Comparative Study of The Yield and Fruit Quality of Salustiana Orange Cv. Grafted on Some Citrus Rootstocks

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To evaluate the effect of the three citrus rootstocks: Sour orange, Rough lemon and Cleopatra mandarin on yield and fruit quality of Salustiana orange (Citrus sinensis L. Osbeck) trees a study was conducted during the two successive seasons of 2018 and 2019. The experimental trees were 12-year-old and grown in sandy soil in Wadi El-Natron region, Behira Governorate, Egypt. The obtained results indicated the Salustiana orange trees budded on Rough lemon had greater the yield/tree, fruit weight, size, fruit dimensions, pulp and peel weights/fruit as well as peel thickness than those on Cleopatra mandarin and sour orange. Juice TSS percentage and TSS/acid ratio of fruits for trees budded on sour orange were higher than those on rough lemon and Cleopatra mandarin. Juice volume/fruit for trees budded on sour orange were smaller than those budded on rough lemon and Cleopatra mandarin.

While, total acidity percentage was higher in fruits of trees budded on rough lemon than those on Cleopatra mandarin. Seed number and weight/fruit of trees budded on rough lemon reached 10.38 & 11.12 and 6.45 & 10.30 folds its values on sour orange in the both seasons. The corresponding values for trees budded on Cleopatra mandarin trees were 6.98 & 10.59 and 6.35 & 10.15 folds, respectively. This indicates that rootstock type may affect fertility of reproductive organs of Salustiana flowers, especially ovules.

Keywords: Citrus, Salustiana orange, Rootstocks, Yield, Fruit quality.
characters including: tree health and size, root system distribution and depth, low temperature tolerance, adaptability to some unsuitable soil conditions, nematodes and diseases resistance as well as tree yield, fruit quality and nutrient status (Legua et al., 2014; Somkuwar et al., 2015; Tietel et al., 2020). The effect of rootstocks on fruit quality incidences such as fruit volume, weight, rind thickness, juice content, TSS and acidity percentages of scion cultivars have been reported by many researchers (Mehrotta et al., 2000; Zekri and Al-Jaleel, 2004; Al-Jaleel et al., 2005; Ramin and Alirezanezhad, 2005; Muhtaseb and Ghnaim, 2006 and Ahmed et al., 2007). Ghnaim (1993), Georgiou and Georgiou (1999) and Muhtaseb and Ghnaim (2006) stated that fruit size, weight, rind thickness, juice content, Brix and total acids of Shamouti orange fruits were affected by rootstock type. Similar trends were reported on other sweet orange cultivars (Wheaton et al., 1991 & 1995).

The previous works have shown that citrus rootstocks impact invertely on scion growth such as environmental and soil conditions (Forner-Giner et al., 2014; Chahal and Gill, 2015). The chosen of appropriate graft is essential for the production of fruits because of effects physiological both scion and rootstock relations of each other (Sharma et al., 2015), minerals uptake (Toplu et al., 2012 and Hayat et al., 2019), vigor and yield behavior (Mallick et al., 2019 and Martins et al., 2020).

This study carried out to evaluate the effect of some different rootstocks citrus as Sour orange, Rough lemon and Cleopatra mandarin rootstocks on yield, physical and chemical fruit characteristics of Salustiana sweet orange trees.

**Materials and Methods**

This work was carried out on randomly picked ripe fruit samples in the first week of December in 2018 and 2019 seasons from similar mature Salustiana orange budded on three rootstocks namely: Rour orange, Rough lemon and Cleopatra mandarin and grown in sandy soil of the citrus orchard in Wadi El-Natron region, Behira Governorate, Egypt. The trees received similar cultural practices in respect of irrigation, fertilization, pest management and weeding. This investigation was planned to study the effect of the previous rootstocks on tree yield as well as physical and chemical characteristics of Salustians orange fruits. Yield/ tree (kg) was recorded by weighing the total number of fruits/tree at the time of harvesting. Thereafter, 60 fully ripen fruits were randomly selected from the obtained fruits from three trees budded on each rootstock. The collected fruit samples of each rootstock were randomly divided to four replicates (15 fruits for each). The following parameters were recorded: average fruit weight (g), size (cm³) and fruit dimensions (height and width, cm). Thereafter, 10 fruits from each replicate were manually peeled to estimate pulp and peel weight/ fruit (g), peel thickness (mm), seed number and weight/ fruit, also pulp and peel moister percentages. The remained 5 fruits were peeled for juice extraction. After filtering the extracted juice, average juice volume/ fruit (cm³) was estimated. Also, total soluble solids percentage (TSS) was determined using hand Refractometer and titretable acidity percentage as citric acid by titration against 0.1 N sodium hydroxide (A.O.A.C., 2006). TSS/acid ratio was also calculated.

The obtained data were statistically analyzed according to the randomized complete block design with 3 replicates and differences between means were compared using LSD at 5 % level according to Snedecor and Cochran (1980). Mean value and stander deviation (SD) for variables were calculated.

**Results and Discussion**

**Yield components and fruit dimensions**

The effect of rootstock type on yield/ tree, fruit weight, size and dimensions of Salustiana orange cv. is presented in Table 1, and differed significantly among the tested rootstocks. Trees budded on rough lemon rootstock gained the highest yield/tree (89.80 & 96.31 kg), the highest fruit weight (214.70 & 251.68 g) and size (238.26 & 280.23 cm²), followed by those trees budded on Cleopatra mandarin. Whereas, trees budded on sour orange recorded the least yield/ tree (62.86 & 65.66 kg), fruit weight (188.2 & 190.31 g) and size (203.53 & 211.24 cm²) in the first and second season, respectively. The average increases in yield of trees budded on Rough lemon and Cleopatra mandarin were higher than those on sour orange by 42.86 & 9.53% in the first season and 46.68 & 11.74% in the second season, respectively. However, fruit weight of Salustiana orange cv. budded on all rootstocks, ranged in the two seasons between 188.2 - 251.68 g, while size ranged between 203.53 -280.23 cm². Fruit height and diameter followed the same trend in both seasons.

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These results are in line with those reported by Zekri and Al-Jaleel (2004), Muhtaseb and Ghnaim (2006), Ahmed et al. (2007), Castle et al., (2010), Shafieizargar et al. (2012) and Hifniy et al. (2013). They found that orange, mandarin and grapefruit trees budded on rough lemon, Volkamer lemon and macrophylla rootstocks produce heavier yields and fruits than those on sour orange, citron and trifoliolate orange ones.

**Fruit physical characteristics**

Data in Table 2 clearly show that values of physical characteristics of Salustiana sweet orange fruits were significantly affected by rootstock type. The highest fruit pulp and peel weights (163.26 & 183.52 g for fruit pulp and 59.48 & 59.47 g for peel) were recorded for trees budded on Rough lemon budded trees, while the lowest values (131.47 & 133.63 g for pulp and 55.28 & 46.23 g for peel) were recorded for trees budded on Cleopatra mandarin in the first and second seasons, respectively.

Peel thickness was significantly affected by the tested rootstocks in both seasons. The thickest peel (5.56 & 4.84 mm) was recorded for fruits of trees budded on rough lemon. The other two rootstocks recorded equal statistically values (4.64 & 4.69 mm) in the first season and (3.83 & 3.97 mm) in the second one for trees budded on Sour orange and Cleopatra mandarin, respectively. This means that rough lemon rootstock produces fruits with thicker peel, while Sour orange produces fruits with thinner peel and Cleopatra mandarin came in between in this respect.

The larger juice volume/ fruit was extracted from fruits of trees budded on Cleopatra mandarin rootstock (128.08 cm$^3$/ fruit) in the first season and those on Rough lemon rootstock (180.27 cm$^3$/ fruit) in the second one. The least juice volume/ fruit (108.45 & 147.06 cm$^3$/ fruit) was found in fruits of trees budded on sour orange in the two studied seasons, respectively.

The obtained findings are in full agreement with those previously reported by Mehrotra et al. (2000), Zekri and Al-Jaleel (2004), Al-Jaleel et al. (2005), Ramin and Alirezanezhad (2005), Garcia–Sanchez et al. (2006), Muhtaseb and Ghnaim (2006), Ahmed et al. (2007), Bassal (2009) and Yildirim et al. (2010).

Fruits of trees budded on Rough lemon and Cleopatra mandarin trees contained the highest seed number and weight without significant difference between them for seed weight/ fruit. While, those trees budded on sour orange contained the least values. Seed number and weight/ fruit of trees budded on Rough lemon reached 10.38 & 11.12 and 6.45 & 10.30 folds its values on Sour orange in the both seasons.

### TABLE 1. Influence of different rootstocks on yield/ tree and its components as well as fruit dimensions of Salustiana sweet orange fruits during 2018 and 2019 seasons .

| Rootstock         | Yield/ tree (kg) | ± (%) | Fruit weight (g) | Fruit size (cm$^3$) | Fruit height (cm) | Fruit diameter (cm) |
|-------------------|------------------|-------|------------------|----------------------|--------------------|---------------------|
| **First season (2018)** |                  |       |                  |                      |                    |                     |
| Sour orange       | 62.86±1.32       | -     | 188.2c±1.96      | 203.53c±1.60         | 6.80c±0.04         | 6.94c±0.03          |
| Rough lemon       | 89.80±1.51       | +42.86| 214.70a±2.70     | 238.26a±5.24         | 7.23a±0.01         | 7.19a±0.01          |
| Cleopatra mandarin| 68.85±1.10       | +9.53 | 194.53b±1.74     | 213.56b±1.70         | 7.07b±0.01         | 7.02b±0.02          |
| **LSD at 0.05**   | 0.48             | -     | 2.49             | 0.56                 | 0.04               | 0.05                |
| **Second season (2019)** |                  |       |                  |                      |                    |                     |
| Sour orange       | 65.66±1.25       | -     | 190.31c±2.05     | 211.24c±1.89         | 6.72c±0.01         | 6.90b±0.08          |
| Rough lemon       | 96.31±0.99       | +46.68| 251.68a±2.24     | 280.23a±1.92         | 7.20a±0.01         | 7.36a±0.03          |
| Cleopatra mandarin| 73.37b±1.02      | +11.74| 209.88b±1.86     | 235.18b±1.82         | 6.83b±0.02         | 6.85b±0.03          |
| **LSD at 0.05**   | 1.37             | -     | 0.89             | 0.29                 | 0.03               | 0.06                |

± (%) = increase or decrease (%) in relation to Sour orange.
TABLE 2. Influence of different rootstocks on some physical characteristics of Salustiana sweet orange fruits during 2018 and 2019 seasons.

| Rootstock         | Pulp weight/fruit (g) | Peel weight/fruit (g) | Peel thickness (mm) | Juice volume (cm³/fruit) | Seed No./fruit | Seed weight/fruit (g) |
|-------------------|-----------------------|-----------------------|--------------------|--------------------------|----------------|------------------------|
| **First season (2018)** |                       |                       |                    |                          |                |                        |
| Sour orange       | 139.64±0.86           | 55.55±0.43            | 4.64±0.14          | 108.45±1.57              | 0.87c±0.02     | 0.20c±0.01             |
| Rough lemon       | 163.26±0.68           | 59.48±0.22            | 5.56±0.06          | 117.34±2.50              | 9.03a±0.25     | 1.29a±0.01             |
| Cleopatra mandarin| 131.47±1.35           | 55.28±0.62            | 4.69±0.09          | 128.08±2.15              | 6.07b±0.02     | 1.27a±0.01             |
| LSD at 0.05       | 0.86                  | 0.49                  | 0.13               | 1.27                     | 0.31           | 0.03                   |
| **Second season (2019)** |                       |                       |                    |                          |                |                        |
| Sour orange       | 157.32±1.09           | 47.15±0.73            | 3.83±0.09          | 147.06±2.00              | 1.32c±0.02     | 0.20c±0.01             |
| Rough lemon       | 183.52±0.67           | 59.47±0.55            | 4.84±0.11          | 180.27±1.75              | 14.68a±0.02    | 2.06a±0.01             |
| Cleopatra mandarin| 133.63±2.45           | 46.23±0.66            | 3.97±0.05          | 155.17±1.75              | 13.98b±0.07    | 2.03a±0.02             |
| LSD at 0.05       | 3.01                  | 0.52                  | 0.16               | 0.44                     | 0.06           | 0.05                   |

The corresponding values for trees budded on Cleopatra mandarin were 6.98 & 10.59 and 6.35 & 10.15 folds, respectively. This indicates that rootstock type may affect fertility of reproductive organs of Salustiana flowers, especially ovules. This point of study was of no previous reports in the available literature.

**Fruit chemical characteristics**

Table 3 show the effect of tested rootstocks on TSS percentage, total acidity percentage, TSS/acid ratio, pulp and peel moisture percentages in the first and second experimental seasons.

Fruit juice of trees budded on Sour orange contained the highest TSS percentage and TSS / acid ratio (12.93 & 13.03% and 17.10 & 21.60), followed by those budded on Cleopatra mandarin (10.43 & 12.83% and 12.77 & 17.04) in both seasons, respectively. While that of trees budded on Cleopatra mandarin were lower values (10.43 & 11.97% and 10.13 & 16.32) in the first and second seasons, respectively. Juice TSS percentage in fruit juice of Salustiana on Sour orange grafted trees was larger than those on Rough lemon and Cleopatra mandarin by 1.19 & 1.24 and 1.02 & 1.09% in both seasons, respectively.

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TABLE 3. Influence of different rootstocks on some chemical characteristics of Salustiana sweet orange fruits during 2018 and 2019 seasons.

| Rootstock               | TSS (%)   | Total acidity (%) | TSS/ acid ratio | Pulp moister (%) | Peel moister (%) |
|-------------------------|-----------|-------------------|-----------------|------------------|-----------------|
| **First season (2018)** |           |                   |                 |                  |                 |
| Sour orange             | 12.93±0.06| 0.76±0.01         | 17.10±0.42      | 88.20±0.26       | 69.42±0.50      |
| Rough lemon             | 10.90±0.06| 0.85±0.02         | 12.77±0.32      | 90.22±0.36       | 76.95±0.85      |
| Cleopatra mandarin      | 10.43±0.10| 1.03±0.05         | 10.13±0.19      | 91.56±0.54       | 73.78±5.51      |
| LSD at 0.05             | 0.06      | 0.02              | 0.41            | 0.58             | NS              |
| **Second season (2019)**|           |                   |                 |                  |                 |
| Sour orange             | 13.03±0.11| 0.60±0.01         | 21.60±0.19      | 88.17±0.45       | 69.77±0.21      |
| Rough lemon             | 12.83±0.05| 0.73±0.01         | 17.04±0.18      | 89.04±0.83       | 71.85±0.21      |
| Cleopatra mandarin      | 11.97±0.05| 0.75±0.01         | 16.32±0.40      | 90.10±0.49       | 74.42±0.50      |
| LSD at 0.05             | 0.11      | 0.02              | 0.48            | 1.01             | 0.51            |

Acknowledgment
My sincere thanks to all members of Horticulture Department, Faculty of Agriculture, Zagazig University for their support in completing this research.

Funding statements
The authors received no specific funding for this work.

Conflict of interest
No conflicts of interest during this research

References
A.O.A.C. (2006) Official methods of analysis of the association of official agricultural chemists. Twelfth edition, Washington, D. C., USA.

Ahmed, W., Azher Nawaz, M., Azhar Iqbal, M. and Khan, M.M. (2007) Effect of different rootstocks on plant nutrient status and yield in kinnon mandarin (Citrus reticulata Blanco). Pak. J. Bot., 39(5),1779-1786.

Al-Jaleel, A., Zekri, M. and Hammam, Y.O. (2005) Yield, fruit quality tree health of “Allen Eureka” lemon on seven rootstocks in Saudi Arabia. Scientia Horticulturae, 105(4), 457-465.

Bassal, M.A. (2009) Growth, yield and fruit quality of ‘Marisol’clementine grown on four rootstocks in Egypt.Sci. Hort., 119, 132-137.

Bellini, C., Pacurar, D.I., and Perrone, I. (2014) Adventitious roots and lateral roots: Similarities and differences. Annual Review of Plant Biology, 65(1), 639-666.

Castle, W.S., Baldwin, J.C. and Muraro, R.P. (2010) Performance of ‘Valencia’ sweet orange trees on 12 rootstocks at two locations and an economic interpretation as a basis for rootstock selection. HortScience, 45, 523-533.

Chahal, T. S., and Gill, P. P. S. (2015) Performance of exotic sweet orange (Citrus sinensis Osbeck) cultivars on different rootstocks under North Western India.Indian J. Sci. and Technol., 8(16), 59391.

Davies, F. S. and Albrego, L. G. (1994) Citrus. Chapter 4, Rootstocks, Wallingford, UK: CAP International, pp. 83-107.

Economides, C.V. (1976) Performance of Marsh seedless grape fruit on six rootstocks in Cyprus. J. Hort. Sci., 51, 393-400.

Forner-Giner, M.A., Rodriguez-Gamir, J., Martinez Alcantara, B., Quiñones, A., Iglesias, D.J., PrimoMillo, E., and Forner, J. (2014) Performance of Navel orange trees grafted onto two new dwarfing rootstocks (Forner-Alcaide 517 and Forner-Alcaide 418). Scientia Horticulturae, 179, 376-387.
Garcia–Sanchez, F., Perez-Perez, J.G., Botia, P. and Martinez, V. (2006) The response of young mandarin trees grown under saline conditions depends on the rootstock. *Eur. J. Agron.*, **24**, 129-139.

Georgiou, A. and Georgiou, C. (1999) Growth, yield and fruit quality of Shamouti* orange on fourteen rootstocks in Cyprus. *Scientia Horticulturae*, **80**(1-2), 113-121.

Ghaaim, H. (1993) Performance of “Shamouti” orange grafted on some citrus rootstocks in Jordan Valley. *MSc. Thesis*, Jordon Univ. 65p.

Hayat, F., Qiu, C., Xu, X., Wang, Y., Wu, T., Zhang, X., Nawaz, M. A., and Han, Z. (2019) Rootstocks influence morphological and biochemical changes in young ‘Red Fuji’ apple plants. *Intern. J. Agric. and Biol.*, **21**(5), 1097-1105.

Hifny, H.A., Fahmy, M.A., Bagdady, G.A., Abdabobo, G.A. and Hamdy, A.E. (2013) Effect of Nitrogen Fertilization Added at Various Phenological Stages on Growth, Yield and Fruit Quality of Valencia Orange Trees. *Nature and Science*, **11**(12)220-229.

Kumar, S., Awasthi, O.P., Dubey, A.K., Pandey, R., Sharma, V.K., Mishra, A.K., and Sharma, R.M. (2018) Root morphology and the effect of rootstocks on leaf nutrient acquisition of Kinnow mandarin (*Citrus nobilis*Loureiro ex Tan.). Variation from rootstock. *Sciencia Horticulturae*, **174**, 60-64.

Mallick, M., Dubey, A. K., Singh, S. K., and Sharma, R. M. (2019) Tree morphology, yield and fruit quality of grapefruit cultivars on different rootstocks in Inceptisol. *Indian J. Hort.*, **76**(3), 405-410.

Martins, C. R., de Carvalho, H. W. L., Teodoro, A. V., de Barros, I., de Carvalho, L. M., dos Santos SoaresFilho, W., and Passos, O. S. (2020) Performance of the pineapple sweet orange on different rootstocks. *Bioscience Journal*, **36**(2), 458-472.

Mehrotra, N. K., Kumar, H., Vij, V. K. and Aulakh, P. S. (2000) Performance of Jaffa cultivar of sweet orange (*Citrus sinensis* L. Osbeck) on different rootstocks. *J. Res. Punjab Agricultural Univ.*, **37**(1-2), 56-60.

Pyramasinghe, D. M., Weerasekera, D. W., and Dias, J. P. (2002) Effect of different rootstocks on yield and juice quality of ‘Kinnow’ mandarin. *J. Agric. Sci.*, **138**(1), 117-121.

Muhtaseb, J. and Ghraim, H. (2006) Effect of four rootstocks on fruit quality of sweet orange cv. Shamouti under Jordan valley conditions. *Emir. J. Agric. Sci.*, **18**(1), 33-39.

Ramin, A. and Alirezanezhad, A. (2005) Effects of citrus rootstocks on fruit yield and quality of Ruby Red and Marsh grapefruit. *Fruits*, **60**(5), 311-317.

Richardson, A., Mooney, P., Anderson, P., Dawson, T., and Watson, M. (2003) How do rootstocks affect canopy development? Hort. Research, Kerikeri Research Centre, NewZealand. Retrieved from http://www.hortnet.co.nz/publications/science/t/richardson/rootcan.htm.

Shafieizargar, A., Awang, Y., Juraimi, A. and Othman, R. (2012) Yield and fruit quality of ‘Queen’ orange (*Citrus sinensis* (L.) Osb.) grafted on different rootstocks in Iran. *IJS, 6*, 777-783.

Sharma, R. M., Dubey, A. K., and Awasthi, O. P. (2015) Physiology of grapefruit (*Citrus paradisi*Maef.) cultivars as affected by rootstock. *J. Hort. Sci. and Biotechnol.*, **90**(3), 325-331.

Shireen, F., Jaskani, M. J., Nawaz, M. A., and Hayat, F. (2018) Exogenous application of naphthalene acetic acid improves fruit size and quality of Kinnow mandarin (*Citrus reticulata*) through regulating fruit load. *J. Animal and Plant Sci.*, **28**(4), 1080-1084.

Snedecor, G. W. and Cochran, W. G. (1980) *Methods of Statistical Analysis*, 7th ed. Iowa State Univ., Ames, Iowa.

Somkuwar, R. G., Taware, P. B., Bhang, M. A., Sharma, J. and Khan, I. (2015) Influence of different rootstocks on growth, photosynthesis, biochemical composition, and nutrient contents in ‘Fantasy Seedless’ grapes. *Intern. J. Fruit Sci.*, **15**(3), 251-266.

Tietel, Z., Srivastava, S., Fait, A., Tel-Zur, N., Carmi, N. and Raveh, E. (2020) Impact of scion/rootstock reciprocal effects on metabolomics of fruit juice and phloem sap in grafted *Citrus reticulata*. *PloS One*, **15**(1), e0227192.

Toplu, C., Uygur, V., Kaplankiran, M., Demirkeser, T. H. and Yildiz, E. (2012) Effect of citrus rootstocks on leaf mineral composition of ‘Okitsu’, ‘Claussellina’, and ‘Silverhill’ mandarin cultivars. *J. Plant Nutrition*, **35**(9), 1329-1340.
COMPARATIVE STUDY OF THE YIELD AND FRUIT QUALITY OF SALUSTIANA ORANGE

Wheaton, T. A., Castle, W. S., Whitney, J. D. and Tuker, D. P. H. (1991) Performance of citrus scion cultivars and rootstocks in a high-density planting. *HortScience, 26* (7), 837-840.

Wheaton, T. A., Whitney, J. D., Castle, W. S., Muraro, R. P., Browning, H.W. and Tuker, D. P. H. (1995) Citrus scion and rootstock, topping, height and tree spacing affect tree size, yield, fruit quality and economic return. *J. Amer. Soc. Hort. Sci., 120* (5)-Abstract.

Yildirim, B., Yesiloglu, T., Kamiloglu, M.U., Incesu, M., Tuzcu, O. and Çimen, B. (2010) Fruit yield and quality of ‘Santa Teresa’ lemon on seven rootstocks in Adana (Turkey). *Afr. J. Agric. Res., 5*, 1077-1088.

Zekri, M. and Al-Jaleel, A. (2004) Evaluation of rootstocks for Valencia and Navel orange trees in Saudi Arabia. *Fruits, 59*, 91-100.

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دراسة مقارنة لمحصول وجودة ثمار الريوان سالوستيانا المطعوم على بعض أصول الموالح

أجريت هذه الدراسة خلال موسمين متتاليين 2018 و 2019 علي أشجار الريوان صنف سالوستيانا عمر 12 عام ومطعمه علي ثلاثة أصول من الموالح هي: النارنج، الليمون المخرشف ويوفسي كليوباترا ومنزرا. وجدت نتائج العينات أنها أشجار الريوان على الليمون المخرشف كانت أكبر في متوسط المحصول / شجرة وزن وحجم والنقشة / ثمرة وكذلك سمك الفصيرة من تلك المطعومه علي كل من أصل عوضي كليوباترا والنارنج. وكانت نسبة المواد الصلبة الذائبة ونسبة المواد الصلبة الذائبة إلى الحمضة في عصير ثمار الأشجار المطعومه علي النارنج أكبر من تلك الموجودة على الليمون المخرشف ويوفسي كليوباترا. وكان حجم العصير / ثمرة للثمار الأشجار المطعومة على النارنج أقل من من مثبتها علي الليمون المخرشف ويوفسي كليوباترا. بينما كانت نسبة الحمضة الكلية في ثمار الأشجار المطعومه على الليمون المخرشف أكبر منها في يوفسي كليوباترا. بلغ عدد البذور وزنها / ثمرة في ثمار الأشجار المطعومه علي الليمون المخرشف 11,11,12 و 10,10,30 & 6,645 و 0,645 و 10,11,12 في كلا المواسم. و كانت القيم المقابلة لثمار الأشجار المطعومه علي أصل يوفسي كليوباترا 6,98 و 10,09 ذات النموذج. و يشير هذا إلى أن نوع الأصل قد يؤثر على خصوبة الأعضاء الجنسية في أزهار السالوستيانا خاصة اليوباترا.

الكلمات الدالة: الموالح، الريوان سالوستيانا، الأصول، المحصول، جودة الثمار.

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