

EVALUATION OF LE-CONTE PEAR SEEDLINGS ON DIFFERENT ROOTSTOCKS IN THE NORTH MIDDLE NILE DELTA REGION

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ABSTRACT: *The present investigation was carried out during the two successive growing seasons 2014 and 2015 at Sakha Horticultural Research Station Farm, Kafr EL-Sheikh Governorate, in North Middle Nile Delta, Egypt, to evaluate the impact of three pear rootstocks (*Pyrus communis*, *Pyrus beutilifolia* and *Pyrus calleryana*) on counteracting the adverse effects of heavy clay soil affected with saline alkaline in the North Middle Nile Delta region on growth, leaf water relations and mineral contents of the widespread pear cv. in Egypt namely "Le Conte". The main results can be summarized as follows:*

*Pear plants budded on *P. beutilifolia* or *P. calleryana* rootstock significantly increased most of growth parameters (plant height, stem diameter growth percentage, total shoot lengths, leaf area, and specific leaf weight) and leaf photosynthetic pigments content (chlorophyll A and B). With regard to leaf total water and free water content, plants grown on *P. beutilifolia* rootstock gave the highest values followed by those budded on *P. calleryana* in this respect. On the contrary, bound water content and water deficit percentage were increased in plants budded on *P. communis*. With respect of proline content *P. communis* rootstock had significantly higher values while *P. calleryana* recorded lowest values. Pear plants budded on *P. calleryana* rootstock had the right leaf-N content, while the right leaves in P, Na and Cl content recorded by plants budded on *P. communis*. However, K percentage was increased in pear leaves which budded on *P. beutilifolia* a followed by *P. calleyana* rootstock. These results suggested that, *P. beutilifolia* may have a salt exclusion mechanism in the root, and this character is maintained even if scion cultivars were budded. Therefore, *P. beutilifolia* rootstock followed by *P. calleryana* are a useful rootstocks for pear cultivation under saline alkaline conditions than the *P. communis* rootstock.*

Key wards: *Le Conte" pear, vegetative growth, salinity, water relations, leaf mineral content.*

INTRODUCTION

"Le Conte" is the main pear cultivar that widely grown in Egypt. It is well known that several factors affect the productivity of pear trees, i.e. rootstock and salinity. Salinity is one of the most brutal environmental factors limiting the productivity of crop plants because most of the crop plants are sensitive to salinity caused by high concentration of salts in the soil, and the area of land affected by it is increasing day by day. For all important crops, average yields are only a fraction – somewhere between 20% and 50% of record yields, these losses are mostly due to drought and

high soil salinity (Shrivastava and Kumar, 2015). In Egypt, approximately 0.9 million ha. (2.1 million Fed.) Suffer from salinization problems in the cultivated irrigated areas. Furthermore, 60% of the cultivated lands in the Northern Delta, 20% of the Southern Delta and Middle Egypt, and 25% of the Upper Egypt regions are all salt-affected (Abdel-Hafez, 2011). Salinity can negatively affect plants through three limited components: osmotic, nutrients and toxic stresses (Lauchli and Epstein, 1990 and Munns, 1993). When exposed to salinity, growth and development tend to decline, with consequent reduction in their economic

value. Pear trees are generally sensitive to salinity (Francois and Maas, 1994) and are damaged by exposure to relatively low salinity for long periods (Okubo *et al.*, 2000). Important factor influencing pear productivity is rootstocks. Most fruit trees are commonly propagated on rootstocks, rather than begin grown on their own roots. The selection of a suitable rootstock is a significant economic factor in fruit culture (Wheaton *et al.*, 1991). In pears, using the rootstocks showed significant growth and scion contents of nutrient elements (Robbani *et al.*, 2006 and Ma *et al.*, 2005) and are important factors in the salt tolerance of fruit crops, which are sensitive to salinity and susceptible to toxic effects of Na and Cl (Mass and Hoffman, 1977).

The present study carried out to evaluate growth, some physiological properties and leaf nutrient content of "Le Cote" pear seedlings budded on different rootstocks in the North Middle Nile Delta region condition, which soil are heavy clay soil affected with saline alkaline.

MATERIALS AND METHODS

This investigation was carried out

during the two successive growing seasons 2014 and 2015 at Sakha Horticultural Research Station Farm, Kafr EL-Sheikh Governorate, in North Middle Nile Delta, Egypt (The site is located at 31°07' N latitude and 30°57' E longitude with an elevation of about 6 meters above mean sea level), to study the tolerance of Le Conte pear seedlings budded on *Pyrus communis*, *Pyrus beutilifolia* and *Pyrus calleyana* rootstocks to salinity and alkalinity under Kafr EL-Sheikh Governorate conditions. The seedlings planted on heavy clay soil at 5×5 metre apart and irrigated by surface irrigation. Some chemical and physical characteristics for the experimental soil site were presented in Table (1 & 2). The metrological data of the studied period were presented in Table (3).

The selected trees were in a good health condition and uniform in vegetative growth. The used experimental design in this present study is randomized complete blocks with five replicates with six seedlings for each replicate. All agricultural practices were carried out according to the crop and the area.

Table (1): Some chemical characteristics for the studied soil at different depths.

Soil depth (c m)	pH	EC (ds/m)	SAR	Esp	Soluble cations (Meq/L)				Soluble anions (Meq/L)		
					Na ⁺	Ca ⁺²	Mg ⁺²	K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻
0-30	8.42	4.03	7.81	11.09	22.5	5.85	10.75	0.35	4.7	12.0	22.75
30-60	8.45	4.22	13.37	17.37	31.0	3.45	7.30	0.10	3.15	9.6	29.1
60-90	8.60	4.29	14.06	18.09	30.0	3.80	5.30	0.15	1.55	7.2	30.50
Mean	8.49	4.18	11.75	14.18	27.83	4.37	7.78	0.20	3.13	9.6	27.45

EC: were measured in the extract of soil paste at 25 C⁰, pH: soil water suspension (1:2.5)

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Table (2): Some physical characteristics and soil water constants for the studied soil at different depths.

Soil depth (cm)	Particle size distribution				K Cm/d	IR Cm/h	Soil moisture characteristics			Bulk Density (kg/m)
	Sand (%)	Silt (%)	Clay (%)	Soil texture			F.C (%)	WP (%)	AW (%)	
0-30	15.76	31.70	52.54	clayey	2.15	0.65	42.50	22.6	19.90	1.29
30-60	14.84	30.86	54.30				40.60	21.8	18.80	1.36
60-90	14.67	30.61	54.72				38.91	20.7	18.21	1.43
90-120	17.23	33.18	49.59				37.98	19.8	18.09	1.55
Mean	15.63	31.59	52.78				39.98	21.23	18.75	1.41

FC: Field capacity, WP: wilting point, AW: available water, IR: infiltration rate, K: hydraulic conductivity

Table (3): Mean of some metrological data for KafEl-Sheikh area during the two growing seasons.

month	T (C°)			RH%			Ws m/sec	Pan Evap. Mm/day	Rain mm
	Max	Min	Mean	Max	Min	mean			
Season 2014 *									
Jan	19.22	7.62	13.42	91.06	65.35	78.21	0.52	1.99	78.74
Feb.	20.68	8.88	14.78	89.89	64.04	76.97	0.73	2.89	-----
Mar.	24.56	12.45	18.51	79.48	50.84	65.16	1.03	4.46	-----
April.	26.04	15.87	20.96	74.20	43.90	59.05	1.11	5.30	8.40
May	31.43	21.85	26.64	75.03	45.78	60.41	1.20	6.35	0.00
June	32.44	23.97	28.21	74.63	51.27	62.95	1.34	6.61	0.00
July	32.32	24.31	28.31	79.57	54.70	97.14	1.28	6.11
Agus.	33.79	24.72	29.29	83.63	60.52	72.08	1.04	5.13	-----
Sep.	32.50	22.93	27.72	81.00	56.60	68.80	1.04	3.82	-----
Oct.	27.79	19.42	23.61	76.23	57.36	66.80	1.26	2.87
Nov.	25.39	15.14	20.27	87.00	64.43	75.72	0.80	2.28	0.00
Dec.	19.64	8.51	14.06	92.07	67.61	79.84	0.61	4.15	81.90
Season 2015*									
Jan	20.34	7.55	13.95	93.69	70.55	80.55	0.54	0.61	20.70
Feb.	20.64	8.19	14.42	91.90	67.15	79.53	0.79	2.52	16.50
Mar.	22.94	11.71	17.33	86.10	56.80	71.45	0.96	3.14	26.20
April.	27.50	15.53	21.52	81.80	49.80	65.80	1.07	4.91	20.20
May	30.47	19.57	25.02	77.20	48.60	62.90	1.14	5.87	0.00
June	32.65	20.60	26.63	86.23	52.30	69.27	0.95	6.56	0.00
July	33.15	23.64	28.40	83.19	55.11	69.15	1.13	7.73
Agus.	34.10	21.80	27.95	92.40	53.50	72.95	1.15	8.14	-----
Sep.	32.49	20.76	26.63	87.57	52.20	69.89	1.03	6.65	-----
Oct.	29.75	18.75	24.25	80.92	53.39	67.16	0.95	4.51
Nov.	24.30	13.79	19.05	87.80	60.50	74.15	0.78	2.77	24.60
Dec.	22.27	9.72	16.00	88.60	63.50	76.05	0.53	1.72	5.70

T: temperatures, RH: relative humidity, Ws: wind speed

*Source: meteorological station at Sakha 31 07' Nlatitude, 30 57 E longitude & with an elevation of about 6 meters above mean sea level (MSL).

Some soil physical properties, soil water constants and chemical Properties:-

The studied soil chemical characteristics such as soil reaction (PH) values were determined in 1:2.5 soil water suspension. Total soluble salts were measured by electrical conductivity (EC) apparatus in the saturated soil paste extract. Soluble cations and anions (Ca⁺⁺, Mg⁺⁺, Na⁺, K⁺, CO₃⁻, HCO₃⁻ and Cl⁻ as meq/L) were determined in soil paste extract (Jackson, 1973). SO₄⁻ as meq/L was calculated by the difference between cation and anions. Sodium adsorption ratio (SAR) was calculated according to this equation:

$$SAR = \frac{Na^+(meq/L)}{\sqrt{(Ca^{++} + Mg^{++})/2}}$$

$$ESP = 0.8843 + 1.4107(SAR) - 0.0133(SAR)^2$$

Where: Na⁺, Ca⁺⁺ and Mg⁺⁺ are soluble sodium, calcium and magnesium as meq/L, respectively.

The studied physical characteristics and soil water constants were determined according to the (Klute, 1986).

The following data were recorded in this study:

1. Vegetative growth:

Plant height (cm), total shoot length (cm), and 20 mature leaves were sampled in July to determine leaf area (cm²) by using a leaf area meter Model Li 3100 area- meter, and dry weight was recorded after drying at 70° C for 42 h., then specific leaf weight was calculated as mg/cm² according to (Ferree and Forshey, 1988). Stem diameter growth percentage calculated as follows:

Stem diameter growth (%) =

$$100 \times \frac{(final\ diameter - initial\ diameter)}{initial\ diameter}$$

2. Water relation studies of leaf:

Leaf samples were taken before irrigation for analysis. The samples were collected

usually at sunrise and taken to the laboratory in will tight plastic bags with moist cloth sheet. These prepared samples were used as described later for the following determinations according to the method described by (Gosev, 1960), and modified by (Koshnirinko *et al.*, 1970) for fruit trees during two seasons as follow:

2-1- Total water content:

Total water content was estimated by drying a known weight of the cleaned fresh green leaves in glass vials in an oven adjusted at 85 °C until constant weight, total water content was calculated by the equation :

$$Total\ water\ content\ (\%) = \frac{Fresh\ weight - dry\ weight}{Fresh\ weight} \times 100$$

2-2- Free water content:

Free water content was estimated by putting a known weight of cleaned green fresh leaves in a known volume of 60% sucrose solution for 2 hours, using "Penicillin" bottles. The initial and final concentration of the sucrose solution was measured by Abbi refractometer. Free water content was calculated by the equation:

$$X = \frac{A \times B}{C \times D} \times 100$$

Where:

X = the free water content of the leaves.

A = solution weight.

B= the difference between the initial and final concentration of the sucrose solution.

C = the fresh weight of the leaves

D= the final concentration of sucrose solution.

2-3- Bound water content:

Bound water content was calculated by subtracting free water content from total water content in each sample.

2-4- Water deficit:

10 discs about 1 cm² in diameter were cut from the mature leaves, weighted, flooded into distilled water for some hours

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until they attain equilibrium, reweighed and oven dried at 85°C for 24 hours to reach a constant weight. Water deficit were calculated as (Barrs, 1968) :

$$\text{Water deficit} = \frac{\text{Turgid weight} - \text{field weight}}{\text{Turgid weight} - \text{oven dry weight}} \times 100$$

3-Chlorophyll determination:

For Chlorophyll determination, discs about 1 cm² of the fresh leaf samples were dipped in 10 ml N,N-Dimethyl Form amide solution for 48 hours at 4°C in the dark. Chlorophyll concentration (as mg/cm²) fresh leaf was measured in the extraction colorimetric ally by using UV/visible spectrophotometer-LKB-Biochrom 4050 at 664 nm for chlorophyll-a and 647 nm for chlorophyll-b according to (Moran, 1982), chlorophyll was calculated (as mg/cm²) by using the following mathematic manipulation:

$$\text{Ch1-a} = 12.64 A_{664} - 2.99 A_{647}$$

$$\text{Ch1-b} = 5.6 A_{664} + 23.26 A_{647}$$

$$\text{Chl. Concentration (mg/cm}^2\text{)} = \text{ch1. a or b} \times \frac{\text{Solution volume}}{\text{Discs area}}$$

4- Leaf proline content:

The proline content was estimated in fresh leaves according to the method described by Batels *et al.*, (1973) and confirmed by Draz (1986).

5- Leaf mineral content:

Leaf samples consisted of 10 leaves each was collected from the tested pear trees on August of both seasons. Leaf samples were taken from the middle of the tagged shoots, washed several times with tap water, rinsed into distilled water and dried at 70 ° C to a constant weight. The dried leaves were ground and digested with sulphoric acid and hydrogen peroxide according to the method described by (Evenhuis and DeWaard, 1980). Suitable quantities were taken for mineral elements determination. Nitrogen and Phosphorus were determined colorimetrically according to (Evenhuis, 1976) and (Murphy and Riley,

1962), respectively. The contents of Na and K were determined by flame photometer E.E.L. Model (Jackson, 1967). The contents of Ca and Mg were determined by using versin (Chapman and Pratt, 1961). The content of Cl was estimated volumetrically as described by (Jackson, 1967), using silver nitrate and potassium dichromates reagents.

6- Statistical analysis:

Statistical analysis of the studied experiment was randomized complete block design and all data obtained throughout this present work were tested by analysis of variance (Little and Hills, 1998) and L.S.D test at 0.05 level was used for comparing between averages.

RESULTS AND DISCUSSION.

1-Vegetative growth parameters:

Data noticed from Table (4) showed plant height; stem diameter growth percentage and total shoot lengths of "Le-conte" pear young trees as affected by different rootstocks. There was significant variation among all rootstocks in both seasons. Pear plants budded on *P. calleryana* or *beutilifolia* gave the best effect on plant height; stem diameter growth percentage and total shoot lengths without significant differences between them compared to the lowest values recorded by the plants budded on *P. communis*. With respect to leaf area and specific leaf weight, data presented in Table (4) cleared that, there were significant differences obtained among rootstocks in both seasons. As for leaf area, plants grown on *Pyrus calleryana* stock gave the higher values than the other stocks in both seasons. However, the highest specific leaf weight recorded by *Pyrus beutilifolia*. The results of vegetative growth of this study generally indicated that pear trees were more vigorous on *Pyrus calleryana* or *beutilifolia* than on *P.communis*. These

results are in line with those obtained by Matsumoto *et al.*, (2006) and Abdel Aal (2009) found that the investigated growth traits were lower in "Le-Conte" grafted onto *Pyrus communis*, *P. calleryana* and *P. beutilifolia* in ascending order when irrigated by salinity water (50 mM NaCl), Salem *et al.* (2010) and Soliman (2010) mentioned that scions on *Pyrus calleryana* or *beutilifolia* had proved to be superior than on *P.communis* and appeared to be the most suitable rootstocks for "Le-Conte" pear cultivar during its early years of growth.

2- Leaf water relations characteristics:

Four physiological characteristics (total water content of leaf, free water content, bound water content and water deficit %) were investigating regarding their response

to effects of different rootstocks Table (5). With regard to total water content and free water content of leaf, data revealed that, plants grown on *Pyrus beutilifolia* followed by *Pyrus calleryana* gave the highest values in this respect compared to the lowest values resulted by plants grown on *Pyrus communis* in both seasons. On the contrary, bound water content and water deficit were increased in plants grown on *Pyrus communis* comparing with other rootstocks under study. The effect of the rootstocks on scion water relations were evaluated by Cohen and Naor (2002) on apple trees, Morsy (2003) on pear, Soliman (2010) on pear, Hemeed (2011) on grapevines. They showed that certain rootstocks are more efficient in water utilization than others may be due to better transpiration control and leaf anatomical structure.

Table (4): Effect of rootstocks on some growth measurements of pear transplants grown on saline alkaline heavy clay soil during 2014 and 2015 seasons.

Rootstocks	Plant height (cm)		Stem diameter growth (%)		Total shoot lengths (cm)		Leaf area (cm ²)		Specific leaf weight(mg/cm ²)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
<i>P. calleryana</i>	135	170	21.24	26.28	195.67	230.00	26.60	27.42	25.88	25.70
<i>P. communis</i>	120	149	19.28	22.26	180.33	209.00	24.60	25.74	26.25	25.22
<i>P. beutilifolia</i>	126	164	22.71	25.00	187.00	224.67	25.43	25.91	26.95	25.80
LSD at 5%	6.22	9.45	2.162	NS	1.853	14.495	0.640	0.640	0.239	0.036

Table (5): Effect of rootstocks on some leaf physiological properties of pear transplants grown on saline alkaline heavy clay soil during 2014 and 2015 seasons.

Rootstocks	Total water content (%)		Free water content (%)		Bound water content (%)		Water deficit (%)	
	2014	2015	2014	2015	2014	2015	2014	2015
<i>P. calleryana</i>	68.80	66.64	56.55	54.68	12.25	12.01	12.86	12.70
<i>P. communis</i>	63.85	65.56	49.73	52.25	14.12	13.31	13.22	13.30
<i>P. beutilifolia</i>	68.68	68.85	56.77	56.07	11.91	12.79	11.44	12.99
LSD at 5%	0.893	0.381	0.880	1.367	1.494	0.946	0.026	0.028

3- Leaf photosynthetic pigments and proline content:

Table (6) showed that chlorophyll A, B and total chlorophyll were affected by the rootstocks. Hence, both chlorophyll A and B were significantly higher with *Pyrus beutilifolia* followed in decreasing order by *P. calleryana* and *P. communis*. As for total chlorophyll, there were non-significant differences among the rootstocks in both seasons. The decline in photosynthetic pigments content of salt-stressed plants budded on *P. communis* might be due to the decrease in the absorption of minerals needed for chlorophyll biosynthesis specially under high soil pH, i.e., iron and magnesium (Poljakoff and Gale, 1975) or due to inhibition of chlorophyll syntheses. Such findings are in harmony with those reported by Abd El-Kader *et al.*, (2002), Darwesh (2006) Abdel Aal (2009), and Bosa *et al.*, (2014) on pear trees.

With regard to the effect of different rootstocks on proline content of leaves under salinity conditions, leaves of pear plants grafted on *P. communis* rootstock had significantly higher value of proline comparing with those budded on the rest rootstocks that take the second rank without significant differences between them in the second season. The increasing of proline content in leaves of pear plants budded on *P. communis* rootstock showed the low tolerant to salt stress compared to *P. calleryana* and *P. beutilifolia*. These results are confirmed by El-Sayed *et al.*, (1996) on olive trees, Abdel Aal (2009) and Soliman (2010) on pear trees found that the more sensitive pear rootstock to salinity was *P. communis*, while the most tolerance pear rootstocks to salt stress were *P. beutilifolia* and *P. calleryana*. These differences to salinity tolerance among the studied pear rootstocks may be mainly due to the ability of each rootstock to exclude both Na and Cl ions in the roots.

4- Leaf minerals content:

As for the effect of rootstocks on leaf mineral composition of salt stressed pear transplants, data obtained in Tables (7 and 8) revealed obviously that, pear plants budded on *P. calleryana* rootstock had statistically the richest leaves in N content, while the reverse was true with those budded on *P. communis* in both seasons. While the richest leaves in P, Na and Cl content recorded by plants grafted on *P. communis* but the other stocks take the second rank without significant differences between them. However, K percentage was increased in pear leaves, which budded on *P. beutilifolia* followed by *P. calleryana* rootstocks comparing with the lowest values obtained by plants budded on *P. communis*. As for leaves Ca content, data showed that plants budded on *P. communis* gave the highest value in the first season while in the second one plants budded on *P. calleryana* rootstock had statistically the richest leaves in Ca content compared to the lowest one resulted by *P. beutilifolia* in both seasons. Plants budded on *P. calleryana* or *P. beutilifolia* rootstocks gave the highest Mg content without significant differences between them. Such results are in general agreement with those obviously reported by Neilson and Kappel (1996) who reported that different rootstocks showed different ability to absorb ions, Matsumoto *et al.*, (2006) showed that leaf Na and Cl contents for *P. beutilifolia* rootstock were lower than those for *P. calleryana*, *P. pyrifolia*, *P. fauriei*, and *P. dimorphophylla* rootstocks grown under saline conditions. The Japanese pear 'Akibae' grown on *P. beutilifolia* exhibits a higher salt tolerance than those grown on *P. pyrifolia* and *P. calleryana*. These results suggested that *P. beutilifolia* may have a salt exclusion mechanism in the root, and this character was maintained even if scion cultivars were grafted. Therefore, *P. beutilifolia* is a useful rootstock for Japanese pear cultivation

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under saline conditions. In addition, Abdel Aal (2009) found that the more sensitive pear rootstock to salinity was *P. communis*, while the most tolerance pear rootstocks to salt stress were *P. beutilifolia* and *P.*

calleryana. These differences to salinity tolerant among the studied pear rootstocks may be mainly due to the ability of each rootstock to exclude both Na and Cl ions in the roots.

Table (6): Effect of rootstocks on leaf photosynthetic pigments and proline contents of pear transplants grown on saline alkaline heavy clay soil during 2014 and 2015 seasons.

Rootstocks	Chlorophyll (A) Mg/cm ²		Chlorophyll (B) Mg/cm ²		Total Chlorophyll Mg/cm ²		Proline (mg/gF.W.)	
	2014	2015	2014	2015	2014	2015	2014	2015
<i>P. calleryana</i>	0.860	1.030	0.260	0.273	1.123	1.306	0.171	0.164
<i>P. communis</i>	0.780	0.890	0.250	0.300	1.026	1.186	0.196	0.179
<i>P. beutilifolia</i>	0.930	1.190	0.280	0.290	1.213	1.486	0.180	0.166
LSD at 5%	0.094	0.020	0.012	0.012	0.133	NS	0.002	0.003

Table (7): Effect of rootstocks on leaf N, P, K and Ca content of pear transplants grown on saline alkaline heavy clay soil during 2014 and 2015 seasons.

Rootstocks	N (%)		P (%)		K (%)		Ca (%)	
	2014	2015	2014	2015	2014	2015	2014	2015
<i>P. calleryana</i>	2.29	2.92	0.14	0.14	1.48	1.34	2.65	2.71
<i>P. communis</i>	1.97	2.37	0.16	0.18	1.29	1.18	2.87	2.58
<i>P. beutilifolia</i>	2.12	2.21'	0.13	0.15	1.57	1.50	2.52	2.52
LSD at 5%	0.028	0.395	0.020	0.026	0.027	0.041	0.012	0.028

Table (8): Effect of rootstocks on leaf Mg, Na and Cl content of pear transplants grown on saline alkaline heavy clay soil during 2015 and 2016 seasons.

Rootstocks	Mg (%)		Na (%)		Cl (%)	
	2014	2015	2014	2015	2014	2015
<i>P. calleryana</i>	0.34	0.33	0.90	0.96	1.22	1.34
<i>P. communis</i>	0.31	0.28	1.10	1.10	1.88	1.78
<i>P. beutilifolia</i>	0.35	0.36	0.92	0.90	1.24	1.29
LSD at 5%	NS	0.042	0.103	0.060	0.038	0.116

CONCLUSION

The present results clearly showed that *Pyrus beutilifolia* and *P. calleryana* induced better vegetative growth (plant height, stem diameter, shoot length and leaf area), leaf water relations (total leaf water content and free water content), photosynthetic pigments (chlorophyll A, B and total) as well as leaf minerals content (N, K and Mg). On the other hand, "Le-Conte" pear budded on *p. communis* has higher bound water, water deficit, proline, P, Na and Cl. So, we recommend "Le-Conte" pear growers to budded their transplants on *pyrus calleryana* or *p. beutilifolia* to have benefits of better vegetative growth, leaf water relations, photosynthetic pigments and leaf mineral content specially on heavy clay soil.

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تقييم شتلات الكمثرى المطعومة على أصول مختلفة في منطقة شمال وسط دلتا النيل

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أجريت هذه الدراسة خلال موسمي ٢٠١٤ و ٢٠١٥ بمزرعة محطة بحوث البساتين بسخا محافظة كفر الشيخ في شمال وسط الدلتا (تربة طينية ثقيلة متأثرة بالملوحة والقلوية)، وذلك بهدف تقييم شتلات الكمثرى الليكونت المطعومة على أصول مختلفة : البتشيولوفوليا و الكاليريانا والكميونس وكانت النتائج كالتالي :

النباتات المطعومة على أصول البتشيولوفوليا و الكاليريانا أعطت زيادة معنوية في معظم قياسات النمو (ارتفاع النبات - قطر الساق - الطول الكلي للأفرع - مساحة الورقة - الوزن النوعي للورقة) وكذلك محتوى الورقة من الكلوروفيل - A, B- اما بالنسبة لمحتوى الورقة من الماء الكلي والماء الحر أعطت النباتات النامية على أصل البتشيولوفوليا أعلى القيم تليها النباتات النامية على أصل الكاليريانا وفي المقابل كان محتوى الورقة من البرولين ونسبة الماء المرتبط ونسبة النقص المائي أعلى في النباتات النامية على أصل كميونس - الكمثرى المطعومة على أصل كاليريانا حققت أعلى القيم في محتوى الأوراق من النتروجين بينما أعلى القيم في محتوى الورقة من الفوسفور والصوديوم والكلوريد وجدت في النباتات المطعومة على أصل كميونس - بينما نسبة البوتاسيوم زادت في أوراق النباتات المطعومة على أصل البتشيولوفوليا يليها تلك المطعومة على أصل الكاليريانا

من خلال الدراسة يتبين أن أصل البتشيولوفوليا أصل جيد لتطعيم الكمثرى عليه تحت ظروف الاراضى المتأثرة بالملوحة والقلوية.