Zn and Fe content were also improved, in addition to ensure the highest yield, improved the physical and chemical characteristics of fruits.

"Le-conte" is the main pear cultivar, widely grown in Egypt grafted on the main rootstock, *P. communis* that shows high susceptibility to pear blights (Reimer, 1950). In the last 20 year, the pear cultivated area in Egypt decreased from 14923 feddans in 1995 to 10616 feddans in 2012 (Egyptian Ministry of Agriculture Statistics).

Calcareous soil contains high percentage of $CaCO_3$ and a high pH value that cause a precipitation of Fe, Mn and Zn in an unavailable form for plants. Thus foliar applications seem to be valuable for correcting the widespread occurrence of certain micronutrient deficiency symptoms (Marschner, 1995 and Taiz and Zieger, 1998). Essential elements either as macro or micro-nutrients play a vital role in growth and productivity of fruit crops. Several investigators have demonstrated the role of potassium in growth (Semenovich and Salmina, 1979 and Delcheva and Makariev, 1982), yield (Mantinger, 1983) and fruit quality (Ljones, 1974 and Yogaratnam and Johnson, 1982).

The occurrence of adequate nutrition of plants with micronutrient cations Cu, Mn, Zn, and Fe depends on several factors. The ability of soil to supply plant roots with these nutrients, mobility and translocation of these within the plant and the interaction between micronutrients themselves as with some macro-nutrients like phosphorus, whether in soil and/or the plants; are factors governing nutrients balance in the plants (Amer *et al*., 2010). Furthermore, soil applied micronutrients increased their concentrations in leaves and fruits of Ber tree more than foliar application except Cu (Amer *et al*., 2010).

The foliar application of micronutrients has become in wide use to correct the problem of micronutrients deficiency in many fruit crops. Although micronutrients are needed in relatively small quantities for adequate plant growth and production, their deficiencies cause a great disturbance in the physiological and metabolic processes involved in the plant as a result of foliar application of chelated iron and zinc on "Thompson Seedless" grapes (El-Gazzar *at al*., 1979). Microelements problems have increasing importance in Egypt not only in calcareous soil at the newly reclaimed areas but also in alluvial soil in the Nile Delta as a result of high microelements swallowed by several crops per year (Amberger, 1982).

Some work has been carried out in Egypt concerning the effect of microelements spray on deciduous fruits (Awad and Atawia, 1995; Kabeel *et al.*, 1998, Gobara 1998 on pear, El-Shazly 1999, El-Shobaky *et al*., 2001 and Naiema 2006). Also, El-Seginy *et al*. (2003) reported that, foliar application of "Anna" apple trees with a mixture of chelated (Fe, Zn and Mn) is recommended to increase fruit set, yield quantity and fruit quality of trees grown on calcareous soil. Moreover, Sayed *et al.* (2013) found that, phosphorus and copper have an antagonistic impact on zinc.

Therefore, the main objective of this study was to study the effect of foliar application of some nutrients on "Le-Conte" pear trees grown under calcareous soil conditions.

Material and Method

This investigation was carried out during two successive seasons of 2010 and 2011 on "Le-Conte" pear trees *(Pyrus communis X Pyrus pyrifolia).* The trees were 8 years old, budded on *Pyrus communis* rootstock and grown on calcareous soil under flood irrigation system in a private orchard located at Borg El-Arab region, Alexandria governorate. Some physical and chemical analysis of this experimental soil is illustrated in Table 1.

TABLE 1. Physical and chemical characters of experimental orchard soil.

Clay (%)	**17.5**	**$CaCO_3$(meq/L)**	**20.26**
Silt (%)	12.5	Ca^{++} (meq/L)	6.35
Sand (%)	70	Mg^{++} (ppm)	3.81
Texture	Sandy loam	Na^{+} (ppm)	6.087
EC (Ds/m)	0.761	K^{+}(%)	0.513
Organic matter %	3.76	Cl^{-} (ppm)	5.5
Co3- and HCO3- (meq/L)	17.27	So_4^{-} (ppm)	4.1
Available P (meq/L)	37.76	Total N^{+} (ppm)	7.1
pH	7.6	B (ppm)	1.539

Twenty-four trees (5 x 5m apart) as uniform as possible were selected for this study. The trees received the cultural practices that are recommended by Ministry of Agriculture. Complete randomized block design was applied. The experiment involved the following six treatments:

- Control.
- Potassium sulphate at 0.10%.
- Copper sulphate at 0.02%.
- Sequestrated zinc at 0.04%.
- Sequestrated iron at 0.06%.
- All the studied nutrients mixed by the same concentrations.

Each treatment was replicated four times, one tree per each. The previous four compounds were applied three times during the growing season starting immediately after fruit set and at 21 days intervals. Triton B was added as wetting agent to all spraying solutions at 0.1 %.

Samples of twenty leaves from the middle part of the shoots according to Chuntanaperb and Cummings (1981) were selected at random from each replicate (last week of August) to determine their contents of K, Cu, Zn and Fe according to Wilde *et al.* (1985). Leaf samples were washed and oven dried at 70 C to constant weight and then ground. Determinations of the leaf content of the above mentioned nutrients were carried out on dry weight basis.

Four main branches as similar as possible were chosen at the four cardinal points of each treated tree, tagged and the average of the current shoots per selected branch were counted, their length and diameter were measured as (cm) on mid October. Leaf area was determined using leaf area meter (Model CI-203, CID, Inc., U.S.A.). Fruits were collected at maturity stage (late August) and yield was recorded as weight in Kg.

Physical properties

Fruit weight (g), dimensions (cm) and fruit firmness was estimated by Magness and Taylor (1925) pressure tester which has a standard 5/16 of inch plunger and recorded as $lb/inch^2$.

Chemical properties

TSS (%) was determined by ATAGO hand refractometer, acidity (%) (as malic acid) according to A.O.A.C. (1992), total sugars (%) contents according to Malik and Singh (1980) and reducing sugars (%) by Nelson arsenatemdybdate colorimetric method (Dubois, *et al*., 1956). Non-reducing sugar (%) were calculated by the difference between total sugars and reducing sugars.

Regression equations as well as correlation coefficient were assessed between shoot length and fruit yield and juice total sugars.

Data obtained were statistically analyzed using the analysis of variance method reported by Snedecor and Cochran (1990) and the differences were tested by L.S.D. at 5% level.

Results and Discussion

Foliage characters

Vegetative growth

Concerning shoot length and diameter, results of Table 2 illustrate that, Mixed treatments significantly increased the length and diameter of pear shoots. Moreover, mixed nutrients resulted in the longest (59.00cm) and widest (1.23cm) shoots. However, iron spray at 0.06% followed that treatment on the shoots length and width. Also, all treatments significantly increased leaf area compared with control. The highest area was due to mixed compound (30.53 and 31.41cm^2) in both seasons, respectively, then the effect of zinc at 0.04% (28.48 and 29.07cm^2).

However, this increment presented as a result of foliar application of micronutrients may be attributed to their effect on formation of carbohydrates and proteins as well as to the effect of Zn on building up the natural auxin IAA and consequently activation of cell division process in plant tissues (Nijjar 1985). Iron spray was effective of increasing pear vegetative growth. Larue and Johnson (1989) stated that, foliar fertilizers as chelate should be easily absorbed by the plants and rapidly transported and should be easily release their ions to affect the plant of peach, plum and nectarine. Pear trees suffer from colorosis on calcareous soil and iron can greatly correct this phenomenon (Westwood, 1993).

In addition, spraying nutrients *i.e.* B, Zn, K, and S were appeared for improving growth and productivity of "Anna" apple trees (Ahmed *et al*., 1997). However, the same results were reported by Ubavic *et al.* (1984) on apple, Chekan (1988) and Mohamed and Ahmed (1991) on "Anna" apple, Naiema (2006) on pear, El-Khawaga (2007) on olive and El-Sisy (2011) on guava trees.

TABLE 2. Effect of foliar application of some nutrients on some vegetative growth parameters of "Le-Conte" pear trees during 2010 and 2011 seasons.

Treatments	Shoot length (cm)		Shoot diameter (cm)		Leaf area (cm2)	
	2010	2011	2010	2011	2010	2011
Control (untreated trees)	45.18	44.38	0.87	0.86	23.98	23.67
Potassium sulphate at 0.1%	50.83	49.97	1.00	1.03	27.51	27.81
Copper sulphate at 0.02%	49.81	48.42	0.96	0.94	26.21	27.77
Sequestrated zinc at 0.04%	51.70	52.58	1.01	1.00	28.48	29.07
Sequestrated iron at 0.06%	54.39	54.17	1.18	1.15	27.04	28.29
Mixed nutrients	59.00	57.77	1.23	1.22	30.53	31.41
L.S.D. at 0.05	1.65	1.89	0.03	0.05	0.84	0.96

Chemical analysis

The effect of treatments on leaf K, Cu, Zn and Fe content

Data in Table 3 cleared that all treatments increased leaf content of K, Cu, Zn and Fe compared to control. Moreover, treatment of mixed nutrients resulted in the highest values significantly (1.39 and 1.45% K; 17 and 18 ppm Cu, 38 and 40 ppm Zn and 138 and 139 ppm Fe) in both seasons respectively. The same results were reported by Sarma and Bhattacharyya (1989) and El-Sisy (2011) on guava, Raesa *et al.*, Mohamed and Ahmed (1991), Sourour (1992), Kabeel *et al.* (1998) and El-Segin and Khalil (2000) on pear, El-Shazly (1999) and El-Segin (2003) on apple and Abd-Ella and El-Sisy (2006) on fig. The increase of plant nutrient status resulted from spraying different solutions may be attributed to quick absorption via leaves and the limited loss of the nutrients when they were sprayed (Marschner, 1995).

Metabolism of plant hormones such as auxin (IAA) and tryptophan decrease in zinc deficiency condition, as a result of leaf growth withdraw. In fact, zinc is essential for tryptophan synthesis, which is a prerequisite for auxin formation, therefore amount of auxin decreases by zinc deficiency (Marschner, 1995 and Pedler *et al.*, 2000). Zinc is the main building part of some enzymes and is needed for the plant enzymes formation of most species. In addition, many enzymatic reactions be active by zinc (Vitosh *et al.*, 1994, Pedler *et al.*, 2000 and Akay, 2011).

TABLE 3. Effect of foliar application of some nutrients on leaf macro and micro elements contents (% and ppm dry weight, respectively) of "Le-Conte" pear trees during 2010 and 2011 seasons.

Treatments	K (%)		Cu (ppm)		Zn (ppm)		Fe (ppm)	
	2010	2011	2010	2011	2010	2011	2010	2011
Control (untreated trees)	1.00	0.98	10	11	19	20	109	108
Potassium sulphate at 0.1%	1.37	1.35	12	13	26	27	116	114
Copper sulphate at 0.02%	1.06	1.03	15	17	24	26	113	112
Sequestrated zinc at 0.04%	1.02	1.01	11	12	32	33	114	11 3
Sequestrated iron at 0.06%	1.07	1.04	13	13	29	28	125	128
Mixed nutrients	1.39	1.45	17	18	38	40	138	139
L.S.D. at 0.05	0.06	0.08	1.36	1.24	1.15	1.21	2.25	2.16

Fruit characteristics

Yield

Data presented in Table 4 demonstrate the effect of conducted treatments on the pear tree yield (Kg.).

TABLE 4. Effect of foliar application of some nutrients on yield, some physical parameters and firmness of "Le-Conte" pear trees during 2010 and 2011 seasons.

Treatments	Yield (Kg/tree)		Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		Fruit firmness (lb/Inch^2)	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Control (untreated trees)	38.80	39.29	156.05	161.68	7.97	8.02	6.68	6.82	12.45	12.75
Potassium sulphate at 0.1%	44.08	45.46	196.38	199.57	8.85	8.91	7.33	7.35	12.34	12.63
Copper sulphate at 0.02%	41.70	40.61	164.81	173.72	8.25	8.45	7.04	7.08	12.44	12.75
Sequestrated zinc at 0.04%	41.74	41.94	175.72	185.12	8.43	8.56	7.07	7.16	12.50	12.78
Sequestrated iron at 0.06%	46.51	46.31	187.14	200.66	8.54	8.72	7.23	7.43	12.52	12.81
Mixed nutrients	57.18	58.23	221.54	210.19	8.95	8.89	7.68	7.95	12.77	13.06
L.S.D. at 0.05	2.48	2.27	3.52	3.61	0.09	0.08	0.06	0.05	0.37	0.41

All studied treatments increased the yield compared with control. However, this result was statically confirmed except copper sulphate in 2nd season.

Mixed nutrients resulted in significantly the highest yield (57.18 and 58.33 Kg/tree in both seasons respectively) compared to the remaining treatments and control. Sequestrated iron at 0.06% followed (46.51 and 46.31 Kg/tree) then potassium sulphate at 0.1% (44.08 and 45.46 Kg/tree) in this respect with significant differences.

Fe had an important function in enzymatic systems and chlorophyll formation and consequently increased photosynthesis which finally increased the yield (Smith 1957). However, the improvement of yield as a result of Zn sprays may be explained by the fact that Zn plays a role in tryptophan synthesis which is the precursor of endogenous natural hormone (IAA) which is necessary for all plant metabolic processes (Price 1970). Although foliar sprays are more effective, foliar-absorbed Zn is not easily translocated in plants which necessitates repeated spray application (Swietlik 2002).

Zinc is essential micronutrient for proteins production in plant; also, zinc is the main composition of ribosome and essential for their development. Amino acids accumulated in plant tissues and protein synthesis decline by zinc deficit. One of the sites of protein synthesis is pollen tubes that amount of zinc in their tip is 150 micrograms per gram of dry matter. In addition, zinc will contribute on the pollination by impact on pollen tube formation (Marschner, 1995; Outten and O'Halloran, 2001 and Pandey *et al.,* 2006).

These results were in line with those obtained by EL-Gazzar *et al.* (1979) on grapes, Yogarotnam and Johnson (1982), Dasham and Ali (1986) and El-Sisy (2011) on guava, Kilany and Kilany (1991) and El-Seginy *et al.* (2003) on apple and Datir *et al.* (2012) on "Chilli".

Physical fruit characters

Average fruit weight

Data in Table 4 present the effect of conducted treatments on the average fruit weight in both seasons of the investigation. Significant enhancements were dedicated to conducted treatments compared with control in both seasons. Mixed nutrients induced significantly the highest average fruit weight (221.54 and 210.19 gm) followed by iron at 0.06% (187.14 and 200.66 gm) then K at 0.1% (196.38 and 199.57 gm) for both seasons, respectively compared with the remaining treatments.

These findings disagreed with El-Safty *et al.* (1998) on citrus, El-Shazly (1999) on apple, Amer *et al.* (2010) on ber fruit who found that fruit weight wasn't affected neither by increasing rate of applied micronutrients nor by method of application, while, EL-Sisy (2011) found that the best results associated with the high rate of mixture (Fe + Mn + Zn) at 3000 ppm either foliar or soil application in form chelate or sulphate twice annually on guava trees.

Fruit length and diameter

Data in Table 4 illustrate the effect of applied treatments on both fruit length and diameter respectively. It is evident that all considered treatments resulted in significant increases in both parameters compared with control in both seasons. The effect of mixed nutrients was markedly the utmost compared with control and remaining treatments.

These results were partially agreed with Awad and Atawia (1995) and El-Shazly (1999) on apple. However, the results of this study are in harmony with those reported by El-Seginy and Khalil (2000) on pear, Abd-Ella and El-Sisy (2006) on fig, Amer *et al*. (2010) on ber fruit and El-Sisy (2011) on guava fruits.

Fruit firmness (Ib/inch^2)

Data tabulated in Table 4 show the effect of conducted treatments on the fruit firmness (Ib/inch^2) compared with control. Fruit firmness was insignificantly affected by the majority of conducted treatments. Mixed nutrients, sequestrated Iron at 0.06% and copper sulphate at 0.02% treatments increased this parameter insignificantly compared with control and with differences between them in both seasons.

The obtained results agreed with those reported by El-Sisy (2011) on guava fruits.

Chemical fruit characters

Juice total soluble solids percentage (TSS %): Data in Table 5 illustrate the effect of considered treatments on the average juice TSS%. Data clarify that juice of control fruits attained the least TSS% amounting to (12.57 and 12.43% in both seasons respectively). All treatments increased this parameter compared with control in both seasons. Significantly the highest effect was due to mixed nutrients treatment in both seasons (14.80 and 14.77%) and potassium sulphate at 0.1% treatment followed (14.43 and 14.77%).

TABLE 5. Effect of foliar application of some nutrients on some fruit quality of "Le-Conte" pear trees during 2010 and 2011 seasons.

Treatments	T.S.S. (%)		Acidity (%)		T.S.S./acid ratio	
	2010	2011	2010	2011	2010	2011
Control (untreated trees)	12.57	12.43	0.40	0.41	31.43	30.32
Potassium sulphate at 0.1%	14.43	14.77	0.29	0.32	50.19	44.85
Copper sulphate at 0.02%	13.63	13.83	0.34	0.38	39.83	36.76
Sequestrated zinc at 0.04%	13.70	13.63	0.36	0.35	37.41	39.45
Sequestrated iron at 0.06%	14.07	13.87	0.34	0.32	41.84	42.94
Mixed nutrients	14.80	14.77	0. 27	0.31	55.30	47.68
L.S.D. at 0.05	1.31	1.48	0.03	0.04	2.73	2.64

Juice acidity percentage: Data in Table 5 present the effect of conducted treatments on the juice acidity percentage compared with control; juice acidity was significantly decreased by all of the conducted treatments in the both seasons. Mixed nutrients were the lowest percentage in this respect (0.27 and 0.31%) in both seasons respectively. Potassium sulphate at 0.1% was followed (0.29 and 0.32%).

The obtained results were partially agreed with those reported by Mohamed and Ahmed (1991) on "Anna" apple who found a reduction in total acidity in fruit pulp due to fertilization, while El-Sisy (2011) reported that there was no significant effect in fruit acidity percent due to all treatments in both seasons of study, but there was a slight decrease in acidity due to all treatments fertilization on guava.

TSS/acid (ratio): Data in Table 5 indicated that all treatments increased significantly the ratio of TSS% to acidity % compared with control in both seasons. Mixed nutrients treatment was the highest value (55.30 and 47.68%) in both seasons. Potassium sulphate at 0.1% treatment followed (50.19 and 44.85 in both seasons respectively).

Mohamed and Ahmed (1991) found that applying the three elements together (Cu + Zn + Fe) at the higher rate was also accompanied with improve in total soluble solids in apple trees. Also, Ahmed *et al*. (1997) and El-Sisy (2011) found the same trend.

Fruit K, Cu, Zn and Fe content: Concerning the effect of foliar application of some nutrients on fruit potassium (K) content, data of Table 6 cleared that all treatments significantly increased K% content compared with control. Mixed nutrients treatment induced significantly the highest percentages in both seasons amounting to (1.19 and 1.24% respectively). Results due to potassium sulphate 0.1% treatment followed (1.13 and 1.17%). Whereas, control fruit potassium content was the least amounting to 0.88 and 0.87% in both seasons respectively.

TABLE 6. Effect of foliar application of some nutrients on fruit macro and micro elements contents of "Le-Conte" pear trees during 2010 and 2011 seasons.

Treatments	K (%)		Cu (ppm)		Zn (ppm)		Fe (ppm)	
	2010	2011	2010	2011	2010	2011	2010	2011
Control (untreated trees)	0.88	0.87	7	8	12	11	85	86
Potassium sulphate at 0.1%	1.13	1.17	10	10	14	13	91	88
Copper sulphate at 0.02%	0.96	0.95	13	12	15	16	92	90
Sequestrated zinc at 0.04%	0.95	0.94	9	10	21	20	87	86
Sequestrated iron at 0.06%	0.96	0.92	11	10	21	19	96	97
Mixed nutrients Together	1.19	1.24	15	14	23	24	101	102
L.S.D. at 0.05	0.05	0.04	1.11	1.13	1.15	1.17	2.28	2.53

Micronutrients in fruits (Cu, Zn and Fe) in Table 6 show that there was a significant increase in fruit Cu, Zn and Fe content in all treatments comparing with control in both seasons of study. The highest level of Cu was associated with mixed nutrients following copper sulphate at 0.02% and sequestrated Iron at 0.06%. As for Zn content the highest value associated with mixed nutrients followed sequestrated Iron at 0.06% and sequestrated zinc at 0.04% in both seasons. Concerning Fe content data in Table 6 indicated that mixed nutrients, sequestrated iron at 0.06% and copper sulphate at 0.02% were increased significantly Fe content compared to control, in both seasons. The highest value recorded by mixed nutrients (101 and 102 ppm).

Amer *et al*. (2010) reported that soil applied micronutrients increased their concentration in leaves and fruits more than foliar application except Cu. These results agreed with El-Sisy (2011) who reported that there were a significant increase in fruit Fe, Mn and Zn comparing with control in both seasons of study. On the other hand, El-Gazzar *et al*. (1979) who reported that fruits of grapes were not significantly affected by either soil or foliar application of $FeSO_4$ and $ZnSO_4$.

Total sugar, reducing and non-reducing sugars (%): The effect of foliar application of some nutrients on fruit content of total sugars % is tabulated in Table 7. Data relieved that some treatments increased fruit content of total sugars compared with control. The highest percentage was induced from mixed nutrients in both seasons (10.00 and 10.16%) respectively.

Effect of potassium sulphate at 0.1% followed without significant differences between them in both seasons, then sequestrated Zinc at 0.4% followed with significant differences between them and to control in both seasons.

Concerning reducing sugars percentage, data in Table 7 indicated that all treatments significantly increased reducing sugars % compared to control in both seasons except, copper sulphate at 0.02%. Mixed nutrients and potassium at 0.1% gave the highest percentage and followed by sequestrated Iron at 0.06% in both seasons.

Data in Table 7 showed that, in the first season all treatments except copper sulphate at 0.02% and sequestrated Iron at 0.06% cleared significant increase in fruit non reducing sugars % compared to control. The highest percentage recorded at mixed nutrients, then sequestrated zinc at 0.04% followed. The lowest percentage was recorded at sequestrated Iron at 0.06%. In the second season, data indicated that all treatments increased the percentage of non reducing sugars in fruit compared with control. The highest value was recorded at mixed nutrients and followed by sequestrated Iron at 0.06%, while the lowest value induced at control.

TABLE 7. Effect of foliar application of some nutrients on some fruit quality of "Le-Conte" pear trees during 2010 and 2011 seasons.

Treatments	Total sugars (%)		Reducing sugars (%) (%)		Non-reducing sugars (%)	
	2010	2011	2010	2011	2010	2011
Control (untreated trees)	8.23	8.29	5.93	5.94	2.31	2.35
Potassium sulphate at 0.1%	9.59	9.84	7.13	7.35	2.46	2.49
Copper sulphate at 0.02%	8.46	8.50	6.21	6.02	2.25	2.48
Sequestrated zinc at 0.04%	8.94	8.72	6.43	6.39	2.51	2.39
Sequestrated iron at 0.06%	8.67	8.65	6.80	6.43	1.89	2.55
Mixed nutrients	10.00	10.16	7.17	7.53	2.84	2.63
L.S.D. at 0.05	0.46	0.39	0.35	0.32	0.02	0.04

The data of this study are partially in line with Dahsham and Aly (1986) and El-Sisy (2011) on guava fruits, Mohamed and Ahmed (1991) and El-Seginy *et al*. (2003) on apple.

In plants, zinc plays a key role as structural constituent or regulatory Co-Factor of a wide range of different enzymes and proteins in many important biochemical pathways and these are mainly concerned with carbohydrate metabolism both in photosynthesis and in the conversion of sugars to starch, protein metabolism, auxin (growth regulator) metabolism, pollen formation, the maintenance of the integrity of biological membranes, the resistance to infection by certain pathogen (Alloway, 2008).

The present data showed a positive effect (mostly significant) of the studied treatments on the shoot length and fruit yield and juice total sugars. However, data illustrated in Fig. 1 & 2 indicate high positive correlation coefficient and regression between shoot length (Independent factor) as well as all of fruit yield and juice total sugars (Dependent Factors) through the two studied seasons.

Conclusion

The results in the present research strongly provide that foliar application of “Le Cont” pear trees with single and mixture of chelated or sulphate (K, Cu, Zn and Fe) at the named concentrations (applied three times during growing season starting immediately after fruit set and at 21 days intervals) cleared that mixed nutrients were the best treatment for enhancing vegetative growth, leaf area, leaf elements content, yield, fruit weight and fruit quality.

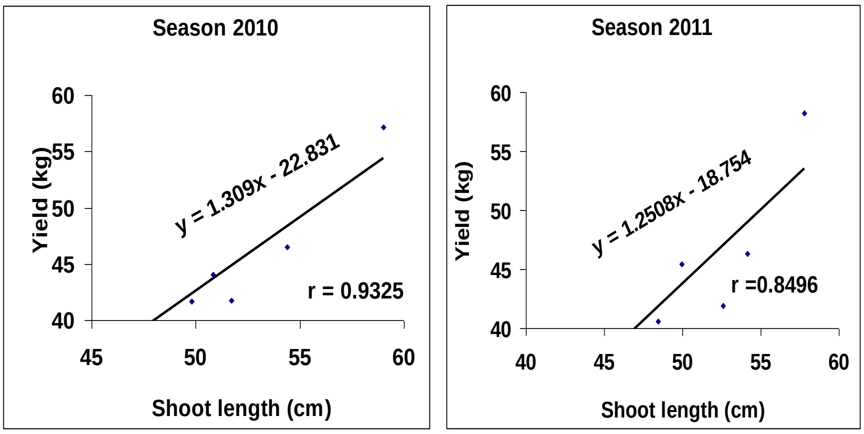

Fig. 1. Relationship between shoot length (cm) and yield (kg).

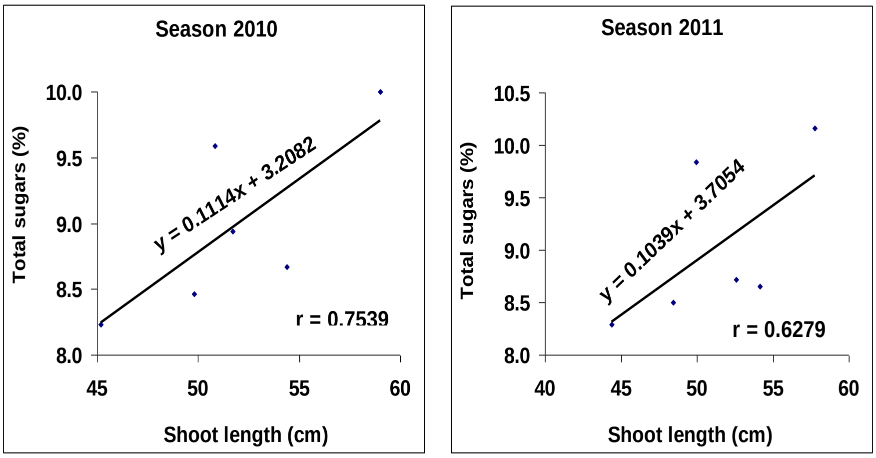

Fig. 2. Relationship between shoot length (cm) and total sugars (%).

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تأثير رش بعض المغذيات الورقية على نمو أشجار الكمثرى صنف "ليكونت" تحت ظروف التربة الجيرية

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أجرى هذا البحث لمدة موسمين متتاليين (٢٠١٠، ٢٠١١) على أشجار الكمثرى صنف "الليكونت"، حيث كان عمر الأشجار ثمانية سنوات مطعومة على أصل "بيرس كميونس" منزرعة فى تربة جيرية وكانت تروى بنظام الرى بالغمر فى مزرعة خاصة بمنطقة برج العرب التابعة لمحافظة الاسكندرية. تم اختيار ٢٤ شجرة متماثلة ومنزرعة على مسافة ٥ X ٥ متر وأجريت التجربة متضمنة ستة معاملات وهى كالاتى: أشجار غير معاملة (كنترول)، الرش بكبريتات البوتاسيوم بتركيز ٠،٠١٪ ، الرش بكبريتات النحاس بتركيز٠،٠٢ ٪ ، الرش بالزنك المخلبى بتركيز ٠،٠٠٤٪ ، الرش بالحديد المخلبى بتركيز ٠،٠٠٦٪ ، الرش بخليط من المغذيات السابقة بنفس التركيزات السابقة. وتم اضافة المعاملات ثلاثة مرات تبدأ بعد العقد على فترات متتالية حيث تكون بين الفترة والأخرى ٢١ يوم.

أشارت نتائج الدراسة إلى أن جميع المعاملات وخاصة المعاملة الخليطة من كل مركبات الرش قد أعطت أفضل النتائج مقارنة بالكنترول حيث أعطت أفضل قياسات خضرية مع تحسين حالة الأوراق من عناصر البوتاسيوم، النحاس، الزنك، الحديد بالاضافة إلى أنها أعطت أعلى محصول مع تحسين الصفات الطبيعية والكيماوية للثمار.