J. Agric. Sci. Mansoura Univ., 32 (5): 3651 - 3666, 2007

THE ROLE OF HUMIC ACID AND ROOTSTOCK IN ENHANCING SALT TOLERANCE OF"LE-CONT" PEAR SEEDLINGS

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ABSTRACT

The effect of humic acid treatments (soil, foliar and soil + foliar with Actosol which contain 2.9 % humic acid and 10-10-10 NPK) on growth parameters (shoot length, number of leaves, leaf area and leaf chlorophyll content), nutritional status (percentage of leaf dry matter and NPK content), root growth (root length, number of roots, and dry matter of main and secondary roots), toxic ions (chloride and sodium leaf content), and amino acid proline of 'Le-Conte' pear plants budded on *Pyrus communis* or *P. betulifolia* rootstocks was studied under 0, 1000 and 2000 ppm saline irrigation water that contained equal parts by weight of: NaCl, $CaCl_2$, $MgSO_4$, and $NaHCO_3$. Salinity treatments significantly decreased growth parameters, nutritional status and root system growth, while they significantly increased toxic ions and proline amino acid content. Salt tolerance of *P. betulifolia* rootstock was higher than that of *P. communis* as 'Le-Conte' pear plants on *P. betulifolia* rootstock grew better. Humic acid application (especially soil treatment with 20 ml Actosol in 1 L of water per 35 cm pot every other week from late June to October 15^{th}) markedly minimized the harmful effects of salinity and enhanced pear salt tolerance.

INTRODUCTION

Salinity is a significant limiting factor to agricultural productivity impacting about 2×10^8 ha of land surface on the earth (Epstein *et al*., 1980). Gratten and Grieve (1998) stated that the relation between salinity and mineral nutrition of horticultural crops is extremely complex. They added that crop performance may be adversely affected by salinity- induced nutritional disorders. These disorders may result from the effect of salinity on nutrient availability, competitive uptake, transport, or partitioning within the plant. For example, salinity reduces phosphate availability, uptake, and accumulation. Na^+ salts reduce Ca^{2+} and K^+ availability, transport and mobility, while Cl^- reduces NO^{-3} uptake.

Rootstocks 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 & Haffman, 1977). Under salinity conditions plant growth is affected by reduced water availability (Schleiff, 1979). Also, Okubo *et al*. (2000) showed that pear rootstock *Pyrus betulifolia* Bunge tolerates salinity more than *P. pyrifolia* Burm stock and that this tolerance was due to the ability of *P. betulifolia* to restrict Na and Cl ion transport to leaves.

Humic acid induced a wide range of effects on growing conditions in the rhizosphere (Bohme & Lua, 1997). Demir *et al*. (1999) revealed that salinity increased Na and Cl content of leaf and stem tissues and increased K leaf content in leaves but decreased it in stem tissues, while the reverse trend was noticed with Ca.

Accordingly, this investigation was carried out to study the response of 'Le-Conte' pears on two pear rootstocks, *P. communis* and *P. betulifolia,* to irrigation with saline water and the role of rootstocks in increasing salt tolerance of the scion. The possibility of using humic acid as a soil conditioner to reduce the harmful effects of salinity was also determined.

MATERIALS AND METHODS

This study was conducted in the orchard of the Horticulture research Institute, Agricultural Research center, Giza Egypt during the 2004 and 2005 seasons. Treatments were applied to one-year-old seedlings of either *P. communis* or *P. betulifolia* as rootstocks for 'Le-Conte' pears.

A split-split plot experiment in a randomized complete block design was used with three replicates. Each experimental unit consisted of 3 pots, each containing one seedling. Pots were 35 x 50 cm and were filled with a mixture of 15 kg sand and 100 g peatmoss. Seedlings were planted during late February in the two seasons. The two rootstocks were allocated to the main plots. Irrigation was done using tap water until the end of June in each season. Thereafter, salinity treatments were applied until Oct 15^{th} twice weekly as sub-plots. They were 0, 1000, 2000 ppm of a mixture of equal parts by weight of each of sodium chloride, calcium chloride, magnesium sulfate and sodium bicarbonate salts. Sub-sub treatments were applied every other week during the same period, i.e., from July 1^{st} to Oct. 15^{th} using humic acid (in the form of Actosol) as follows: (a) soil application at the rate of 20 ml Actosol in 1 L water, (b) foliar application with 0.5 % Actosol solution + soil application as above, (c) foliar application as above and (d) control. Actosol is a commercial product that contains 2.9 % humic acid and 10-10-10 NPK. It is manufactured by Arctick Inc., Chentilly, VA, USA.

Foliage measurements included the following characters: (a) relative shoot length expressed as percentage of shoot length and relative number of leaves as percentage of number of leaves compared to control which were recorded in August, September and October of both seasons and (b) leaf area and leaf chlorophyll content as measured on Aug. 20^{th} on 20 fully-expanded leaves per seedling and sampled from the middle of shoots. Leaf area was recorded using a Cl203Area Meter (CID, Inc., USA), while a SPAD 502 chlorophyll meter (Minolta Corporation, Ramsey, N.J., USA) was used in recording chlorophyll readings.

Subsequently, in December of both seasons, measurements were made for the percentage of dry matter in vegetative growth, i.e. remaining laves and stems and in main and secondary roots.

Chemical analysis was made on leaf samples to determine some mineral elements content. Samples were taken from intermediate position on scion shoots in August. Leaves were first washed several times with tap water; then with distilled water and 0.1 NHCl, dried at 70 ^{o}C, and finely ground. Samples, 0.5 g each, were digested using H_2SO_4-H_2O_2 as described by Cottenie (1980). Then, extracts were prepared for chemical analysis as described by Jackson (1973). Nitrogen was determined according to the modified Kjeldahl method as described by A.O.A.C. (1975). Phosphorus content was clorimetrically estimated according to Troug & Meyer (1939). Wet digestion was used for the determination of potassium as described by

Piper (1950) using flame photometer according to Brown & Lilleland (1946). Sodium also was determined by using flame photometer (Brown and Lilleland, 1946). Chloride content was assessed according to the methods of Higinbothan *et al*. (1967). Proline content was then colorimetriaclly estimated at 520 nm according to Bates *et al*. (1973).

The obtained data were statistically analysed according to Snedecor & Cochran (1990). Mean separation was calculated using L.S.D. values at 5 % level.

RESULTS

Growth parameters:

Growth parameters of pear seedlings included shoot length (Fig.1), number of leaves (Fig.2), leaf area, and leaf chlorophyll content (Table 1).

Humic acid treatments stimulated shoot length and number of leaves. Soil treatment increased these measurements to 151.5 % and 134.9 % with *P. communis* and to 168.4 % and 257.6 % with *P. betulifolia* rootstocks compared to control (100.0 %). Soil and soil + foliar treatments were more effective than foliar alone. These humic acid treatments inhanced growth of pear plants to produce larger leaves (59.5 cm^2 compared to 32.6 cm^2 in the control) and to have more leaf chlorophyll content (SPAD reading of 51.7 compared to 46.7 in the control).

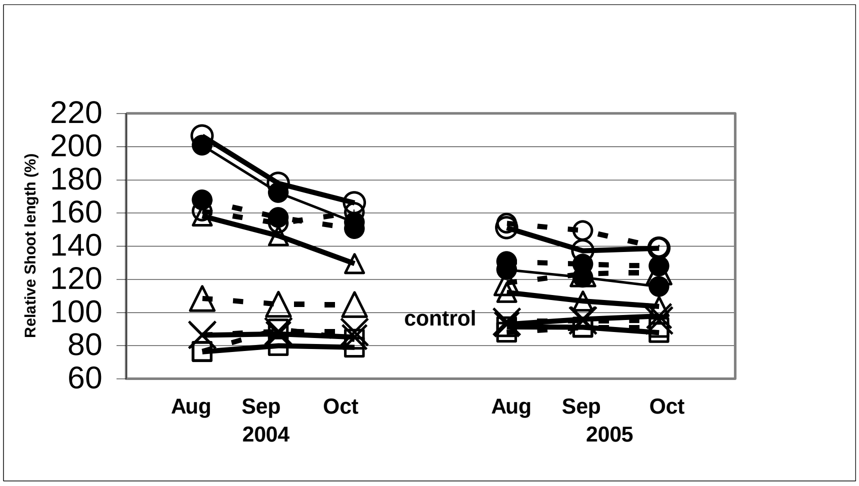

Fig. (1): Relative shoot length (expressed as percentage of length in the control), as affected by humic acid treatments (O soil, ∆ foliar and ● soil + foliar) and salinity treatments (× 1000 and □ 2000 ppm) for Le- conte pear budded on *Pyrus comunis*(-)and *P. betulifolia* (--------) .

P. betulifolia always had better growth parameters than *P. communis* under different salt doses and the differences were mostly significant.

T1

Compared to the control, salinity treatments depressed shoot length to 78.8 % and 87.7 % with *P. communis* and to 83.7 % and 90.8 % with *P. betulifolia* stocks in the two studied seasons, respectively (Fig.1).

Salinity also reduced the number of leaves to 51.6 % and 34.6 % with *P. communis* and to 69.9 % and 53.7 % with *P. betulifolia* stocks (Fig. 2). This reduction was more pronounced with time.

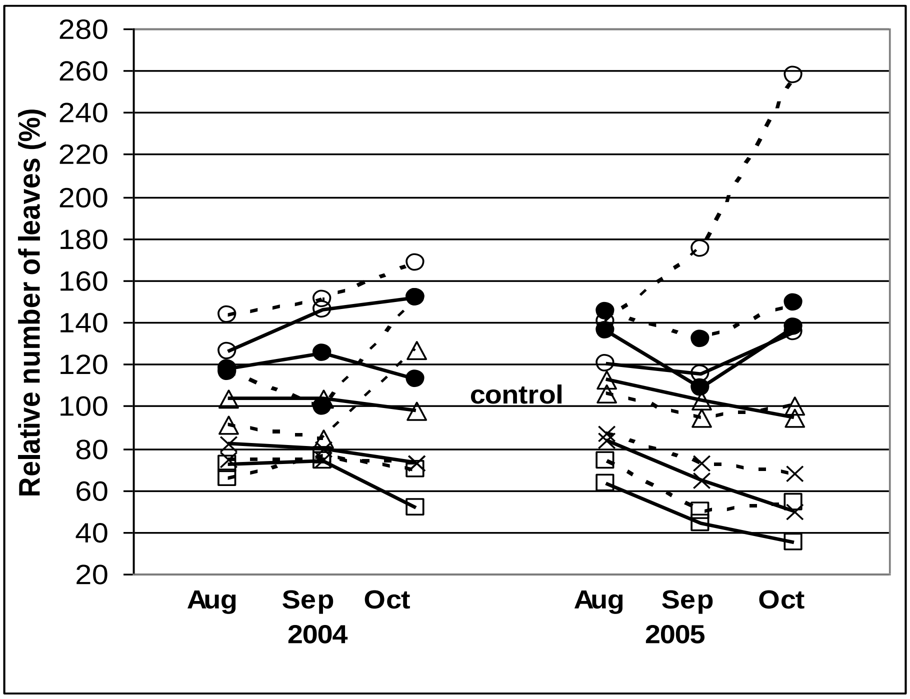

Fig. (2): Relative number of leaves (expressed as percentage of number in the control) as affected by humic acid treatments (O soil, ∆ foliar and ● soil + foliar) and salinity treatments (× 1000 and □ 2000 ppm) for Le- conte pear budded on *Pyrus comunis* (———) and *P. betulifolia* (--------) .

2. Nutritional status:

The percentage of leaf content of dry matter (Table 1) and NPK elements (Table 2)were measured to assess plant nutritional status.

Humic acid treatments (especially soil application) effectively recovered plants and helped them to improve their nutritional status (68.6%, 2.83 %, 0.29 % and 1.62 %, compared with 52.5 %, 1.62 %, 0.19 % and 0.91 % in the control for dry matter and NPK, respectively).

Moreover, pear rootstock successfully aggregated more dry matter (61.7 %) and NPK elements (2.35 %, 0.24 % and 0.94 %) than *P. communis* stock (58.9 %, 2.16 %, 0.20 % and 0.86 %, respectively), and the differences were statistically significant.

T2

Salinity had a significant effect on nutritional status of pear plants, as it minimized dry matter content from 63.4 % to 59.4, then to 58.1 %; nitrogen from 3.12 % to 2.14, then to 1.50 %; phosphorus from 0.24 % to 0.21, then to 0.20 %; and potassium from 1.58 % to 1.29%, then to 1.21 %, with the increase of salinity in irrigation water from 0 to 1000, then to 2000 ppm, respectively.

Concerning the interaction effect, *P. betulifolia* rootstock was less affected by salinity ,while if responded better to humic acid treatments than *P.communis rootstock.*

3. Root system growth:

Root system growth (Figs. 3 and 4) included measurements of root length (Table 3) and number of roots (Table 4) in different diameter categories (< 0.5, 0.5-1.5 and > 1.5 cm). table (5) showes the percentage of dry mater of main and secondary roots (Table 5).Generally, humic acid treatments (especially soil application) induced pear plants to develop more roots (0.50, 9.12 and 22.8), longer roots (11.50 and 36.8 and 25.4 cm), and higher root dry matter content (57.0 % and 51.2 %) than in the control treatment (0.25, 4.87 and 14.6; 7.75, 16.8 and 16.0 cm; and 46.8 % and 31.7 %, respectively).

Fig. (3): Effect of salinity and humic acid treatment (soil application) on root growth of 'Le-Conte' pear on *Pyrus communis* rootstock at 2000 ppm salinity

T3

T4

T5

Fig. (4): Effect of salinity and humic acid treatment(soil application) on root growth of 'Le-Conte' pear on *Pyrus betulifolia* rootstock at 2000 ppm salinity.

P. betulifolia rootstock, developed, relative to *P. communis* longer roots (31.1 and 23.0 cm) that were higher in number (5.02 and 18.5), but with less skeleton roots (>1.5 cm; 5.16 cm and 0.03). It also had higher dry matter in main (53.5 and 55.1 %) and secondary roots (45.3 and 43.2 %) than *P. communis* stock. Overall, salinity treatments significantly minimized root length (from 33.5 to 27.5, then to 24.2 cm and from 23.6 to 19.4, then to 17.0 cm as salinity of irrigation water increased from 0 to 1000, then to 2000 ppm, respectively) and number of roots (from 7.61 to 6.64, then to 5.88 and from 18.9 to 17.9, then to 15.7, respectively). Meanwhile, salinity at low level (1000 ppm) increased skeleton roots (>1.5 cm) in number to 0.29 and in length to 10.91 cm relative to 0.24 and 8.76 cm values, respectively, in the control and 0.29 and 5.41 cm values, respectively, in higher salinity (2000 ppm).

4. Toxic ions content and proline:

Chloride (Cl^-) and sodium (Na^+) leaf content, which are toxic to pants when present in high concentrations, are presented in Table 6. Humic acid treatment (especially soil application), effectively counteracted leaf content of the two toxic ions: Cl^- (0.008 %) and Na^+ (0.05 %) compared to the control (0.014 % and 1.23 %, respectively).

T6

The proline amino acid gradually increased from 0.005 to 0.017, and then to 0.037, as well as from 0.004 to 0.013, and then to 0.041 mg/g as salinity level increased from 0 to 1000, and then to 2000 ppm, especially with *P. communis* roots (0.022 mg/g) which accumulated higher proline than the other stock (0.017 and 0.018 mg/g). Generally, soil treatment of humic acid significantly reduced leaf content of proline to the normal concentration (0.008 as compared with 0.027 mg/g in the control).

P. betulifolia tended to accumulate significantly lesser content of Cl^- (0.010 %) and Na^+ (0.45 %) in the first season than *P. communis* (0.011 % and 0.47 %, respectively), while in the 2nd season the adverse trend was noticed with Na^+, and the two stocks behaved similarly with regard to Cl^- (0.011 % and 0.011 %). The increase of Cl^- from 0.007 % to 0.011 %, and then to 0.013 % as well as from 0.006 % to 0.010, and then to 0.018 % and Na^+ from 0.32 to 0.52, and then to 0.54 % as well as from 0.37 to 0.60, and then to 0.52 %, respectively, paralleled to the increase in salinity level of irrigation water from 0 to 1000, and then to 2000 ppm.

DISCUSSION AND CONCLUSION

The present results indicated that the growth parameters of 'Le-Conte' pear on *P. communis* or *P. betulifolia* stocks expressed as shoot length, number of leaves, leaf area, and leaf chlorophyll content were decreased with higher salinity. The same trend was noticed with the nutritional status expressed as N, P, K, and lead dry matter and with root system growth parameters, viz., root length, number of roots, and root dry matter. On the other hand, Na^+, Cl^- and the amino acid proline gradually increased as salinity level increased (Figs. 1 and 2 and Tables 1-4).

Generally, these results are in line with those reported by Fathi (1989), Sweidan *et al*. (1992), El-Shall & Fathi (1993), and Hussein (1998 and 2004). According to Epstein *et al*. (1980) and Faust (1989), salinity may affect plant growth in two ways: the osmotic pressure of the soil solution may be enough to limit the availability of water to plant and the high concentration of salts may also facilitate the uptake of one or more of the ions so that an accumulation may occur causing a derangement of the normal metabolism. Such effects may be associated with a reduction in the uptake of nutrient elements (Ivanov & Ivanova, 1977) which may be due to disorders of nutrient availability, competitive uptake, transport or partitioning within the plant (Grarttan & Grieve, 1998).

Humic acid applications particularly soil treatment, effectively minimized the negative effects of salinity. Several other investigators had previously reported that humic substances increased dry matter of foliage and roots, promoted lateral root growth, and N uptake rate (Tattini *et al*., 1991), contributed to the nutritional regulation and adaptability of apple trees and enhanced photosynthesis and accumulations of nutrients (Jianguo *et al*., 1998).

Benefit ascribed to humic acid include its slow release of micronutrients to plants, and high water-holding capacity. It also stimulates plant growth, increases the availability of phosphate by breaking the bonds between P and either Fe or Ca, and helps in the minerlaziation and immobilization of N in soil. Additionally, humic acid affects the physiochemical properties of soil, which are important in controlling the uptake of nutrients and their retention, and in counteracting soil acidity (Ghabbour & Davies, 1998).

It was also noticed in this study that *P. betulifolia* rootstock was more tolerant to salinity damage than *P. communis* stock. In former studies Okubo *et al*. (2000) showed that pear rootstock *P. betulifolia* tolerated salinity more than *P. pyrifolia* stock and this tolerance was due to the ability of this stock to restrict Na^+ and Cl^- ion transport to leaves. Similar results were reported previously by Fathi (1989), Sweidan *et al*. (1992), and El-Shall *et al*. (1993) who showed that *Malus communis* was more tolerant to salinity than MM106 apple roots.

Accordingly, it is recommend that pear nursery growers: 1) use *P. betulifolia* as an appropriate rootstock especially under saline conditions, and 2) give soil application at the rate of 20 ml Actosol (2.9 % humic acid and 10-10-10 NPK) in 1 L of water to each pot every other week beginning from the end of June till Oct. 15th.

REFERENCES

A.O.A.C.; Association of Official Agricultural Chemists (1975). Official methods of analysis. pp. 832-849. Washington, D.C., USA.

Bates, L.S., R.P. Waldren, and I.D. Teare (1973). Rapid determination of free proline for water stress studies. Plant and Soil. 939: 205-207.

Bohme, M. and H. Lue (1997). Influence of mineral and organic treatments in the rhizosphere on the growth of tomato plants. Acta Hort.45: 211 -224.

Brown, J.D. and D. Lilleland (1946). Rapid determination of potassium and sodium in plant material and soil extract by flame photometry. Proc. Amer. Soc. Hort Sci. 73: 813.

Cottenie, A. (1980). Soil and plant testing as a basis of a fertilizer recommendation. F.A.O. Soil Bull., p. 3812.

Demir, K., A. Gunes, A. Inal, and M. Alpaslan (1999). Effects of humic acids on the yield and mineral nutrition of cucumber grown with different salinity levels. Acta Hort. 47: 64-71.

El-Shall, S.A. and M.A. Fathi (1993a). The role of rootstock and chloromequate for enhancing the salt tolerance of ‘Anna’ apple. J. Agric. Sci. Mansoura Univ., 18 (4): 1117-1128.

El-Shall, S.A., M.A. Fathi, and, A.S. Ahmed (1993b). The role of rootstock and soil conditioners for enhancing the salt tolerance of ‘Anna’ apple. J. Agric. Sci. Mansoura Univ. 18 (4): 1129-1140.

Epstein, E., J.D. Norlyn, D.W. Rush, and A.F. Wrona. (1980). Saline culture of crops: A genetic approach. Science 210: 399-404.

Fathi, M.A. (1989). Effect of salinity of irrigation water on some apple rootstocks. Ph.D. Thesis, Fac. Agric., Cairo Univ.

Faust, M.(1989). Physiology of Temperate Zone fruit trees. John Wiley & Sons, pp. 133-165.

Ghabbour, E.A. and G. Davies (1998). Humic substances. Royal Society of Chemistry. 2nd ed. pp. 337-345.

Gratten, S.R. and C.M. Grieve (1998). Salinity-mineral nutrient relations in horticultural crops. Scietia Horticulturae 78: 127-157.

Higinbothan, N., B. Etherton, and R.J. Foster (1967). Mineral ion contents and cell trans membrane electropotentials of pea and oat tissue. Plant Physiol. 42: 37-46.

Hussei, S.M. (1998). Influence of irrigation levels on the growth, mineral content and fruit quality of 'Anna' apples. M.Sc. Thesis, Fac. Agric., Cairo Univ.

Hussei, S.M. (2004). Effect of different irrigation levels on the 'Le-Conte' pear trees. Ph.D. Thesis, Fac. Agric., Cairo Univ.

Ivanov, V.F. and A.S. Ivanova (1977). Correlation between growth and mineral nutrition of peach under salinity. Soviet Plant Physiol. 24: 492-498.

Jackson, M.L. (1973). Soil chemical analysis. Prentice-Hall of India Private, Ltd, New Delhi.

Jianguo, Yu., Ye Shuiying, Z. Yujuan and S.Yingchang (1998). Influence of humic acid on the physiological and biochemical indexes of apple trees. Forest Res. 11 (6): 623-628.

Maas, E.V. and G.J. Hoffman (1977). Crop salt tolerance. J. Irrig. Drain. Div. 103: 115-134.

Okubo, M. Y. Furukawa, and T. Sakuratani (2000). Growth, flowering and leaf properties of pear cultivars grafted on two Asian pear rootstocks under NaCl irrigation. Scientia Horticulturae 85: 91-101.

Piper, C.S. (1950). Soil and Plant Analysis. Inter-Science Pub. Inc., New York, 368 p.

Schleiff, U. (1979). Slat contents in the rhizosphere and in soil solution outside the rhizosphere under controlled irrigation. Proc. 14th Colloquium of the Inter. Potash Inst., pp. 93-98.

Snedecor, G.W. and W.G. Cochran (1990). Statistical methods. 7th ed. The Iowa State Univ. Press. Ames, Iowa, USA. 593 p.

Sweidan, A.M., A.T. Salem, and M.A. Fathi (1992). Salt tolerance of three apple rootstocks. Egypt. J. Appl. Sci. 7: 710-730.

Tattini, M. P. Bertoni, A. Laudi, and M.L. Traversi (1991). Effect of humic acids on growth and biomass partitioning of container-grown olive. Acta Hort. 294: 75-80.

Troug, E. and A.H. Meyer (1939). Improvement in Denig's caloriumetric method for phosphorus and arsenic. Ind. Eng. Chem. Anal. pp, 136-139.

دور حامض الهيوميك والاصل فى تحمل شتلات صنف الكمثرى ليكونت لملوحة ماء الرى

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دُرس تأثير المعاملة بحامض الهيوميك (معاملة التربة أو الرش على المجموع الخضرى أو هما معاً) على صفات النمو الخضرى (طول الفرع، عدد الأوراق، مساحة الورقة، محتوى الأوراق من الكلوروفيل) والحالة الغذائية للنبات (% للمادة الجافة فى الأوراق، ومحتوى الأوراق من عناصر النيتروجين والفوسفور والبوتاسيوم) وكذلك نمو المجموع الجذرى للنبات (طول وعدد الجذور، والنسبة المئوية للمادة الجافة فى الجذور الرئيسية والفرعية) وكذلك محتوى الأوراق من عنصرى الصوديوم والكلور ومن الحامض الأمينى برولين لنباتات الكمثرى صنف ليكونت المطعومة على أصلى: بيرس كميونس، بيرس بتشليفوليا، تحت ظروف الرى بتركيزات مختلفة من الماء المالح (الذى يحتوى على مخلوط من أملاح: كلوريد الصوديوم، وكلوريد الكالسيوم، وسلفات الماغنسيوم، وبيكربونات الصوديوم) هى : صفر، و ١٠٠٠، و ٢٠٠٠ جزء فى المليون.

سببت الملوحة نقصاً واضحاً فى كل مظاهر النمو الخضرى والحالة الغذائية ونمو المجموع الجذرى، بينما زاد محتوى الأوراق من عنصرى الصوديوم والكلور والبرولين. وأظهرت الدراسة أن أصل الكمثرى بيرس بتشليفوليا كان الأكثر تحملاً للملوحة حيث نمت عليه نباتات الكمثرى بصورة أفضل مما نمت على الأصل بيرس كميونس. كما أن معاملة النباتات بالهيوميك أسيد (خصوصاً معاملة التربة بـ ٢٠ مللى أكتوسول ٢,٩ % هيوميك أسيد و ١٠-١٠-١٠ N P K/لتر ماء مرة كل أسبوعين من أواخر يونيو حتى منتصف أكتوبر) قللت بوضوح التأثيرات الضارة للملوحة على شتلات الكمثرى.

Table (1): Effect of humic acid (A) and salinity of irrigation water (C) on leaf area, percentage of dry matter and leaf chlorophyll content of pear seedlings (B): on *Pyrus communis* (Pc) and *Pyrus betulefolia* (Pb).

(A)	(C)	Leaf area (cm^2)						Dry matter (%)						Chlorophyll (SPAD reading)					
		2004 season			2005 season			2004 season			2005 season			2004 season			2005 season		
		Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)
Control	0	28.8	27.7	28.3	35.5	37.7	36.6	50.8	56.9	53.9	55.2	56.2	55.7	49.0	48.9	49.0	43.8	49.6	46.7
	1000	23.7	21.3	22.5	31.3	33.8	32.6	51.1	54.9	53.0	53.0	48.2	50.6	45.0	46.3	45.7	41.5	48.8	45.2
	2000	23.8	19.4	21.6	26.8	30.6	28.7	49.3	52.0	50.7	49.2	47.2	48.2	43.1	48.0	45.6	34.8	45.1	40.0
Ave. (A x B)		25.4	22.8	Ave (A) 24.1	31.2	34.0	Ave (A) 32.6	50.4	54.6	Ave (A) 52.5	52.5	50.5	Ave (A) 51.5	45.7	47.7	Ave (A) 46.7	40.0	47.8	Ave (A) 43.9
Soil	0	38.2	38.8	38.5	60.5	63.7	62.1	69.1	68.2	68.7	70.7	73.9	72.3	53.4	54.3	53.9	50.5	51.5	51.0
	1000	35.6	36.4	36.0	56.2	61.4	58.8	67.8	69.4	68.6	63.1	68.8	66.0	52.2	53.3	52.8	47.9	49.7	48.8
	2000	33.9	35.0	34.5	56.1	59.3	57.7	67.3	69.8	68.6	65.5	60.7	63.1	50.1	46.7	48.4	42.1	47.5	44.8
Ave. (A x B)		35.9	36.7	Ave (A) 36.3	57.6	61.5	Ave (A) 59.5	68.1	69.1	Ave (A) 68.6	66.4	67.8	Ave (A) 67.1	51.9	51.4	Ave (A) 51.7	46.8	49.6	Ave (A) 48.2
Foliar	0	34.6	39.8	37.2	36.6	56.8	46.7	49.2	54.2	51.7	52.3	59.7	56.0	49.3	50.1	49.7	46.9	47.9	47.4
	1000	34.4	34.2	34.3	40.5	54.4	47.5	50.9	53.7	52.3	50.7	57.2	54.0	45.6	49.4	47.5	45.7	51.1	48.4
	2000	30.5	32.6	31.6	23.2	55.5	39.4	52.6	55.9	54.3	48.3	59.8	54.1	44.0	46.8	45.4	44.7	46.0	45.4
Ave. (A x B)		33.2	35.5	Ave (A) 34.4	33.4	55.6	Ave (A) 44.5	50.9	54.6	Ave (A) 52.8	50.4	58.9	Ave (A) 54.7	46.3	48.8	Ave (A) 47.5	45.8	48.3	Ave (A) 47.1
Soil + foliar	0	37.0	39.5	38.3	62.0	57.4	59.7	56.6	61.0	58.8	68.8	70.4	69.6	47.9	53.1	50.5	46.2	51.6	48.9
	1000	36.6	35.8	36.2	55.8	55.5	55.7	57.8	53.3	55.6	65.7	68.2	67.0	47.7	49.1	48.4	44.8	51.2	48.0
	2000	31.6	33.3	32.5	52.6	50.7	51.7	54.4	42.0	48.2	63.9	69.8	66.9	43.6	50.5	47.1	45.3	47.5	46.4
Ave. (A x B)		35.1	36.2	Ave (A) 35.6	56.8	54.5	Ave (A) 55.7	56.3	52.1	Ave (A) 54.2	66.1	69.5	Ave (A) 67.8	46.4	50.9	Ave (A) 48.7	45.4	50.1	Ave (A) 47.8
Ave. (B x C)	0	34.7	36.5	Ave (C) 35.6	48.7	53.9	Ave (C) 51.3	56.4	60.1	Ave (C) 58.3	61.8	65.1	Ave (C) 63.4	49.9	51.6	Ave (C) 50.8	46.9	50.2	Ave (C) 48.5
	1000	32.6	31.9	32.3	46.0	51.3	48.6	56.9	57.8	57.4	58.1	60.6	59.4	47.6	49.5	48.6	45.0	50.2	47.6
	2000	30.0	30.1	30.0	39.7	49.0	44.4	55.9	54.9	55.4	56.7	59.4	58.1	45.2	48.0	46.6	41.7	46.5	44.1
Ave. (B)		32.4	32.8		44.8	51.4		56.4	57.6		58.9	61.7		47.6	49.7		44.5	49.0	
LSD at 5% for:																			
Humic acid (A)				2.50			2.82			4.18			4.55			2.84			2.42
Pear rootstock (B)				2.17			2.44			3.62			3.94			2.46			2.10
Salinity (C)				2.17			2.44			3.62			3.94			2.46			2.10
A x B				3.54			3.99			5.91			6.43			4.01			3.43
A x C				4.34			4.89			7.24			7.88			4.92			4.20
B x C				3.07			3.45			5.12			5.57			3.48			2.97
A x B x C				6.13			6.91			10.24			7.68			6.95			5.93

Table (2): Effect of humic acid (A) and salinity of irrigation water (C) on percentage of leaf nitrogen (N), phosphorous (P) and potassium (K) content in pear seedlings (B): on *Pyrus communis* (Pc) and *Pyrus betulefolia* (Pb).

(A)	(C)	N (%)						P (%)						K (%)					
		2004 season			2005 season			2004 season			2005 season			2004 season			2005 season		
		Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)
Control	0	1.75	2.11	1.93	2.84	2.20	2.52	0.15	0.13	0.14	0.16	0.15	0.16	1.44	1.49	1.47	1.44	1.47	1.46
	1000	1.59	1.59	1.59	1.69	1.74	1.72	0.24	0.19	0.22	0.25	0.22	0.24	0.59	0.61	0.60	0.59	0.69	0.64
	2000	1.39	1.29	1.34	1.18	1.38	1.28	0.16	0.15	0.16	0.18	0.16	0.17	0.32	0.38	0.35	0.82	0.46	0.64
Ave. (A x B)		1.58	1.66	Ave (A) 1.62	1.90	1.77	Ave (A) 1.84	0.18	0.16	Ave (A) 0.17	0.20	0.18	Ave (A) 0.19	0.78	0.83	Ave (A) 0.81	0.95	0.87	Ave (A) 0.91
Soil	0	3.32	3.34	3.33	3.41	3.45	3.43	0.28	0.22	0.25	0.29	0.61	0.45	1.75	1.57	1.66	1.75	1.66	1.71
	1000	3.06	3.21	3.14	2.15	2.30	2.23	0.18	0.23	0.21	0.19	0.24	0.22	0.63	0.71	0.67	1.63	1.68	1.66
	2000	2.03	2.02	2.03	1.93	1.92	1.93	0.21	0.20	0.21	0.22	0.19	0.21	0.44	0.51	0.48	1.44	1.57	1.51
Ave. (A x B)		2.80	2.86	Ave (A) 2.83	2.50	2.56	Ave (A) 2.53	0.22	0.22	Ave (A) 0.22	0.23	0.35	Ave (A) 0.29	0.94	0.93	Ave (A) 0.94	1.61	1.64	Ave (A) 1.62
Foliar	0	2.61	3.22	2.92	3.71	3.13	3.42	0.14	0.18	0.16	0.14	0.19	0.17	1.12	1.40	1.26	1.62	1.66	1.64
	1000	2.20	2.30	2.25	2.70	2.20	2.45	0.18	0.15	0.17	0.18	0.16	0.17	0.73	1.30	1.02	1.33	1.36	1.35
	2000	1.03	1.72	1.38	1.13	1.81	1.47	0.15	0.29	0.22	0.17	0.26	0.22	0.56	0.75	0.66	1.26	1.12	1.19
Ave. (A x B)		1.95	2.41	Ave (A) 2.18	2.51	2.38	Ave (A) 2.45	0.16	0.21	Ave (A) 0.18	0.16	0.20	Ave (A) 0.18	0.80	1.15	Ave (A) 0.98	1.40	1.38	Ave (A) 1.39
Soil + foliar	0	3.05	3.20	3.13	2.84	3.40	3.12	0.19	0.23	0.21	0.18	0.23	0.21	1.60	1.50	1.55	1.60	1.47	1.54
	1000	2.05	2.30	2.18	2.14	2.21	2.18	0.19	0.25	0.22	0.20	0.22	0.21	0.50	0.53	0.52	1.50	1.53	1.52
	2000	1.83	1.93	1.88	1.32	1.33	1.33	0.24	0.22	0.23	0.23	0.21	0.22	0.69	0.51	0.60	1.49	1.54	1.52
Ave. (A x B)		2.31	2.48	Ave (A) 2.39	2.10	2.31	Ave (A) 2.21	0.21	0.23	Ave (A) 0.22	0.20	0.22	Ave (A) 0.21	0.93	0.85	Ave (A) 0.89	1.53	1.51	Ave (A) 1.52
Ave. (B x C)	0	2.68	2.97	Ave (C) 2.83	3.20	3.05	Ave (C) 3.12	0.19	0.19	Ave (C) 0.19	0.19	0.30	Ave (C) 0.24	1.48	1.49	Ave (C) 1.48	1.60	1.57	Ave (C) 1.59
	1000	2.23	2.35	2.29	2.17	2.11	2.14	0.20	0.21	0.20	0.21	0.21	0.21	0.61	0.79	0.70	1.26	1.32	1.28
	2000	1.57	1.74	1.66	1.39	1.61	1.50	0.19	0.22	0.20	0.20	0.21	0.20	0.50	0.54	0.52	1.25	1.17	1.21
Ave. (B)		2.16	2.35		2.25	2.26		0.19	0.20		0.20	0.24		0.86	0.94		1.37	1.35	

LSD at 5% for:

	N 2004	N 2005	P 2004	P 2005	K 2004	K 2005
Humic acid (A)	0.29	0.26	0.007	0.007	0.093	0.088
Pear rootstock (B)	0.25	0.22	0.006	0.006	0.080	0.076
Salinity (C)	0.25	0.22	0.006	0.006	0.080	0.076
A x B	0.41	0.36	0.10	0.10	0.131	0.124
A x C	0.50	0.44	0.012	0.012	0.161	0.152
B x C	0.36	0.31	0.008	0.008	0.114	0.108
A x B x C	0.71	0.63	0.017	0.017	0.228	0.215

Table (3): Effect of humic acid (A) and salinity of irrigation water (C) on root length (cm) in different diameter categories (>1.5, 1.5-0.5 and <0.5 cm) of pear seedlings (B): on *Pyrus communis* (Pc) and *Pyrus betulefolia* (Pb).

(A)	(C)	> 1.5 CM						1.5-0.5 CM						<0.5 CM					
		2004 season			2005 season			2004 season			2005 season			2004 season			2005 season		
		Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)
Control	0	13.80	0.00	6.90	0.00	2.70	1.35	17.5	24.7	21.1	21.6	17.1	19.4	17.7	18.9	18.3	15.6	16.1	15.9
	1000	14.80	8.00	11.40	40.80	3.00	21.90	13.5	23.2	18.4	16.3	15.2	15.8	17.2	15.4	16.3	14.7	17.3	16.0
	2000	0.00	0.00	0.00	0.00	0.00	0.00	17.3	24.2	20.8	14.7	15.7	15.2	14.3	14.8	14.6	18.5	13.9	16.2
Ave. (A x B)		9.53	2.67	Ave (A) 6.10	13.60	1.90	Ave (A) 7.75	16.1	24.0	Ave (A) 20.1	17.5	16.0	Ave (A) 16.8	16.4	16.4	Ave (A) 16.4	16.3	15.8	Ave (A) 16.0
Soil	0	13.20	0.00	6.60	11.50	22.70	17.10	41.2	45.7	43.5	37.8	41.4	39.6	12.5	39.6	26.1	26.4	28.6	27.5
	1000	10.80	0.00	5.40	3.80	7.60	5.70	19.1	31.1	25.1	33.2	37.5	35.4	17.5	25.0	21.3	25.2	24.8	25.0
	2000	8.00	0.00	4.00	19.40	4.00	11.70	17.5	24.4	21.0	35.1	35.5	35.3	15.0	19.8	17.4	24.6	22.8	23.7
Ave. (A x B)		10.67	0.00	Ave (A) 5.33	11.57	11.43	Ave (A) 11.50	25.9	33.7	Ave (A) 29.8	35.4	38.1	Ave (A) 36.8	18.0	28.1	Ave (A) 23.1	25.4	25.4	Ave (A) 25.4
Foliar	0	16.10	0.00	8.05	26.60	3.30	14.95	25.2	30.0	27.6	20.0	18.5	19.3	17.4	26.4	21.9	16.1	17.7	16.9
	1000	12.00	0.00	6.00	4.50	7.20	5.85	29.4	27.5	28.5	14.0	16.7	15.4	16.0	23.9	20.0	14.1	16.1	15.1
	2000	7.70	0.00	3.85	7.90	0.00	3.95	18.0	27.0	22.5	15.3	16.8	16.0	15.3	21.8	18.6	11.3	14.9	13.1
Ave. (A x B)		11.93	0.00	Ave (A) 5.97	13.00	3.50	Ave (A) 8.25	24.2	28.2	Ave (A) 26.2	16.4	17.3	Ave (A) 16.9	16.2	24.0	Ave (A) 20.1	13.8	16.2	Ave (A) 15.0
Soil + foliar	0	14.70	0.00	7.35	3.30	0.00	1.65	42.6	41.2	41.9	37.9	38.2	38.1	17.9	29.3	23.6	24.7	25.5	25.1
	1000	18.00	0.00	9.00	15.20	5.20	10.20	39.9	36.4	38.2	35.4	33.9	34.7	17.8	22.3	20.1	22.3	23.8	23.1
	2000	9.70	0.00	4.85	5.80	6.20	6.00	27.9	37.3	32.6	31.2	36.9	34.1	16.6	18.5	17.6	20.4	23.4	21.9
Ave. (A x B)		14.13	0.00	Ave (A) 7.07	8.10	3.80	Ave (A) 5.95	36.8	38.3	Ave (A) 37.6	34.8	36.3	Ave (A) 35.6	17.4	23.4	Ave (A) 20.4	22.5	24.2	Ave (A) 23.4
Ave. (B x C)	0	14.45	0.00	Ave (C) 7.23	10.35	7.18	Ave (C) 8.76	31.6	35.4	Ave (C) 33.5	29.3	28.8	Ave (C) 29.1	18.6	28.6	Ave (C) 23.6	20.7	22.0	Ave (C) 21.3
	1000	13.90	2.00	7.95	16.08	5.75	10.91	25.5	29.6	27.5	24.7	25.8	25.3	17.1	21.7	19.4	19.1	20.5	19.8
	2000	6.35	0.00	3.18	8.28	2.55	5.41	20.2	28.2	24.2	24.1	26.2	25.2	15.3	18.7	17.0	18.7	18.8	18.7
Ave. (B)		11.57	0.67		11.57	5.16		25.8	31.1		26.0	27.0		17.0	23.0		19.5	20.4	

LSD at 5% for

Humic acid (A)	0.052	0.030	3.06	2.05	2.79	2.87
Pear rootstock (B)	0.045	0.026	2.65	1.78	2.42	2.49
Salinity (C)	0.045	0.026	2.65	1.78	2.42	2.49
A x B	0.074	0.043	4.33	2.90	3.95	4.06
A x C	0.090	0.052	5.31	3.55	4.84	4.97
B x C	0.064	0.037	3.75	2.51	3.42	3.52
A x B x C	0.128	0.074	7.51	5.03	6.84	7.04

Table (4): Effect of humic acid (A) and salinity of irrigation water (C) on number of root in different diameter categories (>1.5, 1.5-0.5 and <0.5 cm) of pear seedlings (B): on *Pyrus communis* (Pc) and *Pyrus betulefolia* (Pb).

(A)	(C)	> 1.5 CM						1.5-0.5 CM						<0.5 CM					
		2004 season			2005 season			2004 season			2005 season			2004 season			2005 season		
		Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)
Control	0	1.00	0.00	0.50	0.30	0.30	0.30	4.00	4.70	4.35	5.20	5.80	5.50	11.7	13.7	12.7	16.5	16.5	16.5
	1000	0.70	0.30	0.50	0.30	0.30	0.30	3.70	4.70	4.20	5.80	4.80	5.30	10.1	12.3	11.2	12.7	12.7	12.7
	2000	0.00	0.00	0.00	0.30	0.00	0.15	3.70	5.00	4.35	5.30	2.30	3.80	9.8	11.0	10.4	14.5	14.5	14.5
Ave. (A x B)		0.57	0.10	Ave (A) 0.33	0.30	0.20	Ave (A) 0.25	3.80	4.80	Ave (A) 4.30	5.43	4.30	Ave (A) 4.87	10.5	12.3	Ave (A) 11.4	14.6	14.6	Ave (A) 14.6
Soil	0	0.70	0.00	0.35	0.00	1.00	0.50	4.00	7.00	5.50	9.20	9.80	9.50	23.8	26.5	25.2	24.5	24.5	24.5
	1000	0.70	0.00	0.35	0.00	0.70	0.35	3.70	6.00	4.85	9.50	9.00	9.25	22.8	25.8	24.3	20.8	20.8	20.8
	2000	0.30	0.00	0.15	1.00	0.30	0.65	4.50	6.30	5.40	8.30	8.90	8.60	18.2	19.7	19.0	23.0	23.0	23.0
Ave. (A x B)		0.57	0.00	Ave (A) 0.28	0.33	0.67	Ave (A) 0.50	4.07	6.43	Ave (A) 5.25	9.00	9.23	Ave (A) 9.12	21.6	24.0	Ave (A) 22.8	22.8	22.8	Ave (A) 22.8
Foliar	0	1.00	0.00	0.50	0.00	0.30	0.15	5.20	5.00	5.10	6.90	6.80	6.85	15.3	15.0	15.2	21.3	21.3	21.3
	1000	0.70	0.00	0.35	0.00	0.70	0.35	3.70	2.30	3.00	4.80	2.50	3.65	16.7	17.7	17.2	20.1	20.1	20.1
	2000	0.70	0.00	0.35	0.00	0.00	0.00	2.70	1.50	2.10	4.40	1.80	3.10	11.0	16.5	13.8	19.0	19.0	19.0
Ave. (A x B)		0.80	0.00	Ave (A) 0.40	0.00	0.33	Ave (A) 0.17	3.87	2.93	Ave (A) 3.40	5.37	3.70	Ave (A) 4.53	14.3	16.4	Ave (A) 15.4	20.1	20.1	Ave (A) 20.1
Soil + foliar	0	0.70	0.00	0.35	0.00	0.00	0.00	5.30	6.70	6.00	8.20	9.00	8.60	21.3	23.6	22.5	23.2	23.2	23.2
	1000	1.00	0.00	0.50	0.00	0.30	0.15	5.80	6.00	5.90	8.70	8.00	8.35	15.7	21.8	18.8	22.3	22.3	22.3
	2000	0.70	0.00	0.35	0.00	0.70	0.35	4.70	5.00	4.85	7.70	8.30	8.00	20.7	18.6	19.7	21.3	21.3	21.3
Ave. (A x B)		0.80	0.00	Ave (A) 0.40	0.00	0.33	Ave (A) 0.17	5.27	5.90	Ave (A) 5.58	8.20	8.43	Ave (A) 8.32	19.2	21.3	Ave (A) 20.3	22.3	22.3	Ave (A) 22.3
Ave. (B x C)	0	0.85	0.00	Ave (C) 0.43	0.08	0.40	Ave (C) 0.24	4.63	5.85	Ave (C) 5.24	7.38	7.85	Ave (C) 7.61	18.0	19.7	Ave (C) 18.9	21.4	21.4	Ave (C) 21.4
	1000	0.78	0.08	0.43	0.08	0.50	0.29	4.23	4.75	4.49	7.20	6.08	6.64	16.3	19.4	17.9	18.9	19.0	19.0
	2000	0.43	0.00	0.21	0.33	0.25	0.29	3.90	4.45	4.18	6.43	5.33	5.88	14.9	16.5	15.7	19.5	19.5	19.5
Ave. (B)		0.68	0.03		0.16	0.38		4.25	5.02		7.00	6.42		16.4	18.5		19.9	19.9	

LSD at 5% for::

Humic acid (A)	0.037	0.037	0.78	0.93	2.32	2.00
Pear rootstock (B)	0.032	0.032	0.68	0.81	2.01	1.73
Salinity (C)	0.032	0.032	0.68	0.81	2.01	1.73
A x B	0.052	0.052	1.10	1.32	3.28	2.83
A x C	0.064	0.064	1.35	1.62	4.02	3.46
B x C	0.045	0.045	0.95	1.14	2.84	2.45
A x B x C	0.090	0.090	1.91	2.28	5.68	4.89

Table (5): Effect of humic acid (A) and salinity of irrigation water (C) on percentage of dry matter in main and secondary roots of pear seedlings (B): on *Pyrus communis* (Pc) and *Pyrus betulefolia* (Pb).

(A)	(C)	Dry matter main roots (%)						Dry matter secondary roots (%)					
		2004 season			2005 season			2004 season			2005 season		
		Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)	Pc	Pb	Ave (AxC)
Control	0	51.4	53.8	52.6	51.3	55.6	53.5	30.4	40.4	35.4	37.4	43.6	40.5
	1000	45.6	49.1	47.4	51.8	50.1	51.0	25.0	37.5	31.3	30.0	39.7	34.9
	2000	40.7	40.3	40.5	40.3	48.2	44.3	27.9	28.9	28.4	23.6	31.2	27.4
Ave. (A x B)		45.9	47.7	Ave (A) 46.8	47.8	51.3	Ave (A) 49.6	27.8	35.6	Ave (A) 31.7	30.3	38.2	Ave (A) 34.3
Soil	0	60.4	63.6	62.0	61.3	63.8	62.6	50.6	57.4	54.0	56.2	59.6	57.9
	1000	59.3	60.5	59.9	58.8	60.1	59.5	47.7	54.8	51.3	49.4	52.1	50.8
	2000	44.2	54.0	49.1	51.4	52.6	52.0	48.9	47.7	48.3	40.0	43.1	41.6
Ave. (A x B)		54.6	59.4	Ave (A) 57.0	57.2	58.8	Ave (A) 58.0	49.1	53.3	Ave (A) 51.2	48.5	51.6	Ave (A) 50.1
Foliar	0	48.5	56.0	52.2	48.4	56.9	52.7	47.9	50.4	49.2	37.3	44.7	41.0
	1000	45.6	53.4	49.5	49.1	51.4	50.3	33.9	44.3	39.1	31.1	39.1	35.1
	2000	43.5	43.4	43.5	43.3	52.2	47.8	31.6	37.7	34.7	27.9	31.6	29.8
Ave. (A x B)		45.9	50.9	Ave (A) 48.4	46.9	53.5	Ave (A) 50.2	37.8	44.1	Ave (A) 41.0	32.1	38.5	Ave (A) 35.3
Soil + foliar	0	53.8	59.9	56.8	56.3	61.9	59.1	44.9	51.6	48.3	47.7	47.3	47.5
	1000	50.8	59.8	55.3	46.0	59.5	52.8	38.8	47.9	43.4	43.5	45.2	44.4
	2000	49.8	47.7	48.8	36.2	49.3	42.8	31.9	44.7	38.3	39.1	40.6	39.9
Ave. (A x B)		51.5	55.8	Ave (A) 53.6	46.2	56.9	Ave (A) 51.5	38.5	48.1	Ave (A) 43.3	43.4	44.4	Ave (A) 43.9
Ave. (B x C)	0	53.5	58.3	Ave (C) 55.9	54.3	59.6	Ave (C) 56.9	43.5	49.9	Ave (C) 46.7	44.7	48.8	Ave (C) 46.7
	1000	50.3	55.7	53.0	51.4	55.3	53.4	36.4	46.1	41.2	38.5	44.0	41.3
	2000	44.6	46.4	45.5	42.8	50.6	46.7	35.1	39.8	37.4	32.7	36.6	34.6
Ave. (B)		49.5	53.5		49.5	55.1		38.3	45.3		38.6	43.1	
LSD at 5% for:													
Humic acid (A)				3.14			3.39			2.69			2.76
Pear rootstock (B)				2.72			2.94			2.33			2.39
Salinity (C)				2.72			2.94			2.33			2.39
A x B				4.44			4.80			3.81			3.90
A x C				5.43			5.87			4.67			4.78
B x C				3.84			4.15			3.30			3.38
A x B x C				7.68			8.31			6.60			6.75

Table (6): Effect of humic acid (A and) salinity of irrigation water (C) on proline amino acid and percentage of sodium (Na) and chloride (Cl) of pear seedlings (B): on *Pyrus communis* (Pc) and *Pyrus betulefolia* (Pb).

(A)	(C)	Proline (mg/g)	Na (%)	Cl (%)

		2004 season			2005 season			2004 season			2005 season			2004 season			2005 season		
		Pc	**Pb**	**Ave (AxC)**	**Pc**	**Pb**	**Ave (AxC)**	**Pc**	**Pb**	**Ave (AxC)**	**Pc**	**Pb**	**Ave (AxC)**	**Pc**	**Pb**	**Ave (AxC)**	**Pc**	**Pb**	**Ave (AxC)**
Control	**0**	0.008	0.009	0.009	0.008	0.008	0.008	0.72	0.71	0.72	0.77	0.74	0.76	0.009	0.006	0.008	0.007	0.007	0.007
	1000	0.026	0.019	0.023	0.006	0.010	0.008	1.50	1.43	1.47	1.65	1.62	1.64	0.013	0.009	0.011	0.014	0.010	0.012
	2000	0.056	0.043	0.050	0.067	0.061	0.064	1.56	1.49	1.53	0.86	1.67	1.27	0.012	0.012	0.012	0.025	0.021	0.023
Ave. (A x B)		0.030	0.024	Ave (A) 0.027	0.027	0.026	Ave (A) 0.027	1.26	1.21	Ave (A) 1.24	1.09	1.34	Ave (A) 1.22	0.011	0.009	Ave (A) 0.010	0.015	0.013	Ave (A) 0.014
Soil	**0**	0.003	0.007	0.005	0.003	0.001	0.002	0.04	0.02	0.03	0.03	0.03	0.03	0.006	0.006	0.006	0.005	0.005	0.005
	1000	0.006	0.013	0.010	0.006	0.003	0.005	0.05	0.04	0.05	0.06	0.05	0.06	0.008	0.008	0.008	0.006	0.009	0.008
	2000	0.022	0.017	0.020	0.027	0.007	0.017	0.07	0.05	0.06	0.06	0.06	0.06	0.009	0.013	0.011	0.008	0.014	0.011
Ave. (A x B)		0.010	0.012	Ave (A) 0.011	0.012	0.004	Ave (A) 0.008	0.05	0.04	Ave (A) 0.05	0.05	0.05	Ave (A) 0.05	0.008	0.009	Ave (A) 0.008	0.006	0.009	Ave (A) 0.008
Foliar	**0**	0.005	0.001	0.003	0.003	0.001	0.002	0.49	0.47	0.48	0.64	0.62	0.63	0.006	0.006	0.006	0.005	0.005	0.005
	1000	0.018	0.010	0.014	0.019	0.008	0.014	0.51	0.50	0.51	0.65	0.62	0.64	0.027	0.007	0.017	0.009	0.011	0.010
	2000	0.051	0.036	0.044	0.051	0.046	0.049	0.54	0.46	0.50	0.67	0.64	0.66	0.007	0.012	0.010	0.020	0.019	0.020
Ave. (A x B)		0.025	0.016	Ave (A) 0.020	0.024	0.018	Ave (A) 0.021	0.51	0.48	Ave (A) 0.50	0.65	0.63	Ave (A) 0.64	0.013	0.008	Ave (A) 0.011	0.011	0.012	Ave (A) 0.012
Soil + foliar	**0**	0.003	0.006	0.005	0.003	0.006	0.005	0.06	0.05	0.06	0.08	0.07	0.08	0.006	0.007	0.007	0.007	0.005	0.006
	1000	0.026	0.020	0.023	0.033	0.021	0.027	0.07	0.06	0.07	0.09	0.07	0.08	0.008	0.010	0.009	0.013	0.009	0.011
	2000	0.041	0.031	0.036	0.037	0.035	0.036	0.08	0.06	0.07	0.09	0.08	0.09	0.021	0.018	0.020	0.017	0.016	0.017
Ave. (A x B)		0.023	0.019	Ave (A) 0.021	0.024	0.021	Ave (A) 0.023	0.07	0.06	Ave (A) 0.06	0.09	0.07	Ave (A) 0.08	0.012	0.012	Ave (A) 0.012	0.012	0.010	Ave (A) 0.011
Ave. (B x C)	**0**	0.005	0.006	Ave (C) 0.005	0.004	0.004	Ave (C) 0.004	0.33	0.31	Ave (C) 0.32	0.38	0.37	Ave (C) 0.38	0.007	0.006	Ave (C) 0.007	0.006	0.006	Ave (C) 0.006
	1000	0.019	0.016	0.017	0.016	0.011	0.013	0.53	0.51	0.52	0.61	0.59	0.60	0.014	0.009	0.012	0.011	0.010	0.011
	2000	0.043	0.032	0.037	0.046	0.037	0.041	0.56	0.52	0.54	0.42	0.61	0.52	0.012	0.014	0.013	0.018	0.018	0.018
Ave. (B)		0.022	0.018		0.022	0.017		0.47	0.45		0.47	0.52		0.011	0.010		0.012	0.011	
LSD at 5% for:																			
Humic acid (A)				0.007			0.007			0.007			0.107			0.002			0.002
Pear rootstock (B)				0.006			0.006			0.006			0.092			0.002			0.002
Salinity (C)				0.006			0.006			0.006			0.092			0.002			0.002
A x B				0.010			0.010			0.010			0.151			0.003			0.003
A x C				0.012			0.012			0.012			0.185			0.004			0.004
B x C				0.009			0.009			0.008			0.131			0.003			0.003
A x B x C				0.017			0.017			0.017			0.261			0.005			0.006