Journal

J. Biol. Chem. Environ. Sci., 2010, Vol. 5(4):129-141
www.acepsag.org

# EFFECT OF SOME CITRUS ROOTSTOCKS ON VEGETATIVE GROWTH AND LEAF MINERAL CONTENT OF BALADY LIME TRANSPLANTS

**Manal1 Abd-Alla.1; Abo2-S. R. ; El- Gazzar, A.3 and El-Wakeel H.3**

*1- Production sector, Agric. Res. Center. Egypt.*
*2-Preeding Dept. Hort. Inst. Agric. Res. Center. Giza, Egypt*
*3-Hort.,Dept., Fac. of Agric., Ain Shams Univ., Shoubra El-Khiema, Cairo, Egypt.*

## ABSTRACT

This study was carried out in the Saran house of the horticulture Institute, Agriculture Research Center Ministry of Agriculture and Land Reclamation Giza, Egypt during (2008/2009) and (2009/2010) seasons. Balady lime (B.L.) *Citrus aruntifollia* budded on four seedy citrus rootstocks seedling namely: Volkamer lemon (V.L.) *Citrus volkmeriana* Ten.& Pasq. ; Sour orange (S.O.) *Citrus aurantium* (L.); Rangpur lime (R.L.) *Citrus limonia* Osb. and *Troyer citrange* (T.C.) [*Citrus sinensis*(L.)Osb. X *Poncirus trifolliata* (L.) Raf] as well as seedy lime seedlings were used as five treatments. This investigation aimed to study the effect of some citrus rootstocks on vegetative growth and leaf mineral content of balady lime. The obtained results indicated that, Volkmer lemon rootstock had the highest significant effect on plant height, number of leaf per plant and stem thickness Whereas, Troyer citrange rootstock gave the lowest significant leaf area , Meanwhile ,Volkamer lemon roostock recorded the highest significant values of fresh and dry weight of leaves and stems, Root fresh weight was the highest significantly with Volkamer lemon rootstock and seedy lime seedling, Whereas root dry weight was the lowest value with Troyer citrange rootstock. Leaf N, P, Ca, and Mg contents recorded insignificant differences among treatments but leaf K content had lower significant values with Sour orange and Troyer citrange rootstock. Leaf Fe, Zn, and Mn contents had insignificant differences among treatments.

**Key words**: *Citrus aurantifolia*- Citrus rootstocks- Vegetative growth - Leaf mineral content.

# INTRODUCTION

Egyptian citrus production reached about 3.1 million tons produced from 394500 feddan and there are about 40000 feddan of Balady lime (according to the statistics of M.A.L.R.2007).Selection of suitable rootstock is an important decision for growers, because rootstock has a significant effect on scion growth and root mineral contents. The effect of rootstocks on growth parameters had been studied by many workers such as Monteverde *et.al.*(1989) , Martinez *et al* (1991), Valbuena (1994), El sayed (1999) and Dawood (2001). They concluded that both of Volkamer lemon and Rangpur lime rootstocks exhibited the most vigour growth characterized by longer tree height, larger tree volume, thiner trunk, higher number of new shoots, larger leaf area and leaf number per plant of different citrus varieties. Zayan *et.al.* (2004) indicated that, Volkamer lemon and Rangpur lime produced the highest tree height, trunk diameter, canopy volume, trunk cross sectional area. On the other hand, trees on Sour orange and Troyer citrange rootstocks recorded intermediate values with most growth parameters. Hafez (2006) worked on Troyer citrange, Rangpure lime and Volkamer lemon rootstocks, mentioned that, Troyer citrange seedlings had the highest values of vegetative growth characteristics. Khankahdani *et.al.* (2006) reported that, scions on Volkamer lemon rootstock caused faster vegetative growth compared to the other rootstocks. El-Kady *et.al.* (2007) reported that, trees on Volkamer lemon gave a longer shoots with more number of leaves per shoot and leaf area than those on Rangpure lime or Sour orange rootstocks.Bassal (2009) concluded that, trees budded on Sour orange showed higher vegetative growth parameters.

Saleh and El-Shammaa(1997) found that Volkamer exhibited high N, K and Ca percentages followed by Troyer citrange. Abo- El-Komsan (1998) reported that Sour orange rootstock had the lowest leaf P and Fe content. Azab (1998) showed that, leaves of *C. macrophylla*, *C. volkameriana* and Rangpur lime contained significantly higher N, P, K, Fe, Mn and Cu and lower contents of carbohydrates. Georgiou (2000) and (2002) revealed that, leaf analysis showed that Volkamer lemon are the most promising for replacing the sour orange rootstocks which are used commercially in Cyprus but

which are highly susceptible to tristeza. Moeen *et .al* .(2001) cleared that, Rangpur lime seedling had the highest content of N, P, K and Mn in their leaves.Dawood *et. al.* (2002) noticed that, *C. volkameriana* and Rangpur lime rootstocks are characterized by higher leaf concentrations of N, K, Ca, Mg, Fe and Zn, lower C:N, N:K and higher K:Na ratio. Georgiou (2002) Volkamer lemon were very promising as alternative rootstock. Sayed *et. al.* (2003) stated that, Volkamer lemon registered the greatest leaf N, P, K, F, Zn and Mn contents. Sour orange had the highest leaf chlorophyll a and b, and Ca and Mg contents in both studied years. Hafez (2006) noticed that, macronutrients (N, P and K) in both leaves and roots recorded the highest values with the Sour orange rootstock seedlings. As for micronutrients (Fe, Mn and Zn), the highest values in the leaves were recorded by the Volkamer lemon. Khankahdani *et.al.* (2006) found, that the highest P content was obtained from scions on Volkamer lemon, Ca on Sour orange, Cu on Volkamer Lemon, Zn on Mexican lime and Clementine and Mn on Lisbon lemon.

## MATERIALS AND METHODS

This study was carried out in the Saran house of the horticulture Institute, Agriculture Research Center Ministry of Agriculture and Land Reclamation Giza, Egypt during (2008/2009) and (2009/2010) seasons. Balady lime cv. (B.L.) *Citrus aruntifollia* cv. budded on four seedy citrus rootstocks seedling namely: Sour orange (S.O.) *Citrus aurantium* (L.); Rangpur lime (R.L.) *Citrus limonia* Osb. *;* Volkamer lemon (V.L.) *Citrus volkmeriana* Ten.& Pasq. and *Troyer citrange* (T.C.) [*Citrus sinensis*(L.)Osb. x *Poncirus trifolliata* (L.) Raf.]. These budded transplants were planted in black polyethylene bags (10 x 20 cm) filled with sand. Some holes were made in the bottom of bags to drainage excess water. Transplants received weekly irrigation by nutrient solution and watered as needed.

**The experiment contained five treatments as follow:**

1- Seedy balady lime seedling (control).
2- Balady lime budded on Sour orange rootstock.
3- Balady lime budded on Volkmer lemon rootstock.
4- Balady lime budded on Rangpur lime rootstock.
5- Balady lime budded on Troyer citrange rootstock.

Each treatment was represented by five replicates and each with two plants in a completely randomized design. Two months after budding the following data and measurements were recorded every two months: Scion length, scion thickness at 10 cm above union zone (lime seedy thickness at 25 cm above soil surface) and leaf number per plant. At the end of each season (Jun.), leaf area was recorded. Leaves, stems and roots of each transplant were gathered and washed with tap water then with distilled water the dried at 70°C till a constant weight, ground in electric mill and digested according to (Chapman and Part, 1961).

The following parameters were recorded:

**I. Vegetative growth:** Vegetative growth was evaluated through the two growing seasons after budding. And every two months from Aug. to the following June as follows Plant height, leaf number per plant ,stem thickness increment and leaf area .

**1.1. Plant height (cm):** Plant height from union zone in the budded plant and at 15 cm from soil surface in the seedy lime plant and up to the plant tip.

**1.2. Leaves number per plant:** It was counted for each transplant and expressed as percent of increment.

**1.3 Stem thickness (cm):** Stem thickness was measured by using a Venier Caliper at, 10 cm above union zone inbudded transplants and 25 from soil surface for seedy transplants (control) and expressed as % of increment.

**1.4. Leaf area ($cm^2$):** Average Leaf area was measured for each transplant at the end of each of growing seasons. A representative sample of 15 leaves was randomly chosen from each replicate and subjected to measure their average leaf area using equation Ahmed and Morsy (1999).

**1.5. Leaf, shoots and roots fresh and dry weights (g):** At the end of each growing season, fresh and dry weights of leaves, shoots and roots were determined, where each replicate was represented by one transplant.

**1.6. Top/root ratio:** Leaves plus stem fresh weights and dry were divided on root fresh and dry weights to obtain the ratio for each treatment at the end of each of growing seasons.

**II. Leaf mineral content:** Nitrogen was determined by Microkjeldahl method (jakson, 1967). Phosphorus was determined by the method of (Truog and Meyer, 1929).Potassium was determined by the method of the flame photometer according to the method of (Brown and Lilleland, 1946).Calcium and magnesium were determined by titration against versenate solution(Chapman and Pratt, 1961). Iron, zinc and manganese were estimated by using Atomic Absorption spectrophotometer.

**Statistical analysis:**

Data obtained throughout this study were statistically analyzed using the analysis of variance method as reported by(Snedecor and Cochran,1980).and the differences between means were differentiated by using Duncan's range test.

## RESULTS AND DISCUSSION

**I. Effect on vegetative growth:**

As shown in table (1) regard to the effect of rootstocks, Volkamer lemon had the highest significant effect on plant height increment percentage in the first season. Concerning to the effect of recording date the plant height increment percent was the highest significantly in Oct., Apr. and June. The interaction between two studied factors, revealed that Volkamer lemon. At Oct. gave highest significant value of plant height increment percentage.

**Table (1) Effect of some citrus rootstocks, on plant height increment percentage of Balady lime transplants at the first season (2008/2009)**

| Rootstock | Recording date | | | | | Mean |
|---|---|---|---|---|---|---|
| | Oct. | Dec. | Feb. | Apr. | Jun. | |
| ( lime seedling) Control | 10.8de | 10.0de | 5.4fg | 9.2de | 10.1de | **9.1B** |
| Volkamer lemon | 18.0a | 11.4d | 7.4ef | 15.0b | 13.6c | **13.0A** |
| Rangpur lime | 4.7fgh | 3.4gh | 3.0gh | 3.6gh | 4.0fgh | **3.7C** |
| Sour orange | 4.2fgh | 3.2gh | 2.3gh | 3.1gh | 2.8gh | **3.1C** |
| Troyer citrang | 2.0gh | 3.0gh | 1.1h | 2.0gh | 1.6gh | **1.9C** |
| **Mean** | **7.3A** | **6.2B** | **3.8C** | **7.1A** | **7.6A** | |

Means having the same letter (s) in each row, column or interaction are not significantly different at 5% level.

Data in table (2) with regard to the effect of rootstocks, Volkamer lemon had highest significant effect on plant height compared to all other rootstocks in the second season. Concerning to the effect of recording date the plant height increment percent was the highest significantly in Oct. and Apr compared to other dates. The interaction between the two studied factors,proved that Volkamer at Oct. had the highest significant effect on plant height increment percentage .

**Table (2) Effect of some citrus rootstocks, on plant height increment percentage of Balady lime transplants at the second season (2009/2010).**

| Rootstock | Recording date | | | | | Mean |
|---|---|---|---|---|---|---|
| | Oct. | Dec. | Feb. | Apr. | Jun. | |
| ( lime seedling)Control | 7.6def | 8.6de | 4.5fgh | 9.0de | 8.8de | **7.7B** |
| Volkamer lemon | 18.1a | 9.8d | 5.5efg | 15.3b | 11.6c | **12.4A** |
| Rangpur lime | 2.5hi | 2.5hi | 2.1hi | 3.3ghi | 2.5hi | **2.5C** |
| Sour orange | 2.3hi | 2.1hi | 1.5hi | 3.1ghi | 2.1hi | **1.8C** |
| Troyer citrang | 1.3hi | 2.0hi | 0.5i | 1.3hi | 0.8hi | **1.1C** |
| **Mean** | **6.2A** | **5.0B** | **2.8C** | **6.4A** | **5.1B** | |

Means having the same letter (s) in each row, column or interaction are not significantly different at 5% level.

In table (3) and regard to the effect of rootstocks, Volkamer lemon had highest significant effect on number of leaves per plant as increment percentage. Concerning to the effect of recording date on number of leaves per plant increment percent was the highest significantly in Oct., Apr. and Jun. The interaction between the two studied factors showed that Volkamer lemon at Oct. had the highest significant value.

Results in table (4) with regard to the effect of rootstocks, Volkamer lemon gave the highest significant value of number of leaves per plant as increment percentage in the second season. Concerning to the effect of recording date, Oct. and Apr. had the highest significant value. The interaction between the two studied factors indicated that Volkamer lemon at Oct. had highest significant value.

**Table (3). Effect of some citrus rootstocks, data on number of leaves per plant as increment percentage of Balady lime transplants at the first season (2008/2009).**

| Rootstock | Recording date | | | | | Mean |
|---|---|---|---|---|---|---|
| | *Oct.* | *Dec.* | *Feb.* | *Apr.* | *Jun.* | |
| ( lime seedling)Control | 17.6b-f | 14.0c-f | 15.0c-f | 21.3bcd | 21.0bcd | **17.7B** |
| Volkamer lemon | 35.0a | 29.0b | 25.0b | 29.0b | 21.3bcd | **27.8A** |
| Rangpur lime | 15.3c-f | 11.3def | 12.6c-f | 18.3b-e | 18.3b-e | **15.1B** |
| Sour orange | 14.1c-f | 11.0def | 7.0f | 10.3def | 17.0b-f | **11.8C** |
| Troyer citrang | 11.6c-f | 9.6def | 4.6f | 7.3ef | 9.1def | **8.4C** |
| *Mean* | **18.7A** | **14.9B** | **12.8B** | **17.2A** | **17.3A** | |

Means having the same letter (s) in each row, column or interaction are not significantly different at 5% level.

**Table (4) Effect of some citrus rootstock, on number of leaves per plant increment percentage of Balady lime transplants at the second season (2009/2010).**

| Rootstocks | Recording date | | | | | Mean |
|---|---|---|---|---|---|---|
| | *Oct.* | *Dec.* | *Feb.* | *Apr.* | *Jun.* | |
| ( lime seedling)Control | 21.5b-g | 20.3c-g | 25.6b-f | 31.0bcd | 31.1bcd | **25.9B** |
| Volkamer lemon | 41.3a | 37.0b | 34.2bc | 35.4bc | 36.9bc | **36.9A** |
| Rangpur lime | 21.0b-g | 16.4d-g | 16.8d-g | 29.0b-c | 23.2b-f | **21.2B** |
| Sour orange | 20.4c-g | 15.5d-g | 10.0fg | 25.9b-f | 14.7d-g | **17.3B** |
| Troyer citrang | 19.2b-g | 11.0efg | 6.4g | 13.9efg | 10.1fg | **10.7C** |
| *Mean* | **28.9A** | **20.4C** | **18.6C** | **27.0A\B** | **23.2B\C** | |

Means having the same letter (s) in each row, column or interaction are not significantly different at 5% level.

As shown in table (5) and regard to the effect of rootstocks, Volkamer lemon gave the highest significant value of stem thickness as increment percentage in the first season. Concerning to the effect of recording date, Apr. and June recorded the highest significant values. The interaction between the two studied factors,reveald that Volkamer lemon at Oct. had the highest significant value.

**Table (5) Effect of some citrus rootstock on stem thickness as increment percentage of Balady lime transplants at the first season (2009/2010).**

| *Rootstocks* | Recording date | | | | | *Mean* |
|---|---|---|---|---|---|---|
| | *Oct.* | *Dec.* | *Feb.* | *Apr.* | *Jun.* | |
| **Control( lime seedling)** | 1.51def | 3.00a-e | 3.66abc | 1.66def | 1.16f | **2.20B** |
| **Volkamer lemon** | 4.66a | 2.33b-f | 3.83ab | 3.66abc | 3.83ab | **3.66A** |
| **Rangpur lime** | 2.50b-f | 2.5b-f | 3.16a-d | 2.00c-f | 1.50def | **2.33B** |
| **Sour orange** | 1.50def | 1.16f | 1.33ef | 1.16f | 1.00f | **1.23C** |
| **Troyer citrang** | 2.16b-f | 2.50b-f | 1.33ef | 1.33f | 1.00f | **1.66BC** |
| **Mean** | **2.46A** | **2.29A** | **2.66A** | **1.96A** | **1.69A** | |

Means having the same letter (s) in each row, column or interaction are not significantly different at 5% level.

In table (6) regarding to the effect of rootstocks, Volkamer lemon had the highest significantly value of stem thickness increment as percentage in the second season. Concerning to the effect of recording date, Apr. showed the highest significant value. The interaction between the two studied factors,indicated that Volkamer lemon at Oct. had highest significant value.

**Table (6) Effect of some citrus rootstock on stem thickness increment percentage of Balady lime transplants at the second season (2009/2010).**

| *Rootstocks* | Recording date | | | | | *Mean* |
|---|---|---|---|---|---|---|
| | *Oct.* | *Dec.* | *Feb.* | *Apr.* | *Jun.* | |
| **Control( lime seedling)** | 2.00d-g | 3.50a-e | 4.16abc | 2.16d-h | 1.50fgh | **2.66B** |
| **Volkamer lemon** | 5.16a | 2.83b-g | 4.33ab | 4.16abc | 4.33ab | **4.16A** |
| **Rangpur lime** | 3.00b-f | 3.00b-f | 3.66a-d | 2.50c-h | 2.00d-h | **2.83B** |
| **Sour orange** | 2.66b-h | 3.03b-f | 1.83fgh | 1.33fgh | 1.00h | **1.97BC** |
| **Troyer citrang** | 2.00d-g | 1.66fgh | 1.66fgh | 1.16gh | 1.00h | **1.50C** |
| **Mean** | **2.96A'** | **2.80A'** | **3.13A'** | **2.26A'** | **1.96A'** | |

Means having the same letter (s) in each row, column or interaction are not significantly different at 5% level.

Results in table (7) in the first season, showed that Troyer citrange gave the lowest significant leaf area value. Whereas Volkamer lemon recorded the highest significant values of fresh and dry weight of leaves and stem. Root fresh weight was the highest significant with Volkamer lemon and seedy lime seedling. Root dry weight had the lowest significant value with Troyer citrange. Top/root ratio of fresh and dry weight showed the lowest significant values with Sour orange and Troyer citrange. In the second season, leaf area showed highest significant value with Volkamer lemon. Leaf fresh and dry weight were the highest significant with Volkamer lemon. Sour orange gave higher significant values than that of most other treatments. Troyer citrange recorded lower significant values of top/root ratio of fresh and dry weight compared with most of other rootstocks.

**Table (7) Effect of some citrus rootstocks on leaf area, leaves, stems, root fresh and weight and top/root ratio at both studied seasons.**

| Rootstocks | Leaf area $(cm)_2$ | Fresh weight(g) | | | Dry weight(g) | | | Top/root ratio | |
|---|---|---|---|---|---|---|---|---|---|
| | | Leaves | shoots | Root | Leaves | Shoots | Root | F.W | D.W |
| | First season (June 2009) | | | | | | | | |
| ( lime seedling)Control | 14.1ab | 8.0ab | 18.2ab | 15.1a | 2.7ab | 8.9ab | 5.5a | 1.8a | 2.1a |
| Volkamer lemon | 18.3a | 10.7a | 21.6a | 14.1a | 3.8a | 10.7a | 6.9a | 2.1a | 2.1a |
| Rangpur lime | 17.6a | 5.7bc | 12.3b | 11.8ab | 2.5ab | 6.5b | 5.4a | 1.5a | 1.6a |
| Sour orange | 15.5a | 4.1c | 6.1c | 8.9b | 1.9bc | 3.1c | 5.0a | 1.1ab | 1.0ab |
| Troyer citrang | 11.7b | 1.9c | 5.1c | 5.9b | 1.0c | 2.1c | 3.3b | 1.1ab | .9ab |
| Second season (June 2010) | | | | | | | | | |
| ( lime seedling)Control | 15.1bc | 9.5ab | 19.8a | 14.5a | 3.3a | 8.8a | 6.0ab | 2.0a | 2.0a |
| Volkamer lemon | 19.6a | 13.5a | 22.5a | 15.8a | 5.3a | 10.8a | 7.1a | 2.2a | 2.2a |
| Rangpur lime | 18ab | 6.1b | 10.8b | 11.9ab | 2.3b | 6.8b | 5.5b | 1.4b | 1.6b |
| Sour orange | 16.6ab | 5.5bc | 8.1b | 10.0b | 2.1b | 4.1c | 5.1b | 1.3b | 1.2b |
| Troyer citrang | 12.3c | 3.9c | 5.1c | 7.5c | 1.3c | 2.1d | 3.3c | 1.2b | 1.0b |

Means having the same letter (s) in each column are not significant at 5% level.

**II. Effect on leaf mineral content**:

As shown in table (8) and regarding to macronutrients, N, P, Ca, and Mg leaf content recorded insignificant differences among treatments but leaf K content had lower significant values with Sour orange and Troyer citrange rootstocks compared with other rootstocks. Concerning to micronutrients, Fe, Zn, and Mn leaf content gave insignificant differences among treatments.

**Table (8) Effect of some citrus rootstocks on leaf mineral contents of Baldy lime transplants at the first and the second seasons.**

| Rootstocks | macronutrient % | | | | | micronutrient ppm | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | Ca | Mg | Fe | Zn | Mn |
| **First season(June 2009)** | | | | | | | | |
| ( lime seedling)Control | 2.34a | 0.17a | 1.09a | 3.79a | 0.63a | 158a | 31.3a | 37a |
| Volkamer lemon | 2.73a | 0.19a | 1.07ab | 3.63a | 0.64a | 130a | 30a | 32a |
| Rangpur lime | 2.35a | 0.18a | 1.11a | 3.35a | 0.16a | 193a | 31a | 35a |
| Sour orange | 2.16a | 0.15a | .91c | 3.4a | 0.58a | 218a | 31a | 33a |
| Troyer citrang | 2.06a | 0.16a | .93cb | 3.8a | 0.59a | 170a | 30a | 34a |
| **Second season ( June 2010)** | | | | | | | | |
| ( lime seedling)Control | 2.39a | 0.21a | 1.11a | 3.8a | 0.64a | 162a | 32a | 38a |
| Volkamer lemon | 2.78a | 0.22a | 1.59a | 3.64a | 0.65a | 131a | 31a | 33a |
| Rangpur lime | 2.40a | 0.19a | 1.12a | 3.36a | 0.63a | 198a | 32a | 36a |
| Sour orange | 2.23a | 0.17a | 0.92b | 3.41a | 0.60a | 225a | 32a | 34a |
| Troyer citrang | 2.13a | 0.17a | 0.94b | 3.81a | 0.60a | 178a | 31a | 34a |
| *Optimum level* | 2.4-2.6 | .12-.16 | .70-1.09 | 3-5.5 | .26-.96 | 60-120 | 25-100 | 25-200 |

Means having the same letter (s) in each column are not significant at 5% level.

Finally, from the previously mentioned data it could be concluded that, Volkamer lemon. At Oct. had the highest significant effect on plant height, number of leaves per plant, stem thickness as increment percentages. Also it could be mentioned that, Troyer citrange gave the lowest significant leaf area. Whereas Volkamer lemon rootstock recorded the highest significant values of fresh and dry weight of leaves and stems. Root fresh weight was the highest significant with Volkamer lemon and seedy lime seedling, root dry

weight had the lowest significant value with Troyer citrange. Leaf N, P, Ca, and Mg contents recorded insignificant differences among treatments but leaf K content had lower significant values with Sour orange and Troyer citrange.Leaf Fe, Zn, and Mn contents had insignificant differences among treatments. These results are in harmony with those found by El Sayed (1999), Zayan *et al*. (2004) and El Kady *et al.* (2007) where they reported that Volkamer lemon had superior effect on vegetative growth parameters. But differ than those found by Dawood *et al.* (2002) and Hafez (2006)where they mentioned that there was great effect of rootstocks on leaf mineral content.

## REFERENCES

Abo El-Komsan, E.G., (1998). Evaluation of some grapefruit cultivars budded on different Citrus rootstocks grown in Middle Egypt. Ph.D. Thesis, Fac. Agric., Cairo Univ., P 242. Egypt.

Ahmed F.F. and M.H. Morsy (1999) A new method for measuring leaf area in different fruit species. Minia J. of Agric. Res. & Develop.Vol. (19) pp 97-105. Egypt.

Azab, S.A.(1998). Leaf and root chemical constituents of seven citrus rootstocks under the arid environment of Qatar. Arab-Gulf-Journal-of-Scientific-Research. 16(1) 81:96.

Bassal, M.A. (2009). Growth, yield and fruit quality of 'Marisol' clementine grown on four rootstocks in Egypt. Scientia Horticlturae.119: 2,132-137.

Brown, J.D. and O. Lilleland (1946) Uptake determination of potassium and sodium in plant material and soil extracts by Flame photometry. Proc. Am. Soc., 48,341-346.

Chapman , H.D. and P.F. Pratt (1961) Method of Analysis for Soils , Plants and Waters , Univ. California, Div. Agric. Sci. Priced Pub. 4034. U.S.A.

Dawood, S.A. (2001). Growth, yield, fruit quality and leaf mineral content of Valencia orange trees on Sour orange and Volkamer lemon grown on slightly alkaline clay soil. J. Agric. Res. Tanta Univ.,27(4):726-736.Egypt.

Dawood, S.A. ; El-Sammak, A.F. ; Mohamed, E.M. ; and S.A. El-Sayed (2002). Evaluation of three-citrus varieties buded on five-citrus rootstocks grown on slightly saline alkaline soil at Sakha, Kafr El-Sheikh Governorate. (2)Leaf mineral content, some leaf

nutritional balance and leaf miners infection. Egyptian-Journal-of-Agricultural-Research.; 80(2): 709-725.Egypt.

El-Kady, M.I.; B.N. Samra and M. Arafat (2007). Evaluation of growth and fruiting of Valencia orange trees on different citrus rootstocks. J. Agric. Sci. Mansoura Univ., 32(8):6551-6562,Egypt.

El-Syed, Somaia A. (1999). Physiological studies on some orange varieties budded on different rootstocks. Ph. D. Thesis, Fac. Agric., Tanta Univ.Egypt.

Georgiou, A. (2000). Performance of "Nova" mandarin on eleven rootstocks in Cyprus. Scientia Horticulturae 84:115-126.

Grorgiou, A. (2002). Evaluation of rootstocks for "Clementine" mandarin in Cyprus. Scientia Horticulturae 93:29-38.

Hafez, O.M. (2006).Evaluation of growth characteristics of some citrus rootstocks protein finger print technique. American. Eurasian. Journal. Of – Agricultural – and -Environmental-science.1(3):243-248.

Jakson , M.L. (1967) Soil chemical analysis , Makhija Offset Press, New Delhi, India.

Khankahdani, H.H. ; A. Hasanpour,; A. Aboutalebi, (2006). Effects of different rootstocks on vegetative growth, dry matter and mineral concentration of Mexican lime (Citrus aurantifolia Swingle). Seed and Plant. 2006. 22: 2, Pe155-Pe166, en12. 15 ref. Iran

Marathe, R.A. ; Shyam Singh ; Lallan Ram and R.K. Sonkar, . (2000). Rootstock behavior in relation to leaf nutrients composition of acid lime (*Citrus aurantifolia* Swingle). Indian-Journal- of- Horticulture. 57: 2, 95-101.

Martinez, C.; H. Lima and J. Rivas (1991). Growth and productivity of 5 types of Valencia orange on different rootstocks during the developmental phase. Agrotecnia de Cuba 23 (1/2) 51-55. [c.f.Hort.Abst.64(1);710].

Moeen-Ud-Din ; Muhammad Ibrahim and A-S Khan,(2001). Effect of traditional and hybrid rootstocks on leaf mineral composition and reproductive characteristics of kinnow mandarin (*Citrus reticulate* Blanco). International Journal of Agriculture and Biology.. 3:(4), 491-493.

Monteverde, E.E. (1989): Evaluation of Valencia orange on ten rootstocks in high altitude valleys in Carabobo- Yaracuy. I. Yields, growth and efficiency. Fonalap Divulga, 7 (31) 6-9 . [c.f. Hort. Abst. 62(1) : 703].

Saleh, Malaka A. and M.S. El-Shamaa(1997). Performance of Valancia orange on some rootstocks grown in sandy soils. J. Agric. Sci. Mansoura Univ., 22(10): 3283-3295. Egypt.

Snedecor , G.W. and W.G. Cochran (1980) Statistical Methods . 7th Ed.507 pp Iowa State Univ. Press, Ames . Iowa , U.S.A. .

Truog , E. and A.H. Meyer (1929) Improvement of the Denige,s coloremetric method for phosphorus and arsenic .Ind. Eng. Chem. Anal. Ed.1, 136-139.

Zayan, M.A. ; S.M. Zeerban; H.M. Ayaad; S.A. Dawood andH. A. Enaab(2004). Evaluation study on Washington navel orange cultivar budded on five rootstocks.1. Vegetative growth, root distribution and ability to salt tolerance. J. Agric. Res. Tanta Univ. 30(2)404-420. Egypt.

## تأثير بعض الأصول الجذرية على النمو الخضرى والمحتوى المعدنى لشتلات الليمون البلدى المالح

**منال عبد الله[1]- رمضان ابو سريع[2]- احمد الجزار[3]- حسن الوكيل[3]**

[1] أخصائى زراعى – قطاع الانتاج- مركزالبحوث الزراعيه . [2] معهد بحوث البساتين - مركزالبحوث الزراعيه - الجيزه – مصر.

[3] قسم البساتين – كلية الزراعه – جامعة عين شمس – شبرا الخيمة – القاهرة – مصر .

أجريت هذه الدراسة بالصوبة ا لثران بمعهد بحوث البساتين بمركز البحوث الزراعية بوزارة الزراعة وأستصلاح الأراضي خلال موسمي 2009/2008 و 2010/2009. طعم الليمون البلدي على اربعة اصول هي الفولكامريانا والليمون رانجبور والنارنج والترويير سترانج بالأضافة الى شتلات الليمون البذرية كخمسة معاملات للتجربة. هدف البحث الى دراسة تأثير بعض الأصول الجذرية على النمو الخضري والمحتوى المعدني للأوراق لشتلات الليمون البلدي.اوضحت النتائج المتحصل عليها تفوق الفولكامريانا في اعطاء زيادة معنوية في النسبة المئوية للزيادة في كل من ارتفاع النبات وعدد الأوراق وسمك الساق. كما اتضح أن الترويير سترانج أعطي أقل القيم معنويا لمساحة الورقة والوزن الجاف للجذور . وسجل الفولكامريانا أعلى القيم معنويا لكل من الوزن الطازج والجاف للأوراق والسيقان. وزاد الوزن الطازج معنويا للجذور مع الفولكامريانا والليمون البذري. لم يظهر أي فروق معنوية بين المعاملات في محتوى الأوراق لكل من( ن و فو وكا ومغ) بينما كانت نسبة البوتاسيوم أقل معنويا بأوراق النارنج والترويير سترانج. كما كان مستوى العناصر الصغرى (حديد وزنك ومنجنيز) بالأوراق متساوي معنويا بين المعاملات.