Middle East Journal of Agriculture Research
ISSN 2077-4605

Volume : 06 | Issue : 04 | Oct.-Dec. | 2017
Pages:1389-1402

Effect of capture material mixture and raw iron application on Le- Conte pear trees budded on Calleryana rootstock

Naglaa H. Shakweer

Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

Received: 10 Oct. 2017 / Accepted: 25 Dec. 2017 / Publication date: 30 Dec. 2017

ABSTRACT

This investigation was carried out during two successive seasons (2013/014 and 2014/ 015) on 10 years old "Le-Conte" pear trees budded on Calleryana rootstock, planted at 3.5x4m. and grown in clay-silty soil under flood irrigation system in Horticultural Research Institute Orchard, Agriculture research center, Giza, Egypt. Four experimental treatments were applied to study the effect of Natural Minerals Compound (N.M.C) and magnetic iron (magnetite) as a raw on: trees nutrition status, leaf: chlorophylls, total carbohydrates and minerals content, tree yield and fruit quality. Also, trying to minimize the effects of chlorosis phenomenon in "Le-Conte" pear trees in alkaline soil as follows: T1-(N.M.C. 3kg + Magnitic Iron 0.5kg)/ tree , T2-(N.M.C. 3kg + Magnitic Iron 0.5kg + Ferros sulfate 100g) / tree , T3- (N.M.C.3kg + Magnitic Iron 0.5kg + Ferros sulfate 200g) /tree, T4- (N.M.C. 3kg + Magnitic Iron 0.5kg + Ferros sulfate 300g) / tree and T5- control treatment. Natural Minerals Compound (N.M.C.) and magnetic iron raw were applied once in the first of November, $FeSo_4$ at (100, 200 and 300 g/tree) were applied every month from the first November to the near of growth period (first week of February). The mineral fertilization of control is AGRO Singral with micro elements installation NPK 19 - 19 - 19 + TE soluble fertilizer 50 g / tree twice every month from first February until first of July (550g/tree/year). The obtained results cleared that, N.M.C. plus Magnitic Iron alone or with Ferros sulfate treatments significantly improved the most of parameters in this study in compared to the control. In addition, all of first, thrid and fourth treatments were the promising treatments whereas, they recorded the highest values of vegetative growth, leaf chlorophylls, total carbohydrates and macro or micro – elements contents ; tree yield and fruit quality and more net profit return for producers .These may be contribute to minimize the effects of chlorosis phenomenon in "Le-Conte" pear trees, which consider the main problem of *P. calleryana* rootstock which have the more of advantages as a pear rootstock .

Key words: Chlorosis, Natural Mineral Compound, Magnetite, Pear, *P. calleryana*, Le-cont ,yield, fruit quality, leaf mineral cotent.

Introduction

Rootstocks play an important role for pear production. The main disadvantage of *P. communis* rootstock is its high susceptibility to pear fire blights (Reimer, 1950). Stebbins, (1995) showed that while fire blight is generally among the principal diseases of pear trees with respect to rootstocks, the *P. calleryana* rootstock has a resistance to fire blight. In addition, the same author shows that *P. calleryana is* a good rootstock choice for any pear variety because *P. calleryana* rootstock has the standard vigor, and it has low chilling requirement. Bokszczanin *et al.,* (2007) reported that species *P. calleryana*, *P. pyrifolia* and *P. ussuriensis* are resistant to blight. *Pyrus calleryana*, one of the most popular landscaping tree in the United States (Culley *et al.,* 2011). Li *et al.* (2011) showed that the time when the rate of leaf bud germination was over 50% in Houshui pear tree grafted on *P. calleryana* was 10 days earlier than Houshui pear trees grafted on *P. betulifolia*, Lu *et al.* (2011) found that endodormancy of leaf bud of *P. betulaefolia* Bge was finished after early January and its chilling requirement was more than that of *P. calleryana* Dene and *P. pyrifolia* cv. Hosui. Since fire blight occurs late in the season from mid-March to mid-April, early seasonal blooming of *P. calleryana* rootstock from late February and early March is an extremely important property since it helps the "Le-Conte" pear trees to escape fire blight infection. Yet despite of *P.*

Corresponding Author: Naglaa H. Shakweer, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

calleryana resistance to fire blight and its other relative advantages, the *P. calleryana* seedlings are banned by the Nursery Law of Egypt as a rootstock for pear because of its susceptibility to lime induced chlorosis (Asaad *et al.,* 2014).

In this region pears are among the fruit trees that are affected by Fe chlorosis. Although iron is an abundant in soils, its deficiency is a major nutritional problem that affects cultivated plants in calcareous or alkaline soil (Mortvedt, 1991& Hansen *et al.,* 2003). Jiang *et al.,* (2015) studied the protection and exploitation of *Pyrus calleryana* resources in China it was reviewed from 6 perspectives. Yamada *et al.* (2015) cleared that pear trees (*Pyrus calleryana*) are popular in North America and Australia. Creswell *et al.* (2016) cleared that "Bradford" pear was the first developed cultivar of the Callery pear (*Pyrus calleryana*) and is one of the most widely planted cultivars of the species.

Soil applications of iron and Sulfuer to either the poorly drained or calcareous soils had limited and variable effectiveness on reducing Fe- chlorosis of bearing apple (*Malus domestica*) and pear (*Pyrus communis*) trees (Raese *et al.,* 1986). Moreover, Sanz *et al.,* (1992) cleared that iron chlorosis is one of major problem in fruit trees growing in the Mediterranean region. Chlorotic leaves in pear cv. Blanquilla were treated with acids to activate pre-existing iron pools and with Fe-containing compounds to increase leaf Fe concentrations (Garcia *et al.,* 2002). Ma Chun *et al.,*(2005) stated that among the 3 pear rootstocks, *P. xerophila* showed higher chlorophyll and iron content in fully expanded apical leaves than did *P. betulaefolia* and *P. calleryana* in high pH calcareous soil. In the commercial orchard control pear trees of (*Pyrus communis L*) showed severe leaf Fe-chlorosis symptoms effectively prevented by Fe-chelate (Sorrenti *et al.,* 2011).

Deciduous fruit trees and "Le-Conte" pear trees as well, need essential elements in order to complete its life cycle with high production of good quality; these elements must be found essential for a wide range of higher plant species (Atalla *et al.,* 2010).

Therefore, the alternative use of natural elements compound with organic manure fertilizers improved the soil physical and chemical properties as well as increased nutrient availability (Helail *et al.,* 2003).

Natural Mineral Compound ore (N.M.C) as a raw material which contains a lot of essential elements as: Ca, K, Mg, P, Al, Fe, Mn, Na, S, Ti and Silicon (Si) El-Shazly *et al.,* (2015) . Therefore, using of Natural Mineral Compound and magnetite (Magnetic iron) as substitute for feeding "Le-Conte" pear trees produce a suitable fruit yield with the highest quality with the lowest cost production and without harming the environment or human's health Atalla *et al.,* (2010). Also El-Shazly, *et al.,* (2015) obtained that the rate of Natural Mineral Compound ore (N.M.C) as a fertilizer of Balady mandarin trees for reducing environmental pollution,soil and underground water and to produce safety food with a high fruit quality. Hence, this study aims to assess the effect of Natural Minerals Compound plus Mgnitic iron (Magnitite) and Ferrous sulfate on tree : growth , nutrition status and productivity of pear *Pyrus communis* budded on *P. calleryana* stock.

Materials and Methods

The present study was conducted throughout two successive seasons (2013 & 014 / 2014 & 015) to study the effect of Natural Minerals Compound and Magnitic Iron soil applications on vegetative growth, fruit quality , and leaf mineral content of Le-Cont pear trees budded on *Pyrus calleryana* rootstock grown on Horticultural Research Institute Farm, Agriculture Research Center, Giza, Egypt. The trees were 10 years old planted at 3.5 x 4 m. in a clay-silty soil under flood irrigation system. Chemical and physical characteristics of the experimented soil are shown in Table 1.

Five treatments were used in this study as follows:-

T_1 - *Natural Minerals Compound (N.M.C.) 3 kg / tree + Fe magnetite raw 0.5 kg / tree.
T_2 - Natural Minerals Compound 3 kg / tree + Fe magnetite raw 0.5 kg/tree + $FeSo_4$ 100g/tree.
T_3 - Natural Minerals Compound 3 kg / tree + Fe magnetite raw 0.5 kg/tree + $FeSo_4$ 200g/tree.
T_4 - Natural Minerals Compound 3 kg / tree + Fe magnetite raw 0.5 kg/tree + $FeSo_4$ 300g/tree.
T_5 - Control: The mineral fertilization for the control trees (AGRO) Singral (NPK 19 - 19 - 19 + TE soluble fertilizer) 50 g / tree twice every month from first February until first of July (550 g/tree/year).

*Natural Minerals Compound raw (N.M.C.) as a raw material consists of a lot of essential elements as shown in table (2) obtained from (EL - Ahram Company for Mining and Natural Fertilizers , Giza , Egypt).

Table 1: Chemical and physical characteristics of the experimented soil:

Soil properties	Values
pH	8.1
Ec (ds/m)	1. 8
$CaCo_3$ %	2.0
Particle sized distribution	
Sand %	27.7
Silt %	34.7
Clay %	37.6
Textural grade	Clay silty
Available nutrients	
Total N %	0.74
Available p (ppm)	3.55
Available K (ppm)	54.6
Fe (ppm)	6.5
Mn (ppm)	1.7
Zn (ppm)	1.8

Table 2: Chemical analysis of the Natural Minerals Compound raw (N.M.C) , EL - Ahram Company for Mining and Natural Fertilizers.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Cl	SO_3	L.O.I
(%)												
36.15	0.76	7.80	4.88	0.72	3.07	13.45	1.92	4.37	8.10	0.56	5.38	9.01
V	Cr	Co	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Mo	Sn
(ppm)												
248.10	339.40	17.50	25.80	17.80	3082.00	46.00	246.20	1.50	54.50	5.70	2.40	2.50

The Natural minerals Compound and magnetite were applied once in the 1st of November.
$FeSo_4$ at (100, 200 and 300 g/tree) were applied every month from the first November to the first of February.
All treatments were added around one meter of the tree trunk.
For every addition of Ferros sulfate, citric acid was added as 25g/one kg of $FeSO_4$ /tree. Citric acid was used to stabilize the magnetic-particle suspension, (R˘acuciu *et al.,* 2006).
Each treatment was represented by three replicates (3 trees) and four branches / tree at 10 years old were selected to study the following determinations:-

1 - Vegetative growth parameters:-

Included, the vegetative buds %, the number of leaves / shoot on the selected four branches were counted before fruit set, mean of leaf area (cm^2) was calculated according to Bleasdale, (1978).

2- Flowering buds percent: was determined after 20 days of bud burst.
2-a- Percentage of fruit set: was determined after 20 days of full bloom.

$$\text{Fruit set \%} = \frac{\text{Total No. of Fruit lets}}{\text{Total No. Flowers}} \text{ X } 100$$

2 -b-Yield of trees: - as fruit number and weight per tree (kg).

Physical and chemical properties: -

Fruits were selected from each tree to determine the Physical and chemical properties of mature fruits that carried out when fruits of control attained maturity according to stands recorded by El-Azzouni *et al.,* (1975).The mature fruits from each treatments were taken at random for determining quality.

3- Fruit characteristics:-

3-a - Fruit physical characteristics:-

The average of fruit weight (g), fruit size (cm^3), fruit width (cm), fruit length (cm) and fruit firmness using pentameter pressure tester ($Lb/inch^2$).

3-b - Fruit chemical characteristics:-

Vitamin C was determined in the juice according to A.O.A.C. (1995).

Total soluble solids of juice (TSS) were determined by using ATAGO (ATC - No.1) hand refractometer, Mika *et al.,* (1982) and total acidity (%) was measured as malic acid and TSS/ acidity ratio was calculated according to A.O.C.A. (1995).

4 - Leaves chemical contents:-

4-a- Total chlorophyll content of leaf was determined by using (SPAD) meter (Minolta Corporation, Ramsey NJ, USA).
4-b- Total carbohydrates %, were determined calorimetrically according to Dubios *et al.* (1956) as g /100 g dry weight of sample and measured by using spectrophotometer at 490 nm.
4-c- Leaves minerals content: - fifty mature mid-shoot leaves per tree were sampled and dried. 0.5 gram of these dried samples was digested using the H_2SO_4 and H_2O_2 as described by Cuttenie (1980). The digested samples were used to determine the following macro- elements N%, P%, K%:-
- Nitrogen content by using method as described by Plummer (1971).
- Potassium was determined against a standard using flame-photometer (Piper, 1950).
- Phosphorus content was determined calorimetrically according to the method of Jackson (1958).
4-d- Leaf ash percentage: Ash content was determined as the method described in A.O.A.C. (1995). The extract ash samples were used to determine the following:
- macro elements (Ca and Mg %) and micro-elements (Fe, Zn and Mn (ppm), all were determined by Perking Elmer Atomic Absorption Spectrophotometer Model 2380 A1, According to Jackson and Ulrich (1959) and Yoshida *et al.* (1972).
All trees were horticultural supported and received the recommended orchard management under flood irrigation system.

5- Experimental design:

The present experiment composed 5 treatments each replicated three times with one tree / each replicate in complete randomized block design was adopted in this study.

6- Statistical analysis:

The obtained data were subjected to analysis of variance (ANOVA) according to Snedecor and Cochran, (1990) at probability of 5%. M. Static program and Duncan test were used to compare between means of treatments according to Waller and Duncan, (1969).

Results

Data in Table (3) cleared the effect of experimental treatments on vegetative bud %, leaves number / shoot and leaf area (cm^2): It is obvious that treatments gave the highest significant values when compared to the control. The highest treatment in the 1st season is (N.M.C. 3 kg + magnetite 0.5 kg + $FeSo_4$ 100g) / tree gave 39.12% for vegetative buds without significant different with first and fourth treatment but in the 2nd season the highest value for (N.M.C. 3 kg / tree + magnetite 0.5 kg) / tree 38.81 % without significant difference with other treatments except control which, exhibited the lowest percentage of vegetative buds / branch (24.09 & 28.81%) in the two seasons respectively. Leaves number / shoot and leaf area data showed that either N.M.C. plus Magnitite as a raw materials

only or plus Ferrose sulfate treatments insignificantly enhanced both leaves number or leaf area in compared to the control treatment in both studied seasons. Moreover, it is also noticeable that vegetative tree growth was better in the 2nd season than in the 1st one.

Table 3: Effect of natural minerals compound (N.M.C) , magnetite raw and Ferros sulfates soil application treatments on vegetative buds%, leaves number/shoot, and mean leaf area (cm^2) of Le-cont pear trees in seasons (2014 & 2015).

Treatment	Vegetative buds (%)		leaves Number / shoot		Mean leaf area (cm^2)	
	Seasons					
	2014	2015	2014	2015	2014	2015
T_1	36.45 AB	38.81 A	21.67 A	24.33 A	38.24 A	41.45 A
T_2	39.12 A	34.88 A	21.67 A	23.67 A	37.53 A	40.17 A
T_3	32.41 B	38.04 A	18.33 B	24.33 A	34.50 A	41.00 A
T_4	35.64 AB	35.30 A	21.00 AB	25.67 A	39.88 A	42.77 A
T_5	24.09 C	28.81 B	11.67 C	15. 67 B	29.25 B	30.13 B

Means having the same letter(s) in each column are statistically insignificant at 5% level.

T1 (N.M.C. 3 kg + Magnetite 0.5 kg) /tree
T2 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 100 g) /tree
T3 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 200 g) /tree
T4 4 - (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 300 g) /tree
T5 5 - Control

Table (4): Illustrated the effect of treatments on flowering buds, fruit set % fruit No./tree, fruit yield (kg/ tree).

As for the opening floral buds percentage shows that (N.M.C. 3 kg + magnetite 0.5 kg + Fe So_4 300g) / tree treatment gave the highest values in the first and the second season (38.27 & 44.32 %) respectively, with significant differences with other treatments in compared to the control was significantly lowest percent.

Regard to fruit set % data tabulated in Table (4) revealed that (N.M.C. 3 kg + magnetite 0.5 kg + Fe So_4 100g) / tree gave the highest value in the 1st season (11.04%) but in the 2nd season (N.M.C. 3 kg + magnetite 0.5 kg + Fe So_4 300g) / tree treatment gave the higher significant value than third treatment and control (6.86%). Whereas, other treatments were intermediate. The control treatment significantly reduced fruit set % in both seasons.

Table 4 : Effect of natural minerals compound (N.M.C) , magnetite raw and Ferros sulfates soil application treatments on flowering buds%, fruit set %, fruit No./tree and yield weight kg/ tree of Le-cont pear trees in seasons (2014 & 2015).

Treatment	Flowering buds (%)		Fruit set (%)		Fruit No./tree		Fruit yield (kg)/ tree	
	Seasons							
	2014	2015	2014	2015	2014	2015	2014	2015
T_1	29.33 B	32.83 B	8.18 B	6.47 AB	139.3 A	145.3 B	20.73 B	30.06 B
T_2	31.69 B	37.30 B	11.04 A	5.33 AB	144.0 A	141.3 B	21.41 B	27.43 C
T_3	28.57 B	34.77 B	9.17 B	4.88 B	168.7 A	176.7 A	26.96 A	34.79 AB
T_4	38.27 A	44.32 A	8.41 B	6.86 A	148.7 A	173.0 A	23.84 A	34.96 A
T_5	19.02 C	25.04 C	4.80 C	3.47 C	109.7 B	120.0 C	15.25 C	19.31 D

Means having the same letter(s) in each colum are statistically insignificant at 5% level.

T1 (N.M.C. 3 kg + Magnetite 0.5 kg) /tree
T2 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 100 g) /tree
T3 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 200 g) /tree
T4 4 - (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 300 g) /tree
T5 5 - Control

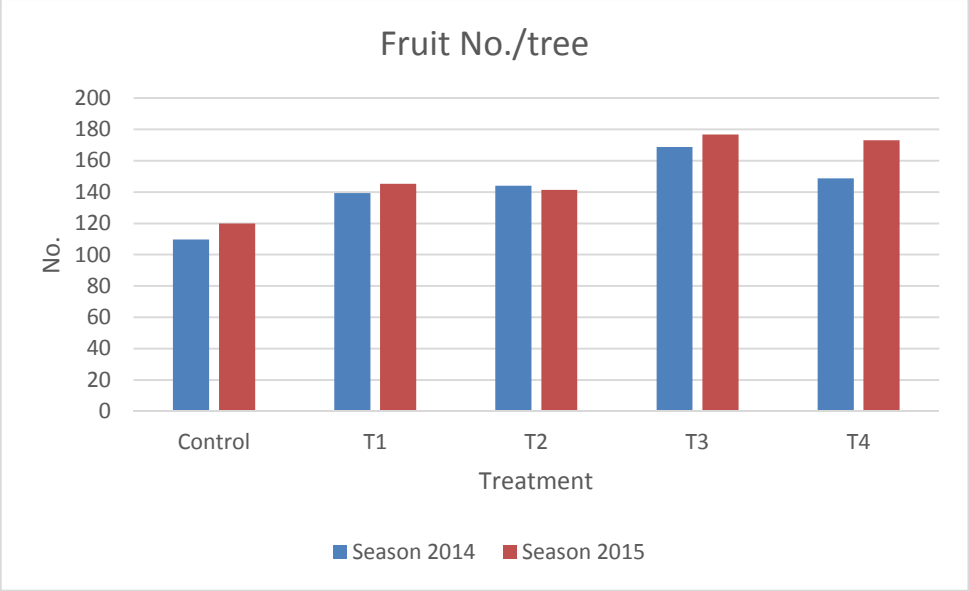

Fig. 1: Effect of treatments on Fruit No./tree of Le-cont pear trees in seasons (2014 & 2015).

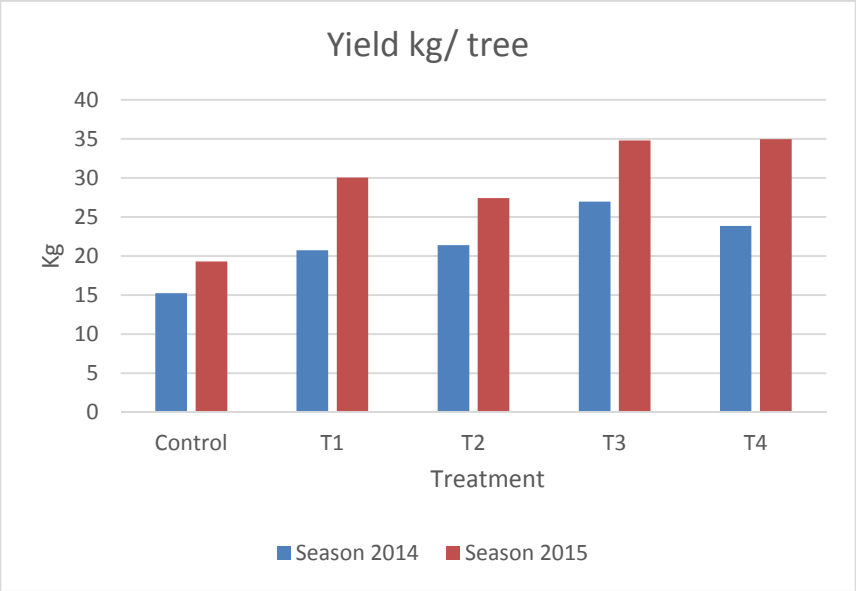

Fig. 2: Effect of treatments on yield kg/ tree of Le-cont pear trees in seasons (2014 & 2015).

With respect of tree yield data presented in table 4. and illustrated by figures (1&2) cleared that, both (N.M.C. 3 kg + magnetite 0.5 kg + Fe So_4 200 g) / tree and (NMC 3 kg + magnetite 0.5 kg + Fe so_4 300 g) / tree treatments gave significantly the highest tree yield (as number and weight of fruits) / tree in the both studied seasons. Whereas, other treatments showed intermediate values with insignificant differences in the 1st season and have significant in the second season. In addition, the control was significantly gave the lowest values of both number and kg fruit yield / tree in the two seasons.

Data in table (5) showed the effect of treatments on some physical fruit characteristics of Le-cont pear tree in 2014 & 2015.

The presented data indicated that both of (N.M.C. 3 kg + magnetite 0.5 kg +$FeSo_4$ 200 g) / tree and (N.M.C. 3 kg + magnetite 0.5 kg + $FeSo_4$ 300 g) / tree treatments were significantly the greatest fruit weight in the 1st season (159.8 &160.3 g) respectively . Whereas, (N.M.C. 3 kg + magnetite 0.5 kg) / tree gave the highest fruit weight with the same effect of treatment (N.M.C. 3 kg + magnetite 0.5 kg +$FeSo_4$ 300 g) / tree and with significant differences with the other treatments and control in the 2nd season . As for the fruit (size, width and length), data gave the fruit weight trend.

Table 5: Effect of natural minerals compound (N.M.C) , magnetite raw and Ferros sulfates soil applications on some physical fruit characteristics of Le-cont pear tree in 2014 & 2015.

Treatment	Fruit weight (g)		Fruit size (cm^3)		Fruit width (cm)		Fruit length (cm)		Fruit firmness ($Lb/inch^2$)	
	Seasons									
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T_1	148.8 B	206.9 A	148.0 B	205.0 A	6.17 B	6.87 A	7.57AB	9.60 A	17.08 C	18.91 B
T_2	148.7 B	194.1 C	148.9 B	194.0 C	6.27 AB	6.83 A	7.57 AB	8.53 AB	16.07 C	18.64 BC
T_3	159.8 A	196.9 BC	158.5 A	197.8 BC	6.43 A	6.60 B	7.47 A	8.53 AB	18.01 B	17.68 C
T_4	160.3 A	202.1 AB	159.7 A	201.7 AB	6.33AB	6.57 B	7.83 A	8.9 AB	17.37 BC	16.66 D
T_5	139.0 C	160.9 D	128.2 C	164.1 D	5.73 C	6.03 C	7.10 C	7.93 B	19.29 A	20.66 A

Means having the same letter(s) in each colum are statistically insignificant at 5% level.

T1 (N.M.C. 3 kg + Magnetite 0.5 kg) /tree
T2 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 100 g) /tree
T3 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 200 g) /tree
T4 4 - (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 300 g) /tree
T5 5 - Control

Concern the fruit firmness it was cleared that the control treatment has significantly the greatest fruit firmness (19.29 and 20.66 $Lb/inch^2$) in compared to other treatments in the both seasons. On contrary both (N.M.C. 3kg + magnetite 0.5 kg + Fe So_4 100g) / tree and (N.M.C. 3 kg + Magnetite 0.5 kg) /tree in the 1st season and (N.M.C. 3g + magnetite 0.5 kg + $FeSo_4$ 300g) / tree in the 2nd season gave significantly the lowest values.

Table (6) the effect of treatments on some chemical fruit characteristics of Le-cont pear tree in 2014 & 2015.

As for chemical fruit characteristics, data presented in Table (6) revealed that (N.M.C. 3kg + magnetite 0.5 kg) / tree gained the greatest flesh vitamin C (ascorbic acid) with a significant differences when compared to other treatments in the 1st season and (N.M.C. 3 kg + magnetite 0.5 kg + Fe So_4 300g)/ tree induced the highest vitamin C contents without a significant differences with the other treatments in the 2nd season of this study .On the other hand, the control treatment gave the lowest significant value in the both seasons.

With respect flesh total acidity percentage data cleared that the control treatment gave the highest flesh total acidity percentage in compared to other experimental treatments which they have significantly reduced it in the both seasons. Moreover TSS data illustrated that (N.M.C. 3kg + magnetite 0.5 kg + $FeSo_4$ 200g)/tree in the 1st season and (N.M.C. 3kg + magnetite 0.5 kg + $FeSo_4$ 300g)/tree in the both seasons gave the highest TSS percentage. While, other treatments gave intermediate values. In addition, Trees treated with (N.M.C. 3 kg + magnetite 0.5 kg) / tree treatment significantly increased TSS/ acid ratio in the 1st season and (N.M.C. 3 kg + magnetite 0.5 kg + $FeSo_4$ 300g) / tree in the 2nd season.

Table 6: Effect of natural minerals compound (N.M.C) , magnetite raw and Ferros sulfates soil application on some chemical characteristicl of Le-cont pear fruits in seasons (2014 & 2015).

Treatment	Ascorbic acid (mg /100g)		Acidity (%)		TSS (%)		TSS/acidity ratio	
	Seasons							
	2014	2015	2014	2015	2014	2015	2014	2015
T_1	2.99 A	2.62 A	0.412 D	0.469 B	12.33 C	13.17 B	45.75 A	28.03 C
T_2	2.24 B	2.62 A	0.494 C	0.421 BC	13.60 B	13.17 B	37.35 AB	31.27 C
T_3	2.01 B	2.71 A	0.498 C	0.372 BC	14.47 A	13.97 B	32.79 AB	36.66 B
T_4	1.96 B	3.08 A	0.521 BC	0.276 C	14.07 AB	15.00 A	28.59 BC	52.08 A
T_5	1.02 C	1.95 B	0.715 A	0.722 A	11.87 C	12.17 C	16.63 C	17.72 D

Means having the same letter(s) in each colum are statistically insignificant at 5% level.

T1 (N.M.C. 3 kg + Magnetite 0.5 kg) /tree
T2 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 100 g) /tree
T3 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 200 g) /tree
T4 4 - (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 300 g) /tree
T5 5 - Control

Table (7): showed the effect of treatments on: Leaf chlorophylls content, total carbohydrate % and Ash % .

In this regard, data presented in the Table (7) displayed cleared that all N.M.C. plus Magnetite applications with or without Ferros sulfate treatments significantly improved Le-Cont pear which budded on *Pyrus calleryana* rootstock leaf chlorophylls, total carbohydrates and ash % contents without a significant differences between them and with a significant differences when compared to the control treatment during the two seasons.

Table 7: Effect of natural minerals compound (N.M.C) , magnetite raw and Ferros sulfates soil application on leaf chemical characteristics of Le-cont pear trees in the two seasons (2014 & 2015).

Treatment	Total chlorophyll (SPAD)		Total carbohydrates (%)		Ash (%)	
	Seasons					
	2014	2015	2014	2015	2014	2015
T_1	46.41 A	51.75 A	29.29 A	32.34 A	8.47 A	9.68 A
T_2	47.00 A	50.11 A	31.42 A	33.29 A	8.31 A	9.44 A
T_3	46.73 A	50.10 A	29.57 A	31.86 A	8.28 A	9.70 A
T_4	47.52 A	51.27 A	30.32 A	31.90 A	8.36 A	9.86 A
T_5	40.70 B	40.00 B	18.72 B	20.88 B	6.52 B	7.12 B

Means having the same letter(s) in each colum are statistically insignificant at 5% level.

T1 (N.M.C. 3 kg + Magnetite 0.5 kg) /tree
T2 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 100 g) /tree
T3 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 200 g) /tree
T4 4 - (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 300 g) /tree
T5 5 - Control

Data in table (8): showed leaf macro-elements nutrient content. Generally, data tabulated in this table disclosed revealed that N.M.C. + Magnetite applications with or without Ferros sulfate treatments significantly improved Le-Cont pear which budded on *Pyrus calleryana* rootstock leaf content : N , P , K , Ca and Mg % during the studied seasons .

Leaf Nitrogen content, third treatment (N.M.C. 3kg + Mgnetite 0.5kg + Fe So_4 200 g) / tree significantly gave the highest leaf N percent than the second treatments and control in the first season, but in the second season both first and fourth treatments (N.M.C. 3kg + Mgnetite 0.5kg)/ tree and (N.M.C. 3kg + Mgnetite 0.5 kg + Fe So_4 300 g) / tree gave the highest significant values. On the other hand, the control treatment gave the lowest values. Leaf phosphorus content, all treatments showed higher significant values than control in the first season. In the second season fourth treatment (N.M.C. 3kg + Mgnetite 0.5kg + Fe So_4 300 g) / tree recorded highest significant value. In contrary, the control treatment gave the lowest values.

Table 8 : Effect of natural minerals compound (N.M.C), magnetite raw and Ferros sulfates soil application treatments on leaf content of macronutrients of Le-cont pear tree in 2014 & 2015.

Treatment	N		P		K		Ca		Mg	
	(%)									
	Seasons									
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T1	2.83 AB	3.00 A	0.36 AB	0.42 B	1.42 AB	1.54 A	2.49 B	3.48 A	0.17 B	0.45 A
T2	2.48 B	2.42 BC	0.39 A	0.48 B	1.55 A	1.40 B	2.27 C	2.91 B	0.16 B	0.38 B
T3	2.93 A	2.79 B	0.39 A	0.47 B	1.34 B	1.56 A	2.29 C	2.33 C	0.22 A	0.32 B
T4	2.73 AB	3.00 A	0.38 A	0.57 A	1.60 A	1.39 B	2.62 A	3.20 AB	0.22 A	0.36 B
T5	1.95 C	2.17 C	0.31 B	0.34 C	1.13 C	1.21 C	1.91 D	1.32 D	0.14 B	0.25 C

Means having the same letter (s) in each column are statistically insignificant at 5% level.

T1 (N.M.C. 3 kg + Magnetite 0.5 kg) /tree
T2 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 100 g) /tree
T3 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 200 g) /tree
T4 4 - (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 300 g) /tree
T5 5 - Control

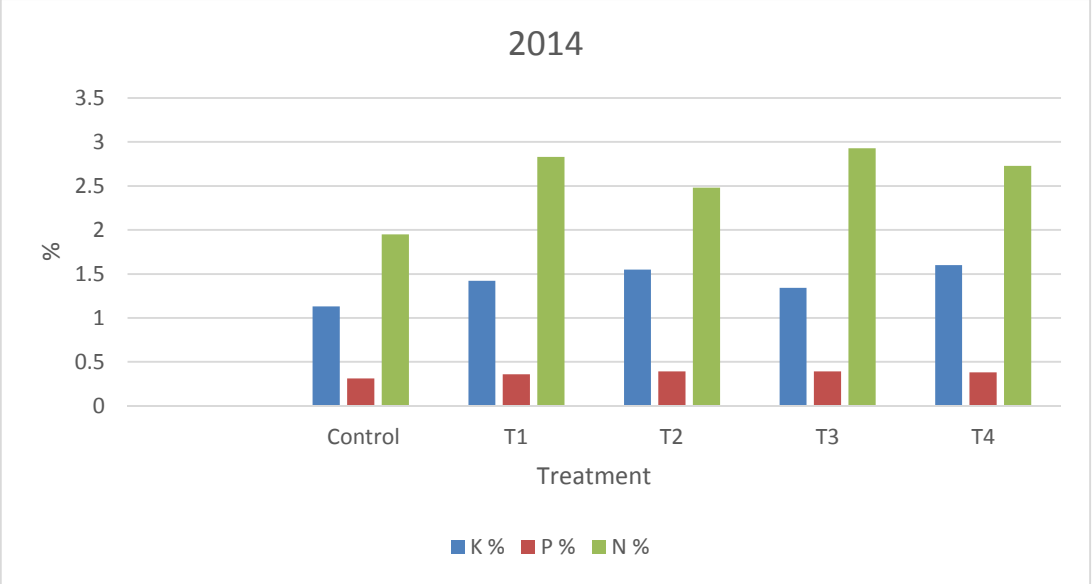

Fig. 3: Effect of treatments on leaf content of NPK% of Le-cont pear trees in season 2014 .

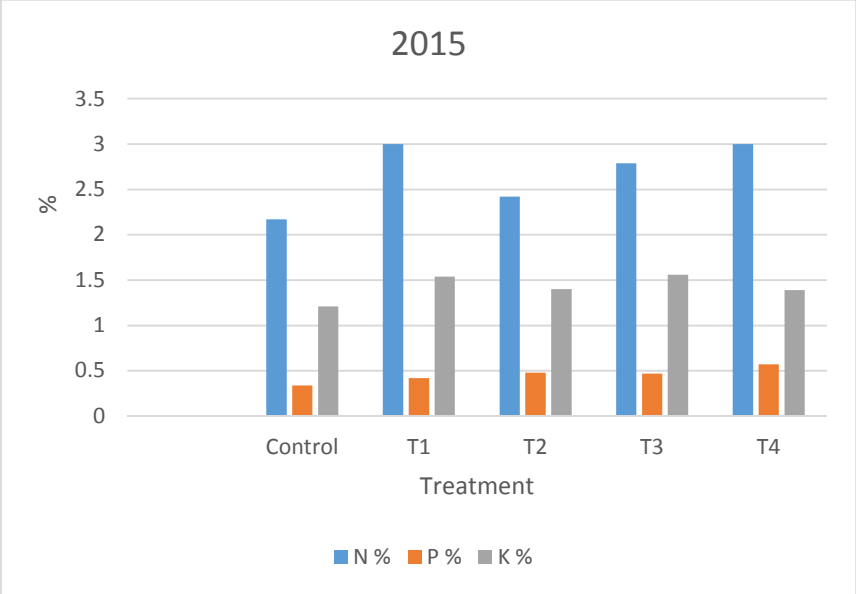

Fig. 4: Effect of treatments on leaf content of NPK% of Le-cont pear tree in season 2015 .

Leaf potassium content: Natural Minerals Compound and Mgnetite raw applications with or without Ferros sulfate treatments had a fluctuated effect on leaf Potassium contents during the two seasons. Whereas, fourth treatment in the 1st season gave highest value without significant differences between the first treatment but in the 2nd season the first and the third treatments showed highest significant values of leaf K contents. Also, the control treatment was the lowest significant value for both seasons. Data presented of NPK results were illustrated by figures (3&4) in 2014 & 2015 seasons.

As for leaf calcium content data showed the same trend of leaf potassium content. So that the fourth treatment in the 1st season and first treatment in the 2nd season were significantly the highest leaf Ca% content . Also, the control treatment ranked in the fewest leaf Ca content in both seasons.

Leaf magnesium data illustrated that (N.M.C. 3 kg + magnetite 0.5 kg + $FeSo_4$ 300g) / tree applications significantly increased leaf Mg content when compared to other treatments. The control was the lowest significant value in both seasons.

With the similar results in leaf micro-elements content, data in table (9) demonstrated the effect of treatments on the level for the all micro- elements. In the control trees recorded the fewest Fe both seasons values with a significant differences among all of treatments while the highest iron (Fe) level

for (N.M.C. 3 kg + magnetite 0.5 kg) / tree (296.0 & 357.9 ppm) in the both seasons respectively with a significant differences among the other treatments. Values of Fe illustrated by figure (5) in seasons 2014 & 2015.

Data of leaf zinc content indicated that all N.M.C. and Magnetite with or without Ferros sulfate treatments positively improved leaf Zn contents in both seasons special first treatment (N.M.C. 3 kg + magnetite 0.5 kg)/tree recorded the superior values (30.4 & 37.20 ppm) in the both seasons respectively without significant differences among other treatments and with significant differences with control .

In a differ trend for leaves content of manganese (Mn ppm) data cleared that, (N.M.C. 3kg + Mgnetite 0.5kg + Fe So_4 200 g) / tree and (N.M.C. 3kg + Mgnetite 0.5kg + Fe So_4 300 g) / tree in the first season but (N.M.C. 3kg + Mgnetite 0.5kg) / tree in the second season indicated the greatest significantly increased leaf Mn content, while other experimental treatments had intermediate effect in the two studied seasons.

Table 9: Effect of natural minerals compound (N.M.C) , magnetite raw and Ferros sulfates soil application treatments on leaf content of micronutrients of Le-cont pear tree in 2014 & 2015.

Treatment	Fe		Zn		Mn	
	(ppm)					
	Seasons					
	2014	2015	2014	2015	2014	2015
T_1	196.0 A	217.0 A	30.4 A	37.20 A	16.52 B	45.00 A
T_2	148.0 D	169.6 C	30.20 AB	34.84 A	16.48 B	37.66 B
T_3	166.5 C	206.2 B	28.30 B	38.84 A	23.29 A	32.34 B
T_4	182.7 B	207.6 B	29.98 AB	35.50 A	22.0 A	35.51 B
T_5	104.2 E	115.0 D	25.97 C	27.56 B	13.80 B	25.68 C

Means having the same letter(s) in each colum are statistically insignificant at 5% level.

T1 (N.M.C. 3 kg + Magnetite 0.5 kg) /tree
T2 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 100 g) /tree
T3 (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 200 g) /tree
T4 4 - (N.M.C. 3 kg + Magnetite 0.5 kg + $FeSo_4$ 300 g) /tree
T5 5 - Control

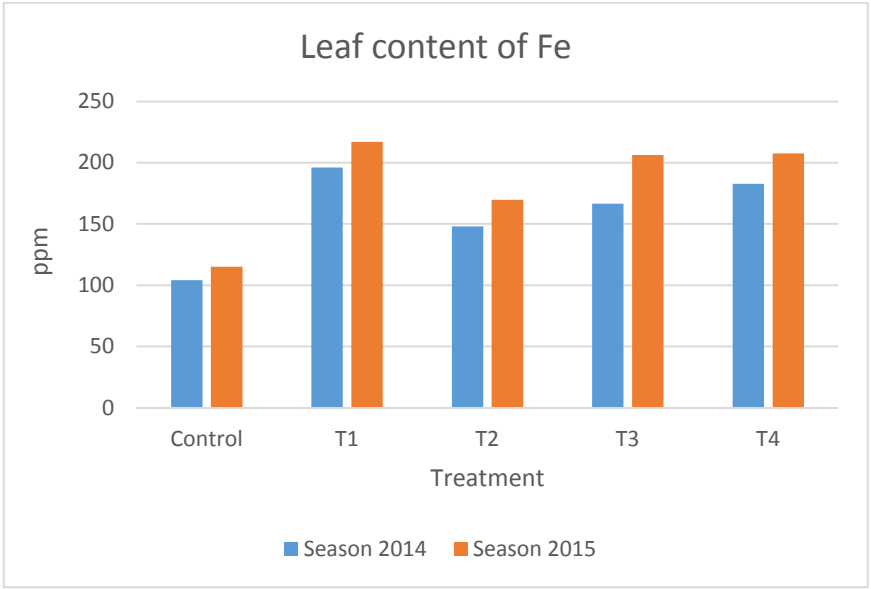

Fig. 5 : Effect of treatments on leaf content of Fe micronutrient of Le-cont pear tree in seasons 2014 & 2015.

Discussion

From the above mentioned results it could be concluded that, the improvement of Le-Cont pear budded on *Pyrus calleryana* rootstock tree growth, blooming, fruit set, leaf chemical contents

and fruit yield and quality due to the use of Magnetite iron raw and natural minerals compound (N.M.C.) as a raw material contains a lot of essential element in the first silicon element (Si) which is considered the major component in this raw material. Also it is noticeable that high trend of the results values in the second season may be due to the benefit accumulative effect of the present treatments. These results are agreement with those obtained by Matichenkov *et al*. (1995), who indicated that soil treatment with silicon optimizes soil fertility through improved water, physical and chemical soil properties while maintaining nutrient in plant-available form which is reflected on fruit yield. Abdel Rahman, (2009) who found that the use of Natural Minerals Compound as a soil application increased the yield of Navel orange trees. In this respect, Taha *et al*., (2011) the highest significant increase in yield appeared under the highest dose of Magnetite treatments application which improved elements uptake in the root area horizental, Ibrahim and Al-Wasfy (2014) working on potassium silicate reported that these treatments can result in good growth and a high yield .

Also, These results are in harmony with those reported by Waterkeyn *et al*. (1982), whom mentioned that, silicon is accumulated primarily in epidermal tissue both in roots and leaves as polymerized Silica-gel and is associated with pectin and calcium ions .In addition, Natural Minerals Compound treatments increased fruit size which may be attributed to that silicon increase the absorption of potassium which maintains the plant water status. Moreover Kaya *et al*. (2006) and Hoda *et al*. (2013) whom reported that, the presence of silicon may result in better supply of potassium. Also, silicon could earlier the harvest date by increasing fruit TSS/ acid ratio and Vitamin C and to decrease fruit acidity.

These results are in agreement with those obtained Wutschr, (1989) ; Matichenkov *et al*. (2001) and Kaya *et al*. (2006) ,whom revealed that, trees treated with silicon (Si) absorbed more nutrient than the untreated trees. Also, application of (Si) influenced not only silicon nutrition of the trees, but also, optimized other plant micronutrient nutrition aspects and the presence of Si may result in better of supply of (K). However, other investigators have reported similar results.

Also, Helail *et al.* (2003) showed that, the alternative use of natural elements compound with organic manure improve soil physical and chemical properties as well as increase nutrient availability. Moreover, Sorrenti *et al.* (2011) successfully used Fe-chelate to prevent Fe-chlorosis on pear trees.

In addition (Atalla *et al.* 2010) reported that the main target of using natural raw mineral mixture and magnetite raw in feeding Le-Cont pear trees is to produce a suitable fruit yield of good quality with reducing the cost without harming the environment or the human's health comparing to the traditional methods in fertilization that depended basically and for a long time on chemical fertilizer have got side effect on the soil and environment, eventually on human because it caused diseases.

The Economic Study:

In the economic study of yield production, the main economic criteria were cost of each substance (Natural Minerals Compound , Magnetite and Ferros sulfate) that used under study (L.E / fed.), cost of labor and mineral fertilizer that used in control treatment (L.E / fed.). Results are given in Table (10). Other expenses such as the costs of supervision and royalties were not taken into consideration in this study. In more details unite price of Natural Minerals Compound was (1.00 L.E / kg), unite price of Magnetite (4.00 L.E/kg) , unite price of $FeSO_4$ (2.00 L.E/kg) and unite price of micro elements installation NPK 19 - 19 - 19 + TE soluble fertilizer (16 L.E/kg). The study also revealed that the cost of labor that were used per treatment and thus the total costs were calculated. And finally the cost over control for each treatment / fed. was calculated. From this economic study it could be noticed that, increasing the final cost of N.M.C., Magnetite and Fe So_4 as comparison with the conventional production (control treatment), while, in spite of the price of Natural raw materials is usually lower than the price of conventional fruit production ,but it has more net profit return for producers , safe food and gave a high fruit quality.

From this table it is cleared that all treatments from T1 to T4 increased the total income/feddan LE than control treatment by 8250, 9250, 17600 and 12900 LE/fed. respectively in 1 st season and 16100, 12150, 23150 and 23400 LE/fed. respectively in 2 nd season that due to increasing in the yield of trees of these treatments than the control treatment.

Table 10: Economic study for using N.M.C., Magnetite and Ferros sulfate and chemical fertilizers for the control applications on yield of Le-Conte" pear trees.

Treatment	*Average cost LE/Fed.	**Tree yield Ton/fed.		*** Total income / feddan LE	
		2014	2015	2014	2015
T1	1500	6.22	9.02	31100	45100
T2	1740	6.42	8.23	32100	41150
T3	1980	8.09	10.43	40450	52150
T4	2220	7.15	10.48	35750	52400
Control	2640	4.57	5.80	22850	29000

**(Wight of materials tree × Times of addition) × price of each material*
*** Fruit yield kg/tree × No. of trees/Fed. (300 tree)*
****Price of one kg. pear fruit in the farm (5 LE) × tree yield ton/fed.*

Reference

A.O.A.C., 1995. Official methods of Analysis, 16th ed. Association of analytical chemists Arlington, Virginia U.S.A.

Abdel Rahman, M., A.El-Metwally and Y.Ibrahim, 2009. Effect of Natural Minerals Compound Applications on Citrus Trees and Seedlings Production. Egypt. J. Appl. Sci., 24 (10A), 293-307.

Asaad, Samia, A., Magda M. Nasr, Wesam A. Nabil and Saad Elshall, 2014. Role of humic acid and some micronutrients for solving chlorosis problem in Le-Conte pear trees budded on pyrus calleryana. J. Biol. Chem. Environ. Sci., 9(4), 201-223.

Atalla Eman, S., W.M.Abd El-Messeih and G.B.Mikhael, 2010. Using of Natural Raw Material Mixture and Magnetite Raw (Magnetic Iron) as Substitute for Chemical Fertilizers in Feeding " Le Cont " pear trees planted in Calcareous soil. Alex. Sci. Exchange J., 31(1): 51-61.

Bleasdale, L.K.A., 1978. Plant physiology in relation to horticulture. ELBS. Edition. The Macmillan press LTD. Associated companies in Delhi, Hong Kong Lagos and Singapore.

Bokszczanin, K., P.Krajewski, M.Schollenberger, A. A.Przybyla and S.Odziemkowski, 2007. Susceptibility of pear hybrids to fire blight. (Polish) progress in plant protection, 47 (2): 48 - 54.

Creswell, T. C., G. E.Ruhl, M. C.Aime, J. L. Beckerman and M. Abbasi, 2016. First report of rust disease of Bredford pear caused by Gymnosporangium clavipes. Plant Disease, 100 (4): 860.

Culley, Theresa M., Hardiman, Nicole, A. and Hawks, Jennifer, 2011. The role of horticulture in plant invasions: how grafting in cultivars of Callery pear (*Pyrus calleryana*) can facilitate spread into natural areas. (Article). Biological Invasions. 13 (3): 739 - 746.

Cuttenie, A., 1980. Soils plant testing as a basis of fertilizer recommendation. FAO soil Bull., 3812.

Dubois, M., F. Smith, K.A. Gilles, J.K. Hammilton and P.A. Robers, 1956. Colorimetric method to determination of sugar and related substances: Anal. Chem. 28 (3): 350-356.

El-Azzouni, M.M., F.I. Abd El.Latif and E.A. Kenawi, 1975. Determination of maturity in pear cultivar Le_Conte, Shoubra and Pine apple. Arch. Gartenban, 23 (8) : 483 – 489 .

El-Shazly; S.A., A. A. El-Gazzar, E.M. Soliman, A.A. Abd El-Hafez, G.F. Abd El-Rahman and Sanaa M. Mohamed, 2015. Effect of natural minerals compound, organic and some bio-fertilizers Application on yield, fruit quality and leaf mineral content of Balady mandarin trees. Egypt, J. Hort.,42(1):211 - 230.

Garcia, L.P., A. Alvarez, F;J. Abadia; A. Abadia (2002): Foliar application of acids with and without FeSO4 to control iron chlorosis in pear. Acta Horticulturae, (594): 217 - 222.

Hansen, N.C., M.A. Schmitti, J.E. Anderson and J.S. Strock, 2003. Iron Deficiency of soybean in the Upper Midwest and Associated soil properties. Agronomy Journal. 95:1595 - 1601.

Helail, B.M., Y.N. Gobran and M.H. Moustafa, 2003. Study on the effect of organic manure source, method of organic manure application and bio-fertilizers on tree growth and leaf mineral content of Washington Navel orange trees. Egypt, J. Apl. Sci., 18 (4 A), 270 - 296.

Hoda, M. Mohamed, Faten A. Al-kamar and Azza A. M. Abd-Elall, 2013. Effect of Magnetite and Some Bio-fertilizers Application on Growth and Yield of Valencia Orange Trees Under El–Bustan Condition. Nat. Sci., 11(6), 46-61.

Ibrahim, H.I.M. and M.M. Al-Wasfy, 2014. The Promotive Impact of Using Silicon with Potassium and Boron of Fruiting of Valencia Orange Trees Grown Under Minia Region Conditions. World Rural Observations, 2, 28-36.

Jackson, N.L., 1958. Soil chemical analysis. Constable, Ltd. Co., London, pp. 498.

Jackson, M.L. and L. Ulrich, 1959. Analytical methods for use in plant analysis. Coll. Agric. Exp. State. Bull. 35 - 66.

Jiang Xueli, Shi Feng Hou, Shen YongBao, Zhong Lei, Lu Ke Cheng, 2015. Protection and exploitation of *Pyrus calleryana* resources (Chinese). Jiangsu Agricultural Sciences; 43 (3): 162 - 165.

Kaya, C., L.Tuna, and D.Higgs, 2006. Effect of silicon on plant growth and mineral nutrition of maize grown under water- stress conditions. J. Plant Nutr., 29, 1469- 1480.

Li Xuan, Sun Quan, Zhao Hui, Lu XinMin, Feng Tie and Wei Jun, 2011. Effects of rootstocks on dormancy of leaf buds in pear trees and its relation to polyamine metabolism. Plany physiology Journal; 47 (5): 463 - 467.

Lu XinMin, Zhu Xia, Zhao Hui, Li Xuan and Wei Jun, 2011. Effect of dormancy releasers on bud dormancy breaking in pear species (Chinese). Journal of Yangzhou University, Agricultural and Life Sciences Edition 32 (2): 77 - 80.

Ma Chun, Hui, K. Tanabe, A.Itai, F.Tamura, Chun Jong Pil and Teng YuanWen, 2005. Tolerance to lime-induced iron chlorosis of Asian pear rootstocks (*Pyrus* spp.). Journal of the Japanese Society for Horticultural Science; 74 (6) 419 - 423.

Matichenkov, V.V., D.L. Pinsky and E.A. Bocharnikova, 1995. Influence of mechanical compaction of soils on the state and form of available silicon. Eurasian Soil Sci., 27 (12), 58-67.

Matichenkov, V.V., E.A. Bocharnikova and D.Calvert, 2001. Response of citrus to silicon soil amendments. Proc. Fla. State Hort. Soc., 114, 94- 97.

Mika, A., E. Makoziz Pasiut, and Gasparsk, (1982):Results of trials on the pruning of bearing apple trees. Prace Institute Sandownictwa I. Kwiaciarstwa W.Skierniewicach, A. 22, 33-42(Hort. Abst.52(6):3541)

Mortvedt, J.J., 1991. Correcting iron deficiencies in annual and perennial plants: present technologies and future prospects. Plant soil, 130: 273 - 279.

Piper, C.S., 1950. Soil and plant analysis. Inter. Sci., Pulp, New York, pp. 368.

Plummer, D.T., 1971. An introduction to practical biochem. Published by Mc Graw Hill Book Company (U.K.) Limited.

R˘acuciu, M., A.; D.E. Creang˘a. b., and A. Airinei (2006): Citric - acid-coated magnetite nanoparticles for biological applications. Romania Received 10 August 2006 / Published online: 27 November 2006 - °c EDP Sciences / Societ`a Italiana di Fisica / Springer-Verlag 2006

Reimer, F.C., 1950. Development of blight resistant French pear rootstocks, stat. Bull. Ore. Agr. Exp. Sta., 24 : 485.

Sanz, M., J. Cavero and J. Abadia, 1992. Iron chlorosis in the Ebro river basin, Spain, J. Pant Nutr., 15, 1971- 1981.

Snedecor, G.W. and W.G. Cochran, 1990. Statistical method. 6th ed. The Iowa State Univ. Press, Iowa, U.S.A. p. 593.

Sorrenti, G., M.Toselli and B.Marangoni, 2011. Effectiveness of *Amaranthus retroflexus* L. aqueous extract in preventing iron chlorosis of pear trees (*Pyrus communis* L.). Soil Science and plant Nutrition, 57(6): 813 - 822.

Stebbins, R., 1995. Choosing pear rootstock for the Pacific Northwest. Pacific Northwest. Extension Publication Washington, Oregon and Idaho State Universities Cooperative Extension Servis: 89 (341).

Waller, A. and D.B. Duncan, 1969. Multiple range and Multiple test. Biometrics, 11:1 - 24.

Waterkeyn, L., Bientait, A. and Peeters, A. (1982) Callose et silice epidermiques rapports avec la transpiration culticulair. *La Cellule,* 73, 263-287.

Wutschr, H.K. (1989): Growth and mineral nutrition of young orange trees grown with high levels of silicon. HortScience, (24) 275-277.

Yamada, K., C. Uematsu and H. Katayama, 2015. Pear (*Pyrus* L.) genetic resources from northern Japan: organoleptic evaluation of ornamental pear trees. Acta Horticulturae; (1094): 117 - 122.

Yoshida, S., D. A. Forno, J.H. Cock and K.A. Gomez, 1972. Laboratory manual for physiological studies of Rice. The International Rice Research Institute, Lose Banos, Philippines.