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Improving Growth and Productivity of "Pear" Trees Using Some Natural Plants Extracts under North Sinai Conditions

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Abstract: *This study was conducted during two successive seasons (2013 and 2014) at Baloza, North Sinai governorate, Egypt. The aim of this research is to study the effect of spraying pear trees with some natural plants extracts on yield, fruit quality and fire blight infection of Le-Conte cultivar. Seven treatments were done as follows: control treatment (spraying with water), garlic extract at (2 and 4 %), moringa extract at (2 and 4 %) and licorice extract at (2 and 4g/ L.). All treatments were sprayed once every month started form January until the harvest time (July).The obtained results revealed that all treatments were very effective in stimulating growth parameters (leaf area, chlorophyll, shoot length, shoot diameter, leaf mineral contents (nitrogen, phosphorus and potassium), yield, physical and chemical characteristics and fire blight infection of the fruits. Generally, licorice extract at (4g/ L.) increased the leaf area, chlorophyll, shoot length, shoot diameter in both seasons. In addition, moringa extract at (4%) improved leaf mineral content (N, P and K), yield/ tree, number of fruits /tree, fruit length, diameter, shape, weight, volume, T.S.S., total sugar, vitamin C, and decreased total acidity. On the other hand, garlic extract at (4%) gave the highest number and percentage of healthy fruits.*
Key word: garlic extract, licorice extract, moringa extract, Le-Conte "pear".

I. Introduction

Pear is one of the favorite fruits in the temperate climate zone. It is considered as the third deciduous fruits in the worldwide and it is also the fourth fruit among all fruit crops in distribution through the global market **(FAO 2011).** 'Le Conte' pear resulted as a hybrid between *Pyrus communis* x *Pyrus serotina* and it is the main pear cultivar grown in Egypt. However, cultivated area of pears fluctuated sharply during the last decades due to fire blight infection.

The world has become aware of environmental issue in recent years. Synthetic compounds are highly polluting, hazardous and much more costly. Researchers are working in the field of natural products extensively as they are less hazardous, low cost and easily available. The dependency on the use of inorganic fertilizers as a source of plant nutrients by farmers and their high cost is further associated with land and soil degradation and environmental pollution **(Phiri, 2010).** Thus, there is continuous need to search for alternative safe natural sources of plant nutrients, natural growth regulators even for protecting against disease and insects. Plant hormones can be used to increase yield per unit area because they influence every phase of plant growth and development. Traditionally, there are five groups of growth regulators which are listed: auxins, gibberellins, abscisic acid, ethylene and cytokinins **(Prosecus, 2006).**

Moringa oleifera (family: Moringaceae) is one of such alternatives, being investigated to ascertain its effect on growth and yield of crops and thus can be promoted among farmers as a possible supplement or substitute to inorganic fertilizers **(Phiri, 2010)**.

Moreover, several researches have indicated that *Moringa oleifera* is a highly valued plant with multipurpose effects **(Yang et al., 2006; Anwar et al., 2007; Adebayo et al., 2011; Mishra et al., 2011 and Moyo et al., 2011)**. It is considered as one of the world's most useful trees, as almost every part of the tree has an impressive effect of food, medication and industrial purposes **(Khalafalla et al., 2010; Adebayo et al., 2011 and Moyo et al., 2011)**.

Zeatin is one form of the most common forms which is naturally occurring cytokinin in plants not only plays an important role in cell division and cell elongation that led to promote the growth of plants but also has anti-aging potential and protective effects in plants **(Siddhuraju and Becker, 2003; Marcu, 2005; Nagar et al., 2006 and Anwar et al., 2007).**

Fresh *Moringa oleifera* leaves have been shown to have high zeatin content. Moringa leaves gathered from various parts of the world were found to have high zeatin concentrations (up to 200 mcg/g) of leaves **(Fuglie, 2000).**

In addition, fresh *Moringa oleifera* also content proteins, vitamins (such as A, B1, B2, B3, ascorbic acid and E), β carotene, amino acids phenolic compounds, sugars, and minerals (such as calcium, magnesium, sodium, iron, phosphorus and potassium) and several flavonoid pigments. Furthermore, ascorbic acid and foliar application have been reported to be growth and yield improving tools in various crops **(Jyotsna and**

Srivastava 1998; Fuglie 2000; Foidl et al., 2001 and Nagar et al., 2006). So it is a good source of natural antioxidants **(Anwar et al., 2007; Jacob and Shenbagaraman, 2011).**

Calcium and potassium play essential roles in crop growth and development through osmoregulation, enzyme activation, photosynthesis, and various other physiological processes **(Hasegawa et al., 2000; Epstein and Bloom 2005)**.

Moreover, Moringia leaf extract has the potential to promote plant growth; hence, it is used as a natural plant growth enhancer. Moringa leaf extract was sprayed onto leaves (25ml.) of onions, bell pepper, soya beans, sorghum, coffee, tea, chili, melon and maize and was shown to increase yields of these crops. In addition, he added that the leaf extract of *M. oleifera* accelerated growth of young plants, strengthened plants, improved resistance to pests and diseases, increased leaf duration, increased number of roots, produced more and larger fruits and generally increased yield by 20 and 35% **(Fuglie, 2000).** Furthermore, **Azra, (2011)** found that spraying wheat, peas and tomato with *M. oleifera* extract at 3.5% increased all growth parameters, productivity and crop characteristics. In addition, **Mona (2013)** found that spraying rocket (*Eruca vesicaria* subsp. sativa) plants with the aqueous extracts of leaves and twigs of *M. oleifera* at rates of 1, 2 and 3% increased all measured growth criteria (plant height), the amounts of each of chlorophyll a and b, total sugars, ascorbic acid and N, P and K.

Licorice, (*Glycyrrhiza glabra*) family Leguminoseae, is a plant which grows in Egypt and some other countries of the world. Its roots possess some nutritive value and medicinal properties. So, widely are used as a cold beverage, and in preparing some pharmaceutical agents (**Fenwick et al., 1990).** The licorice extract contain more than 100 various compounds, some of which accumulated in large amounts, which most important of them are triterpene saponins (including glycyrrhizin) and phenolic compounds **(Shibata, 2000; Shabani et al., 2009).** The yellow color of licorice is due to the flavonoid content of the plant, which includes liquiritin, isoliquiritin, and other compounds. The isoflavones glabridin and hispaglabridins A and B have significant antioxidant activity. In addition, licorice extract contain protein and amino acid (Asparagin), monosaccharide (glucose, fructose, sucrose and maltose), lignins, tannins, starch, choline, phytosterols, different types of vitamins such as B1, B2, B3, B6, C, E, biotin, foli acid, pantothenic acid, many mineral compounds (aluminum, calcium, iron, magnesium, cobalt, zinc, phosphorus, sodium, silicone, potassium and stannous) and bitter principles **(Snow, 1996; Fukai et al., 1998; Rossi, 1999; Arystanova et al., 2001)**. **Zuhair, (2010)** studied the effect of three concentrations of licorice root extract (0, 2 and 4g/L.) used as a foliar spray on vegetative and flowering parameters of two strawberry varieties. The treatments with licorice extract (2 g/ L.) gave a significant increase in average leaf area and foliage dry weight, but (4g/ L.) of liquorices caused a significant increase in total chlorophyll content.

In addition, **Qaraghouli and Jalal, (2005)** found that spraying apple with licorice and garlic extracts gave the highest value in yield and fruit quality. On the other hand, licorice extract is improving all growth parameters. **Hussein, (2008)** found that spraying date palm with licorice extract at 5g/L. increased the fruit quality.

Garlic, (*Allium sativum* L.) is native to central Asia, the Mediterranean region as well as Asia, Africa, and Europe. It was known to ancient Egyptians, and has been used for both culinary and medicinal purposes since their time **(Harris et al., 2001).** It was found that the application of natural extracts protects plants against heavy metals pollution. Among these extract garlic were found to exert positive effect and overcome the harmful effect of some environmental stresses on plant growth **(Hanafy et al., 1994).** A bioactive compound in garlic that has antibacterial activity is allicin, which is volatile compound containing sulphur **(Benkeblia and Lanzotti, 2007).** Alliin, when crushed, converts to allicin which is an antibiotic. Garlic also contains enzymes, B vitamins, proteins, minerals, saponins, flavonoids, and maillard reaction products, which are non sulphur-containing compounds. Furthermore, a phytoalexin (allixin) has been found **(Pandya et al., 2011).** This is a non-sulphur compound with a γ-pyrone skeleton structure that has antioxidant effects, antimicrobial effects and antitumor promoting effects, inhibits aflatoxin B2 DNA binding, and neurotrophic effects **(Yamasaki et al., 1991).** Aqueous extracts of garlic also had antibacterial activity against bacteria that was found for aquaculture products. It is also act as an antibacterial, antifungal and anti-protozoal effects of garlic have been ascribed to the abovementioned constituents of the plant **(Safithri et al., 2011).** In this concern, **El-Gamal and Hammad (2003)** reported that garlic extracts are useful in counteracting the harmful effects exerted by cadmium on tomato plants. In addition, **El-Desouky et al., (1998) and Wanas et al., (1998)** found that the natural extract of garlic cloves improve the growth, sex expression and fruit yield and quality of squash plant. Since, these extracts contain many growth materials and essential requirements at vegetative and reproductive growth. They are rich in phytohormones, vitamins, **Abd El-Razek, et al., (2011)** 'Canino' apricot trees grown under warm winter conditions greatly responded to spraying garlic extract at 4% by improving productivity and fruit quality. Similar results were reported in previous studies stated that "extracts from garlic (*Allium sativum* L.) or past prepared from fresh garlic improve productivity and fruit quality when applied to grapevine", apple, and peach **(Serag El-Deen, 2002; Botelho, et al ., 2007 and Ahmed, et al., 2009)**. In addition **Chowdhury, et al., (2007)**

found that "extracts from garlic improved number of fruits, TSS and yield of mango trees. Garlic extract reduced the incidence of mango anthracnose and resulted higher yield **(Chowdhury, 2005)**. In addition, **Abd El-Razek, et al., (2013)** found that spraying garlic extract at 8% combined with GA at 100 ppm is recommended to improve productivity and fruit quality of 'Le Conte' pear trees grown under warm winter conditions in Egypt.

This trial aimed to study improving growth and productivity of Le- Conte "pear" trees using some natural plants extracts (*Moringa oleifera*, *Glycyrrhiza glabra* and *Allium sativum*) under north Sinai conditions.

II. Materials And Methods

This study was conducted during 2013 and 2014 seasons on 42 Le- Conte "pear" trees of 10- years old, uniform in vigor, budded on Pyrus communis rootstock, with planting space 4 × 4 m grown, in sandy soil (control in Table 1) under drip irrigation system at Baloza, North Sinai Governorate, Egypt,. This study included seven treatments were established as follows control treatment (spraying with water), garlic extract at (2%), garlic extract at (4%), moringa extract at (2%), moringa extract at (4%), licorice extract at (2g/L.) and licorice extract at (4g/L.). All treatments were sprayed once every month started of January until the harvest (July). Fertilization program and other agricultural practices were the same for all trees.

The 2% and 4% garlic aqueous extract was prepared by blending 20 g and 40 g of fresh mature cloves in one liter of distilled water, frozen and thawed two times, and then filtered and diluted by distilled water to one liter **(El-Desouky et al., 1998).**

The 2% and 4% moringa aqueous extract was prepared by blending 20 g and 40 g of young moringa leaves with 675 ml of 80 % ethanol as suggested by **(Makker and Becker, 1996).** The obtained suspension homogenized and filtered by wringing using a mutton cloth. Finally, the solution re-filtered using No. 2 Whatman filter paper and rose to one liter **(Fuglie 2000).**

The aqueous extract of licorice roots (*Glycyrrhiza glabra*) were prepared by boiling (2g or 4g) in one liter of distilled water for 15 minutes. The solution filtered by wringing using a mutton cloth. The obtained extract re-filtered through No. 2 Whatman filter paper and completed by distilled water to one liter.

Triton B at 0.1 % used as wetting agents with all treatments expect with *Glycyrrhiza glabra* extract that contain saponin triterpenes.

The experiments established in randomized complete block design. Randomized complete block design. Each treatment was replicated three times, two tree per each.

Table 1: Some physical and chemical properties of soil of the experimental orchard.

Particle size distribution			Texture soil	Ec dsm^{-1}	pH	Available nutrients (Cation)					Available nutrients (Anion)			
Sand	Silt	Clay				Na %	P %	K %	Ca meg/l	Mg meg/l	CO3	HCO3 meg/l	Cl^-	So_4^{--}
95	5	-	sandy	1.30	7.70	7.7	0.04	0.57	2.65	2.40	-	3.85	3.21	6.2

The following parameters were measured for both seasons:

1- Leaf area (cm^2): was measured using leaf area meter.

2- Average total chlorophyll content: leaves were tested at the end of August in field using Minolta meter SPAD-502.

3-Length and diameter of the new developed shoots (cm): Ten of one year old shoots was collected from around the canopy representing the four main directions were tagged for measuring new developed shoots length and diameter at the end of growing season in September.

4- Macro and micronutrients in leaves: at the end of the experimental season (at the end of September), thirty leaves/tree were collected representing the four main directions. Collected samples prepared and analyzed for macro and micronutrients as described by **Peterburgski (1968) and Jones et al. (1991).** Total NPK are calorimetrically determined as described by **Cottenie, et al. (1982).**

5. The tree yield (Kg /tree) and number of fruits /tree: was recorded.

6-Fruit parameters: fruits sample was taken at the harvest time to be used for determining the physical properties (i.e., fruit length (cm), fruit diameter (cm), fruit shape (fruit length ÷fruit diameter), fruit weight (g) and fruit volume (cm^3)).

7- Fruit quality: a sample of 10 mature fruits of each tree was taken at the harvest time to be used for determining the chemical properties i.e., the total soluble solids percentage (T.S.S.%) was measured by using a hand refractometer and the acidity % as citric acid content using fresh juice with titration against 0.1 NaOH. The total sugars %, and content of vitamin C according to **A.O.A.C (1985)** were determined.

8- Number and percentage of fire blight infected fruits: was recorded and calculated at harvest time.

Statistical analysis:

The data were subjected to analysis of variance and Duncan's multiple range tests was used to differentiate means as described by **Duncan (1955).**

III. Results And Discussion

Leaf area and Total Chlorophylls

Data presented in Table (2) show that all treatments were significantly effective on Le-Conte "pear" leaf area and total chlorophyll. However, spraying trees with licorice extract at (4g/L.) increased leaf area (42.42 and 42.65 cm^2 in both seasons, respectively) and total chlorophyll (58.87 in the 1st and 59.26 in the 2nd season) followed by spraying trees with licorice extract at (2 g/L.). In addition, the control was less in leaf area and total chlorophylls.

This result may be due to that licorice contains mevalonic acid which is the initiator in the synthesis of GA_3 acid in plants, so spraying the plant with licorice extract improves the vegetative growth of many plants.

These results are parallel with those of **Zuhair, (2010)** who studied the effect of three concentrations of licorice extract (0, 2 and 4g/L.) used as a foliar spray on vegetative and flowering parameters of two strawberry varieties and found that licorice extract (2 g/L.) gave a significant increase in average leaf area, but (4g/L.) of licorice extract caused a significant increase in total chlorophyll content.

Table 2. Effect of the extracts of garlic, moringa and licorice on Le-Conte "pear" leaf area and total chlorophylls during 2013 and 2014 seasons.

treatments	Leaf area (cm^2)		total chlorophyll	
	2013	2014	2013	2014
Control	30.45g	30.89g	49.69g	49.76g
Garlic extract at 2 %	35.59e	35.90e	53.11e	53.71e
Garlic extract at 4%	39.05c	39.10c	55.33c	55.77c
Moringa extract at 2%	32.37f	33.22f	51.14f	51.72f
Moringa extract at 4%	37.97d	38.09d	54.09d	54.67d
Licorice extract at (2 g/L.)	41.01b	41.11b	56.56b	57.21b
Licorice extract at (4 g/L.)	42.42a	42.65a	58.87a	59.26a

Means having the same letter (s) in each column is not significantly different at 5% level

Shoot Length and Shoot Diameter

Concerning the Results in Table (3) shoot length and shoot diameter was significantly affected by all treatments in both seasons. Furthermore, spraying trees with licorice extract at (4g/L.) increased shoot length (71.17 in the 1st and 71.45 cm in the 2nd season) and shoot diameter (1.84 in the 1st and 1.85 cm in the 2nd season) in both seasons followed by spraying trees with licorice extract at (2g/ L.) . In addition, the control was the lowest in shoot length and shoot diameter in both seasons.

This may be due to that licorice contains more than 100 various compounds, some of which accumulated in large amounts, most important of them are triterpene saponins (including glycyrrhizin), phenolic compounds, mevalonic acid, protein amino acid (asparagin), polysaccharide (glucose, fructose, sucrose, maltose) lignins ,vitamins such as B1, B2, B3, B6, C and E, Biotin, foli acid and pantothenic acid which play an important role in improving the growth of the plants **(Snow, 1996; Fukai et al., 1998; Rossi, 1999; Arystanova et al., 2001).**

Generally, these results are in agreement with **Zuhair, (2010)** who studied the effect of licorice extract as a foliar spray on vegetative growth of two strawberry varieties and found a significant increase in vegetative growth.

Leaf Mineral Content:

Concerning the Results in Table (4) nitrogen, phosphorus and potassium content in the leaves were significantly affected by all treatments in both seasons. However, spraying trees with moringa extract at 4% gave the best leaf nitrogen content (2.86 in the 1st and 2.87% in the 2nd season), phosphorus (0.27 in the 1st and 0.28% in the 2nd season) and potassium (1.41 in the 1st and 1.44% in the 2nd season), followed by spraying trees with moringa extract 2% in Le-Conte "pear" in both seasons. On the other side, control was the lowest leaf

nitrogen content (1.49 in the 1st and 1.57% in the 2nd season), phosphorus (0.13 in the 1st and 0.15% in the 2nd season) and potassium (0.79 in the 1st and 0.82% in the 2nd season) in both seasons.

This result could be due to the important role of moringa extract that contain a profile of proteins, vitamins, β carotene, amino acids and various phenolics and provide a rich and rare combination of zeatin, protein, vitamins such as, A, B1, B2, B3, ascorbic acid, E, phenolic compounds, sugars, and minerals such as (calcium, magnesium, sodium, iron, phosphorus and potassium) and several flavonoid pigments. In addition, moringa leaf extract has the potential that to promote plant growth; hence, it is used as a natural plant growth enhancer, and zeatin plays an important role in cell division and cell elongation **(Nagar et al., 1982; Siddhuraju and Becker, 2003 and Anwar et al., 2007)**.

These results are parallel with **Fuglie (2000)** who found that the leaf extract of *M. oleifera* accelerated growth of tomato, peanut, corn and wheat at early vegetative growth improved resistance to pests and diseases, increased leaf duration, increased number of roots, produced more and larger fruits and generally increased yield by 20 and 35%. Furthermore**, Azra,(2011)** found that spraying wheat, peas and tomato with *M. oleifera* extract at 3.5% increased all growth parameters. In addition, **Mona (2013)** who found that fertilization of rocket (*Eruca vesicaria* subsp. sativa) plants with *M. oleifera* at rates 2% extracts potentially increased the content of, N, P and K in leaves.

Table 3. Effect of the extracts of garlic, moringa and licorice on shoot length and shoot diameter of Le-Conte "pear" trees during 2013 and 2014 seasons.

treatments	Shoot length (cm)		Shoot diameter (cm)	
	2013	2014	2013	2014
Control	35.81g	36.06g	1.01g	1.09g
Garlic extract at 2 %	51.41e	51.67e	1.28e	1.29e
Garlic extract at 4%	61.08c	61.42c	1.41c	1.43c
Moringa extract at 2%	42.80f	43.06f	1.14f	1.15f
Moringa extract at 4%	56.59d	56.87d	1.35d	1.37d
Licorice extract at (2 g/L.)	66.12b	66.37b	1.67b	1.69b
Licorice extract at (4 g/L.)	71.17a	71.45a	1.84a	1.85a

Means having the same letter (s) in each column is not significantly different at 5% level

Table 4. Effect of the extracts of garlic, moringa and licorice on N, P and K content of Le-Conte "pear" trees during 2013 and 2014 seasons.

treatments	N %		P %		K %	
	2013	2014	2013	2014	2013	2014
Control	1.49g	1.57f	0.13f	0.15f	0.79g	0.82g
Garlic extract at 2 %	1.86e	2.05d	0.16e	0.18e	0.95e	0.98e
Garlic extract at 4%	2.33c	2.43b	0.21c	0.23c	1.19c	1.22c
Moringa extract at 2%	2.66b	2.74a	0.23b	0.26b	1.30b	1.30b
Moringa extract at 4%	2.86a	2.87a	0.27a	0.28a	1.41a	1.44a
Licorice extract at (2 g/L.)	1.75f	1.84e	0.14ef	0.17ef	0.88f	0.91f
Licorice extract at (4 g/L.)	2.11d	2.19c	0.18d	0.21d	1.09d	1.10d

Means having the same letter (s) in each column is not significantly different at 5% level

Yield (Kg /Tree) and Number of Fruits /Tree

It is evident from the data in Table (5) that yield/tree of Le-Conte "pear" was significantly affected by all treatments in both seasons. Moreover, spraying trees with moringa extract at 4% gave the best yield (23.34 in the 1st and 25.53 kg/tree in the 2nd season) and number of fruits /tree (153.92 in the 1st and 166.25 in the 2nd season) followed by spraying trees with moringa extract at 2 %. Results cleared that control gave the minimum values of yield (7.03 in the 1st and 8.14 kg / tree in the 2nd season) and number of fruits /tree (78.54 in the 1st and 89.31 in the 2nd season).

This result could be due the content of *Moringa oleifera* leaves extract have been shown to have high zeatin content. Zeatin is a form of the most common forms of naturally occurring cytokinin in plants, and plays an important role in cell division and cell elongation that led to promotes the growth and having anti-aging potential and protective effects in plants. In addition, *Moringa oleifera* extract also contain proteins, vitamins (such as A, B1, B2, B3, ascorbic acid and E), β carotene, amino acids phenolic, sugars, and minerals (such as calcium, magnesium, sodium, iron, phosphorus and potassium) and several flavonoid pigments. Ascorbic acid improved growth and yield of various crops **(Jyotsna and Srivastava 1998**; **Fuglie 2000; Foidl et al. 2001 and Nagar et al. 2006**).

In addition to calcium and potassium which play essential an roles in crop growth and development through osmoregulation, enzyme activation, photosynthesis, and various other physiological processes **(Hasegawa et al. 2000; Epstein and Bloom 2005**) and being a good source of natural antioxidants **(Anwar et al., 2007; Jacob and Shenbagaraman, 2011)**.

These results are parallel with **Fuglie (2000)** that Moringa leaf extract was sprayed onto leaves of onions, bell pepper, soya beans, sorghum, coffee, tea, chili, melon and maize and was shown to increase yields of these crops. Generally Moringa leaf extract increased yield by 20 and 35 % and improved more fruits. Furthermore**, Azra,(2011)** found that spraying wheat, peas and tomato with *M. oleifera* extract at 3.5% increased productivity.

Table 5. Effect of the extracts of garlic, moringa and licorice on yield/ tree and number of fruit/tree of Le-Conte "pear" trees during 2013 and 2014 seasons.

treatments	Yield/tree		N. of fruit /tree	
	2013	2014	2013	2014
Control	7.03g	8.14g	78.54g	89.31g
Garlic extract at 2 %	10.22f	11.64f	87.85f	97.36f
Garlic extract at 4%	18.11c	19.62c	128.28c	136.39c
Moringa extract at 2%	21.48b	22.92b	146.26b	155.16b
Moringa extract at 4%	23.34a	25.53a	153.92a	166.25a
Licorice extract at (2 g/L.)	12.70e	13.24e	113.84e	116.79e
Licorice extract at (4 g/L.)	14.98d	15.76d	124.64d	127.45d

Means having the same letter (s) in each column is not significantly different at 5% level

Fruit Physical Characteristics

Data in Tables (6) and (7) revealed that fruit length, diameter, shape, weight and volume of Le-Conte "pear" was significantly affected by all treatments in both seasons. It is cleared that spraying trees with moringa extract at 4% gave the best fruit length (8.56 in the 1st and 8.72 cm in the 2nd season), fruit diameter (6.83 in the 1st and 6.91cm in the 2nd season), fruit weight (151.64 in the 1st and 153.56g in the 2nd season) and fruit volume (153.90 in the 1st and 154.23 cm^3 in the 2nd season). On the other hand, garlic extract at 4% gave the highest fruit shape in first season but there was no significant effect between moringa extract (2% and 4%) and licorice extract at (2 g/l) in fruit shape in second season.

On the other side, unfavorable effects on fruit physical characteristics were observed when the Le-Conte "pear" grown without treatment. Control gave the lowest fruit length (5.19 in the 1st and 5.34 cm in the 2nd season), fruit diameter (4.41 in the 1st and 4.45 cm in the 2nd season), fruit weight (89.51 in the 1st and 91.14g in the 2nd season) and fruit volume (91.14 in the 1st and 92.16 cm^3 in the 2nd season) respectively. On the other hand, garlic extract at 4 % and control treatments gave the lowest fruit shape in first season but there was no significant effect between garlic extract at (2 and 4%), licorice extract at (2 and 4 g/L.) and control in fruit shape in second season.

The positive influence of these materials may be due to this content (proteins, vitamins, β carotene, amino acids and various phenolics and provide a rich and rare combination of zeatin, protein, vitamins such as (A, B1, B2, B3, ascorbic acid and E) phenolic compounds, sugars, and minerals such as (calcium, magnesium, sodium, iron, phosphorus and potassium) and several flavonoid pigments). In addition, Moringia leaves extract has the potential to promote plant growth; hence, it is used as a natural plant growth enhancer and zeatin that is important in cell division and cell elongation **(Nagar et al., 1982; Siddhuraju and Becker, 2003 and Anwar et al., 2007)**, and Ascorbic acid that have been reported to be growth and yield improving tools in various crops **(Jyotsna and Srivastava 1998**; **Fuglie 2000; Foidl et al. 2001 and Nagar et al. 2006**). Calcium and potassium play essential roles in crop growth and development through osmoregulation, enzyme activation, photosynthesis, and various other physiological processes **(Hasegawa et al. 2000 and Epstein and Bloom 2005**).

Generally, these results are in agreement with **Fuglie (2000)** who found that the leaf extract of *M. oleifera* accelerated growth of young plants and produced larger fruits. Furthermore**, Azra, (2011)** found that spraying wheat, peas and tomato with *M. oleifera* extract at 3.5% increased crop characteristics.

Table 6. Effect of the extracts of garlic, moringa and licorice on fruit length, fruit diameter and fruit shape of Le-Conte "pear" cv. during 2013 and 2014 seasons.

Treatments	Fruit length (cm)		Fruit diameter (cm)		Fruit shape	
	2013	2014	2013	2014	2013	2014
Control	5.19f	5.34f	4.41g	4.45f	1.18d	1.20b
Garlic extract at 2 %	6.17e	6.32e	5.29f	5.35e	1.17d	1.18b
Garlic extract at 4%	7.83c	7.26c	6.16c	6.18c	1.27a	1.18b
Moringa extract at 2%	8.21b	8.37b	6.62b	6.62b	1.24b	1.26a
Moringa extract at 4%	8.56a	8.72a	6.83a	6.91a	1.25b	1.26a
Licorice extract at (2 g/L.)	6.76f	6.91d	5.47e	5.70d	1.24b	1.21ab
Licorice extract at (4 g/L.)	7.11d	7.11cd	5.93d	5.92d	1.20c	1.20b

Means having the same letter (s) in each column is not significantly different at 5% level

Table 7. Effect of the extracts of garlic, moringa and licorice on fruit weight and fruit volume of Le-Conte "pear" cv. during 2013 and 2014 seasons.

Treatments	Fruit weight (g)		Fruit volume(cm^3)	
	2013	2014	2013	2014
Control	89.51g	91.14g	91.14g	92.16g
Garlic extract at 2 %	116.33e	119.56e	119.56e	124.76e
Garlic extract at 4%	141.18c	143.85c	143.85c	147.46c
Moringa extract at 2%	146.86b	147.72b	147.72b	150.13b
Moringa extract at 4%	151.64a	153.56a	153.90a	154.23a
Licorice extract at (2 g/L.)	111.56f	113.36f	113.36f	119.94f
Licorice extract at (4 g/L.)	120.19d	123.66d	123.66d	130.07d

Means having the same letter (s) in each column is not significantly different at 5% level

Fruit Chemical Characteristics

Concerning the results in Table (8) data showed that all treatments had a significantly difference in T.S.S., total sugar, total acidity and vitamin C in both seasons. However, spraying trees with moringa extract at 4% gave the best T.S.S. (13.56 in the 1st and 13.85 % in the 2nd season), total sugar (8.27 in the 1st and 8.50 % in the 2nd season and vitamin C (48.59 in the 1st and 50.13 mg/100g in the 2nd season) and decreased total acidity (0.25 in the 1st and 0.24% in the 2nd season), followed by spraying trees with moringa extract at 2%, followed by spraying trees with garlic extract at 4%.

On the other side, unfavorable effects on fruit chemical characteristics were observed when the Le-Conte "pear" trees untreated with each material. In general, natural plant extracts can be a great way to provide the plants with the nutrients and different compounds they need to grow and thrive. Natural plant extracts usually contain many trace elements plants need that are not found in most chemical formulations.

These results agreed those obtained by **Mona (2013)** who found that foliar spraying with the aqueous extracts of leaves and twigs of *M. oleifera* at 2 % on rocket (*Eruca vesicaria* subsp. sativa) increased total sugars, ascorbic acid. Furthermore**, Azra,(2011)** found that spraying wheat, peas and tomato with *M. oleifera* extract at 3.5% improved crop characteristics. In addition, with **Chowdhury, et al.,** (**2007)** who found that garlic extract improved TSS of mango trees.

Table 8. Effect of the extracts of garlic, moringa and licorice on T.S.S., total sugar, total acidity and vitamin C of Le-Conte "pear" fruits during 2013 and 2014 seasons.

Treatments	T.S.S %		Total sugar %		Total acidity %		Vitamin C mg/100g	
	2013	2014	2013	2014	2013	2014	2013	2014
Control	9.21g	9.53g	6.62g	6.53g	0.33a	0.35a	28.22g	28.92g
Garlic extract at 2 %	11.12e	11.59e	7.33e	7.62e	0.30bc	0.30c	36.84e	36.86e
Garlic extract at 4%	12.56c	12.76c	7.87c	8.11c	0.28d	0.27d	4282c	43.16c
Moringa extract at 2%	12.89b	13.27b	8.09b	8.23b	0.26e	0.25e	46.37b	47.23b
Moringa extract at 4%	13.56a	13.85a	8.27a	8.50a	0.25e	0.24e	48.59a	50.13a
Licorice extract at (2 g/L.)	10.62f	10.46f	7.16f	7.33f	0.31b	0.32b	32.89f	33.60f
Licorice extract at (4 g/L.)	11.65d	11.74d	7.63d	7.84d	0.29cd	0.28d	38.75d	39.24d

Means having the same letter (s) in each column is not significantly different at 5% level

Number and Percentage of Fire Blight Infected Fruits

It is evident from the data in Table (9) that number and percentage of fire blight infected fruits of Le-Conte "pear" fire blight was significantly affected by all treatments in both seasons. Moreover, spraying trees with garlic extract at 4% gave the lowest fruit infection by fire blight and gave the highest healthy fruits (3.56 in the 1st and 2.76 in the 2nd season) and the lowest percentage of infected fruits (2.78 in the 1st and 2.02% in the 2nd season). The results cleared that control gave the highest number of infected fruits /tree (12.21 in the 1st and 13.53 in the 2nd season) and the highest percentage of infected fruits (15.55 in the 1st and 15.15% in the 2nd season).

The positive influence of these materials may be due garlic content of non-volatile sulphur that has antioxidant effects, antimicrobial effects, and antitumor promoting effects, inhibits aflatoxin B2 DNA binding, and neurotrophic effects **(Yamasaki et al., 1991).** Aqueous extracts of garlic also had antibacterial activity against bacteria that was found for aquaculture products. It is also act as antibacterial, antifungal and anti-protozoal agents due to the constituents of the plant. **Safithri et al., (2011).** This constituents play important role in the antibacterial, antifungal, antiviral and antiprotozoal **(El-Gamal and Hammad 2003).** In addition, with **Fuglie (2000)** who found that the leaf extract of *M. oleifera* improved resistance to pests and diseases.

Generally, these results are in agreement with **Chowdhury, et al., (2007)** who found that the number of healthy fruits was recorded with garlic extract on mongo trees. In addition, with **Lakshmanan et al. (1990)**

who found that garlic clove was most effective in inhibiting mycelia growth and spore germination of Corynespora cassiicola which given to protect fruit infection.

Table 9. Effect of the extracts of garlic, moringa and licorice on the number and percentage of fire blight infected fruits during 2013 and 2014 seasons.

treatments	Number of infected fruits /tree		percentage of infected fruits%	
	2013	2014	2013	2014
Control	12.21a	13.53a	15.55a	15.15a
Garlic extract at 2 %	4.00f	3.59f	4.55e	3.69e
Garlic extract at 4%	3.56g	2.76g	2.78g	2.02g
Moringa extract at 2%	7.00d	6.27d	4.79d	4.04d
Moringa extract at 4%	5.56e	4.85e	3.61f	2.92f
Licorice extract at (2 g/L.)	10.62b	9.45b	9.33b	8.09b
Licorice extract at (4 g/L.)	9.65c	8.46c	7.74c	6.64c

Means having the same letter (s) in each column is not significantly different at 5% level

IV. Conclusion

It can be concluded from the aforementioned results, that *M. oleifera* leaf extracts at 4% improved leaf mineral content, yield, physical and chemical characteristics. In addition, licorice extracts at (4 g /l) improved growth of Le-Conte "pear" plants at Baloza, North Sinai governorate, Egypt. On the other side, garlic extract at 4% gave the highest healthy fruits. Generally, it is concluded that *M. oleifera* leaf extracts can be recommended (as other natural materials) to be used effectively by farmers as natural plant extracts for various crops due to its high potentiality, high nutritive value, antioxidant effect, easy preparation and environmentally friendly nature.

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