EFFECT OF SOME TREATMENTS ON GROWTH AND MINERAL CONTENT OF SOME CITRUS ROOTSTOCKS UNDER SALINITY STRESS CONDITIONS

By

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B.Sc .Agric. Sci.(Pomology), Fac. Agric., Cairo Uni., 2010

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ABSTRACT

A greenhouse experiment was conducted during two successive growing seasons of 2013 and 2014, to study the effect of amino acids treatments on vegetative growth and mineral content of 6- month- old of C-35 Citrange (*Poncirus trifoliate x C. sinensis*); Troyer Citrange (*C. sinensis X Poncirustrifoliata (L) Raf.)* and X-639 hybrid (*Cleopatra mandarin X Poncirus trifoliata*) seedling under different levels of salinity. Seedlings irrigated (twice/week for 24 weeks) with different levels of salinity solution (0, 1000, 1500 and 2000 ppm), moisture content of the planting medium was raised up to the field capacity. Amino Acids treatments were applied at 0.00, 1.5 and 3.00 ml/l. every 15 days as soil application. The obtined resultes indicated that, low levels of salinity (1000 and 1500 ppm) plus both 1.50 and 3.0 ml/l. of amino-acid significantly improved tested rootstocks seedlings stem height, number of shoots/ seedling, stem diameter, number of leaves, leaf area, root length and width and harmful symptoms of salinity stress. Morever, amino-acid rate 3.00ml/l. under the high salinity levels (1500 and 2000 ppm) significantly increased root length. High salinity levels and amino-acid application rates statistically increased the prolin contents in rootstocks roots.

Salinity has insignificant effect of leaf Chl.a, leaf Chl.b and total Chl. content for Troyer Citrange and X-639, leaf carbohydrates of x-639, stem and root carbohydrates for Troyer Citrange and X-639, leaf nitrogen for x-639, leaf and root phosphor, leaf magnesium and root sodium.

Salinity increase Chl.b for C-35, leaf and stem carbohydrates for Troyer Citrange, leaf free amino acids in all rootstocks, proline, leaf nitrogen for Troyer Citrange, root nitrogen, leaf and root potassium, root magnesium, leaf and root calcium, iron, leaf sodium, leaf and root chlorine.

Salinity decrease total Chl. of C-35, leaf and root carbohydrates of C-35, leaf nitrogen of C-35, leaf zinc for all studied rootstocks.

Amino–acid rates played an important role in reducing the effect of salinity stress and the best concentration was 1.5 cm^3/l.

Key words: Citrus rootstocks, Salinity, C-35 Citrange, Troyar Citrange, X-639 Hybrid and Amino Acid.

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INTRODUCTION

Citrus is the major fruit crops cultivated in Egypt. It is the largest horticultural industry during the last few years and harvested area increased rapidly from year to year and reached 530415 Fed. the fruiting acreage of citrus occupies 440706 Fed. produced 4402180 Tons (According to Ministry of Agriculture and Land Reclamation, annual report 2014).

In spite of water scarcity and the fact that Egypt's share of Nile waters remained fixed at 55.5B Cubic Meters/annum. Also, the Nile basin countries crisis that seeks to reduce the share Nile water from Egypt. On the other hand, agricultural expansion and other uses needs a great amount of available water. But, there are many interpretations of research to find unconventional solutions to this problem to by optimizing water resources are to employ these points:

1. Raising efficiency of field irrigation system.
2. Reuse of agricultural drainage water.
3. Searching for other resources of water.
4. The development of research methods in the field of breeding and production assets and plant species tolerant to drought and salinity damage….etc.

Due to the rapid expansion of irrigated area, the efficient use of limited water resources in arid and semi-arid regions is becoming more vital. Moreover, water salinity is a major problem for it's negative effect on the yield and fruit quality of many crops. So, it reduces citrus trees' growth and causes many physiological disorders.

In spite of, three rootstocks of Avocado are better able to exclude the uptake and translocation of these potentially damaging ions to the shoot and are more tolerant of salinity. Whereas, the relative tolerance of these various rootstocks appeared to be due primarily to their ability to exclude Na and Cl from the leaves, (Mickelbart *et al.* 2007).

The increase in the salinity level reduced and delayed seed germination, plant height, stem diameter, number of leaves/seedling, fresh top and root biomass, Singh *et al.* (2003) on some citrus rootstocks. In addition to salinity had negative effects on: leaf defoliation, leaf injury, vegetative growth and leaf and root mineral contents, Amal *et al.* (2008) on citrus rootstock. High salt concentrations caused a great reduction in growth parameters such as fresh and dry weights of shoots and roots, Balal *et al.* (2011) on citrus rootstocks. Salinity had a restrictive effect on rate of root elongation and roots dry weight for tested rootstocks Cvs. had similar trend to that of growth rate weight by increasing irrigation water salinity conc., Nabila *et al.* (2013) on Olive Cultivars. As salinity increased, all measured characteristics of plants after 4.5-month growth except Na uptake, Proline content, and electrolyte leakage decreased on *Citrus jambheri* (Zarei and Paymaneh 2014).

Proline accumulation is a better index of salinity levels exerted on the plant than the salinity tolerance index on six citrus rootstocks Abadi *et al.* (2010). Salinity not only increased soil ECe, Na, Cl and Ca, but also increased P concentration and decreased Mg. Also, it's increased concentration of Na in the fibrous roots and decreased the concentration of root Ca, Mg, K and Cu on citrus (Alva and Syvertsen 1991). The reduction in (N) concentration in leaves and roots was closely related to the accumulation of Cl in tissues. Thus, highly significant negative correlation between N and Phosphor (P) concentrations in the leaves of two citrus cultivars was reported on citrus (Zekri 1991). Salinity had a significant effect on leaf concentrations of Cl, Na, K, Ca, Mg, P, Fe, Mn and Zn and on the SAR and SURL of most elements on citrus (Ruiz, *et al.* 1997). The most noticeable features were an accumulation of nitrogen, phosphorus and potassium and a decrease in calcium and magnesium in the shoot. The root phosphorus and potassium contents decreased, while calcium and magnesium remained unaltered in the increased salinity field on citrus rootstocks (Murkute *et al.* 2006). The accumulation and distribution of K^{+}, Ca^{+2} and Mg^{+2}. K^{+} / Na^{+} ratio decreased in response to salt stress in root, shoot and spikes on Wheat (Tammam *et al.* 2008). Increasing the salinity level tended to increase the concentrations of leaf Na, N, Ca and Cl while P, K, Mg, Fe, Mn, Zn and Cu decreased on citrus (Khalil, *et al.* 2011). Salt treatments increased level of Na+ and Cl- ions in the seedlings leaves and roots and also resulted in a decrease of K+/ /Na+ ratio (Melgar, *et al.* 2008) on citrus and olive seedlings and (Sharma *et al.* 2013) on citrus. Under salinity stress Fe concentration was reduced in all citrus species rootstocks except in Mexican lime and sour orange and increased the concentration of Zn in except in Bakraei. Salinity increased the concentration of Mn in all citrus species rootstocks and reduced the concentration of Cu and B except in Bakraei. The concentration of Cl increased in all species of citrus rootstocks with increased salinity level, (Aboutalebi *et al.* 2009).

Amino acid application significantly increased plant height, number branches and the percentage of dry matter of shoots and reduced the harmful effect of seawater salinity stress in bean plants and chamomile (Reda, *et al.* (1999); Omer, *et al.* (2013) and Sadak, *et al.* (2015)). Vegetative growth were significantly increased, especially with 50 mg ornithine / L., or 100 mg of either proline or cysteine/L., it could be concluded that foliar spraying of amino acids at rate of 3 cm/L. let to obtain the highest values of vegetative growth, yield and its quality of Chinese garlic plants, Fawzy *et al.* (2012). The interaction between highest level of salinity and high dose of amino acids gave the best results for plant height, number of branches as well as fresh and dry weights of flowers and the maximum values of Proline and polyphenol contents (Marhoon and Abbas 2015). Applications of amino acids to the nutrient solution have a beneficial effect on the leaf mineral status (Garcia *et al.* 2011).

Finally, in this study, we present information and data regarding the effect of amino acid on growth and nutrient uptake of C-35, X-639 hybrid and Troyer citrange citrus rootstocks seedlings under salinity conditions at transplanting stage. Hoping to try to reduce the damage of salinity on the growth of citrus trees to increase the yield and improve the quality attributes.

REVIEW OF LITERATURE

Many citrus rootstocks species suffer a decline in growth when exposed to salinity stress. Whereas, the inhibition of growth in long-term exposure to salt stress may result from : osmotic effects on water availability, reduction in net assimilation, specific ion effects, or ion imbalance due to interference with uptake of essential ions or a combination of any of those adverse factors.

The previous investigations were summarized under the following topics

1. **Effect of salinity treatments on**
   a. **Vegetative growth of some rootstocks**

Zekri and Parsons (1990) studied the effect of 40 mM NaCl. The observations showed that reduced sour orange seedlings root and shoot dry weights by approximately 30%, but did not induce leaf necrosis.

Nieves *et al.* (1991)studied the effect of salinity (40 or 80 mol NaCl) on growth of two 1-year-old lemon scion cultivars (Verna and Fino) budded onto either sour orange or Alemow (*Citrus macrophylla*) rootstocks. They found that reduced on growth parameters, but this effect was greater for scions budded on *macrophylla*.

Alva and Syvertsen (1991) studied the effect of irrigation by salinized water to an EC of about 0.3, 1.6 or 2.5 dS/m using a 3:1 ratio of NaCl: $CaCl_2$ plus uniform weekly applications of liquid fertilizer, applied through a drip system root densities of 8-year-old Valencia orange trees on either Carrizo citrange or sour orange rootstocks noticed thatroot densities of both rootstocks were increased by high salinity.

Also, root densities and organic matter percentages were higher in soil sampled under drippers than that sampled outward from drippers.

High salinity irrigation water reduced canopy growth of tree canopy of 6-year-old 'Valencia' orange trees budded on either Carizo citrange (CC) or sour orange (SO) rootstocks (Syvertsen *et al.* 1993).

In this trend, Aljuburi (1996) studied the effect of irrigation with saline water significantly influenced on growth of 1-year-old Volkamer lemon, *Macrophylla*, sour orange, Rough lemon and Balady lime rootstock seedlings and found that leaf DW of rough lemon and *C. Macrophylla* seedlings significantly increased and leaf DW of *C. volkameriana* and Balady lime significantly decreased. The leaf areas of Balady lime and rough lemon were not affected much by salinity treatments. In addition, rough lemon was the most resistant to high salinity in irrigation water.

In an experiment after 30 days of high salinity stress (0.025 or 0.1 M NaCl in irrigation water) Dunn *et al.* (1998) found thatplants exhibited a 38% reduction in growth than non-salt stressed plants of citrus trees.

El-Desouky and Atawia (1998) mentioned to Volkamer lemon and Rangpur lime rootstocks showed greater salt tolerance than sour orange and Cleopatra mandarin rootstocks. Whereas, the maximum tolerable salinity level was determined to be 4000 ppm.

Tozlu *et al.* (2000b) indicated that salt stress responses of *C. grandis*, *P. trifoliata* and their F1. Growth rates, as well as leaf and stem were determined for the three genotypes. The different growth habits resulted in significant differences between the net growth and growth ratios of the three genotypes and between control and salinized plants within each genotype. The average growth of all tissues was reduced in salinized plants compared to those of control plants. Average shoot dry weight reduction was greatest in *C. grandis* and least in *P. trifoliate* in the 40 mM NaCl treatment. While leaf tissues of *P. trifoliata* were the most sensitive to salinity. To avoid salt accumulation, *C. grandis* plants increased leaf mass production. They added that growth response to the different treatments was primarily affected by an osmotic effect, although in *C. macrophylla*.

Anjum *et al.* (2001) on Citrus rootstocks i.e.{Jattikhatti (*Citrus jambhiri*), Jambheri khatti*(C. jambhiri)* Gadadehi (*C. aurantium*), Kharna khatta (*C. karna*), Cleopatra mandarin (*C. reshni*) and Yuma citrange (*Poncirus trifoliata x C. sinensis*)} under salinity stress conditions assessed that gave a good seedling height (>32 cm) and number of leaves (>24) in control soil and the soil with ECe 2.0 dS m-1 anddepressed with further increase in soil salinity. Results divulged that Cleopatra mandarin and Gadadehi proved to be the most tolerant, while Kharna khatta was the least tolerant one and Jattikhatti, Jambheri khatti and Yuma citrange were moderately salt tolerant.

Working on seedlings of sour orange (*Citrus aurantium L.*) and *Citrus macrophylla Wester*) about Forty-five-day-old irrigated with different conc. of salinized water.Treatments reduced leaf dry mass more in *C. macrophylla* (40%) than in sour orange (20%) (Fernández-Ballester*et al.* 2003).

Han Seung Gab *et al.* (2004) observed that growth retardation and leaf burn. Treatment of Satsuma mandarins with dilutions of seawater resulted in defoliation.When irrigation Satsuma mandarin orchards by saline water recorded EC values over 1.0 dS/m, up to 4.5 dS/m.

Singh *et al.* (2004) reported that the increase in the salinity level reduced plant height, stem diameter and number of leaves per seedling. The reduction in these parameters was lowest in *C. limonia*, followed by *C. jambhiri* and *P. trifoliata.* Based on the pattern of growth, *C. limonia* was tolerant, *C. jambhiri* was moderately tolerant, and *P. trifoliata* was susceptible to salinity.

Camara-Zapata *et al.* (2004) noticed thatsalinization reduced plant dry weight more in sour orange than in Cleopatra mandarin plants. Growth of both cultivars was not recovered totally in the relief period, since relative growth rates of recovered plants were lower than in the control plants after 60 days of relief.Onone-year-old seedlings of Cleopatra mandarin (*Citrus reticulata*) and sour orange (*Citrus aurantium*).

Al-Yassin (2005) mentioned that water salinity reduces citrus trees growth and causes physiological disorders. Also, it is a major problem of its negative influence on the yields of many crops.

Garcia-Sanchez and Syverstsen (2006) indicated that salinity decreased plant growth and shoot/root ratio of Cleopatra mandarin and Carrizo citrange citrus rootstocks seedlings.

Turhan and Atilla (2007) studied the effect of salt stress on growth of strawberry plants and found thathigh NaCl concentrations caused serious reductions in growth parameters such as fresh weight (FW) of leaves and stems, leaf area and the number of leaves. Also, leaf temperature was increased with salt treatments.

Otherwise, Aboutalebi *et al.* (2007) on sweet lime grafted on different rootstocks including sour orange (*C. aurantium*), sweet lime (*C. limetta*), Mexican lime (*C. aurantiifolia*), Volkameriana (*C. volkameriana*) and Bakraii (*C. reticulata* x *C. limetta*) under salinity treatments showed thatdifferent changes occurred in fresh and dry weights of scions among the rootstocks. Volkameriana, and to some extent Bakraii, could induce salinity resistance in sweet lime scions.

Melgar *et al.* (2008) reported thatsalinity reduced total plant dry mass on Citrus and olive plants watered with half strength Hoagland's solution plus 0 or 50 mM NaCl for citrus, or plus 0 or 100 mM NaCl for olive.

Furthermore, Abd El-Aziz *et al.* (2008) reported that, Salinity had negative effects on: leaf defoliation, leaf injury and vegetative growth for some citrus rootstocks. Moreover, Cleopatra mandarin is considered as a salt tolerant rootstock, sour orange and Volkamer lemon can be considered as moderate tolerant rootstock and Troyer Citrange was a salt sensitive rootstock.

Ariel Meloni *et al.* (2008) evaluated the salt stress tolerance of citrumelo (*C. paradisi* x *Poncirus trifoliata*) cv.75 AB in comparison with Cleopatra mandarin (*Citrus reticulata*), which is known worldwide a high stress resistance. Whereas, seedlings of both species were incubated between paper towels damped with distilled water or 30 mM NaCI solutions. The growth of Cleopatra was more sensitive to salinity than that of 75AB. Whereas, the relative water content was kept constant in both rootstocks.