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EFFECT OF INTERSTOCK ON GROWTH AND LEAF MINERAL CONTENT OF NAVEL ORANGE TRANSPLANTS

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ABSTRACT

Two famous Citrus rootstocks sour orange (*C. aurantium*.) and volkamer lemon (*C. volkamariana*.) were tested as interstocks at the stage of transplant production to investigate their mutual effects on the scion growth characteristics, mineral content, carbohydrates, total indols and phenols from side; and rootstock growth traits. nitrogen content, carbohydrates, indols and phenols from the other side. Also the results indicated that Navel orange budded on *C. volkamariana* grafted on *C. volkamariana* achieved significantly the highest scion height, root length, leaf number. The highest content of N, P, K, Mg, Fe, Zn, Mn and total phenols in scion stem. Moreover, the mentioned treatment gained the highest significant carbohydrates in roots.

Key words: Interstock, Rootstock, Navel orange, Citrus transplant, Sour orange, Volkamer lemon.

INTRODUCTION

Citrus is one of the most important fruit crops, which occupies the first rank in the production of fruit in Egypt. Citrus fruits represent30% fruit of the production in Egypt with a capacity of 6.5 million tons and export 1.5 million tons according to **The Agricultural Crops Export Council of Egypt (2017)**. Orange is the most productive member of Citrus species.

The common way of propagation in Citrus is grafting, which takes place in the spring, the selection of the rootstock has important effect on the behavior of scion including the vegetative characters, yield and fruit quality **(Sharma et al 2016 and Manal Abo-Eid et al 2017)**

Sour orange rootstock is the predominant in the clay heavy soil, semi dwarf, resistant to *Phytophthora* infection, the scions grafted on it produce high quality, juicy, smooth and thin skinned fruits also have deep root system (**Manal Abo-Eid 2010)**. It has few compatibility with some Citrus varieties **(Castle 2010)**.

Volkamer lemon rootstock has a strong growth and grow well insandy soil and yields high yield. Tolerant to Tristesza, Exocortis and Xyloporosis **(Shafieizargar et al 2012)**. Tolerant to flooding **(Protopapadakis et al 1998)** it produced the most vigorous tree growth for Citrus cultivars **(Khankahdani et al 2006 and Bassel, 2008)**

Navel Orange is the most important cultivar because it haseconomic importance at the local market and export. Also, it isthe most popular cultivar in Egypt, the best taste, medium to medium large size fruit, seedless, gave high juicy, low thickness peel, smooth, sweet flavor and harvest on November to march **(Ferguson, 2014)**.

Interstock originally used to overcome the problem of local incompatibility in grafting in several cases of fruit species **(Hartmann et al 2014)**, In different cases, interstock may be used for its mutual effects on both scion and rootstock that could be useful in Citrus species **(Gimeno et al 2012 and Kamilogu et al 2014)**

In this study, sour orange and volkamer lemon genotypes at the transplant production stage were used as interstocks and rootstocks, alternatively, to take advantage of the distinctive qualities of both rootstocks and their effect on scion. Also, we aimed to appoint the effect of interstocks (sour orange and volkamer lemon) on vegetative growth and leaf mineral content of Navel orange scion.

MATERIALS AND METHODS

The present study was carried out in saran house of Desert Research Center Ministry of Agriculture and Land Reclamation, El Matariya, Cairo, Egypt during 2014 to 2017 seasons. The genotypes which used as rootstocks and interstocks were sour orange (*Citrus aurantium*) and volkamer lemon (*Citrus volkameriana*). Whereas, the cultivars which used as a scion source was Navel orange (*Citrus sinensis*).

The rootstocks were six months old seedlings 70 cm in height for grafting, planted in plastic pots(40 cm) filled with 5 liters of soil mixture (sand: peatmoss 2:1 v/v) for each. In February 2014 the rootstocks were cleft grafted using the scions of interstocks then the same procedures were repeated in February 2015.

After that, In February 2015 the interstocks (the first season plants) were shield budded using Navel orange scions on height of 20-25 cm of the graft union between the interstock and rootstock then the same procedures were repeated in February 2016 (the second season plants).

During the experiment, the plants were fertilized periodically using N P K compound fertilizer and sprayed with pesticides as required. The scion used as interstock was 10 cm in length bears 3-4 buds prepared from shoots.

The experiment treatments

1. Navel orange (N.O) buddedon sour orange (S.O) rootstock (control).
2. Navel orange (N.O) budded on volkamer lemon (V.L) rootstock (control).
3. Navel orange budded on volkamer lemon interstock which grafted on sour orange rootstock [NO/ VL/ SO (rootstock)].
4. Navel orange budded on sour orange interstock which grafted on volkamer lemon rootstock [NO/ SO / VL (rootstock)].
5. Navel orange budded on sour orange interstock which grafted on sour orange rootstock [NO/ SO / SO (rootstock)].
6. Navel orange budded on volkamer lemon interstock which grafted on volkamer lemon rootstock [NO/ VL / VL (rootstock)].

Experimental design

The treatments were completely randomized design, each treatment contained 4 replicates and each one represented by five transplants. At the end of each season (last week of September) the following parameters were measured to evaluate the tested treatment (leaf area, fresh weight and dry weight of vegetative growth and root length).

The measurements: Vegetative growth parameters

Plant height, leaf number of scion growth and stem thickness 5 cm above and below the graft union were measured at end season.

1.1. Scion height (cm)

Readings were taken from the start of union zone of scion at the end of each season for each transplant.

1.2. Number of leaves

The number of leaves for each transplant were counted at end of each season.

1.3. Scion stem thickness

Vernier Caliper was used at 5 cm above and below union zone in budded transplants (interstock and cultivars) and above/ below ratio was calculated at the end of each season.

1.4 Leaf area (cm^2)

Ten leaves were collected at the end of growth seasons for each transplant then the leaf area was determine by using LI-COR, inc. Lincolr, Nebraska USA-LI-3100 area meter.

1.5 Fresh and dry weights of shoot and root system (g)

By the end of each season, fresh and dry weights of shoot system and roots were determined.

2. Chemical parameters

2.1. Leaf mineral concentration

Leaf mineral concentration was determined in 10 leaves for each replicate collected from 6-8 months old leaves in late September in each season. The leaf samples were washed with tap water then rinsed with distilled water, dried at 70 °C in an oven till constant weight. Samples were digested

using sulphoric acid and hydrogen peroxide according to **Parkinson and Allen (1975),** Total nitrogen was determined by Micro-Kjeldahl method approved to **Pregel (1945).** Total phosphorus was determined by method of **Trough and Mery, (1929).** Potassium was determined by flame photometer according to **Brown and Lilleland, (1946).** Magnesium, calcium, manganese, iron and zinc were estimated by using Atomic Absorption spectrophotometer according to **Cottenie (1980).** Macronutrients were calculated as percentage of dry weight whereas, micronutrients as parts per million (ppm).

1.4. Scion stem and roots carbohydrates concentration, nitrogen concentration and C/Nratio

Total Carbohydrates and total nitrogenratio were calculated according to **Dubois et al (1956).** Total nitrogen percentage was estimated in dry matter according to **Pregel (1945).** Total carbohydrates were determined calorimetrically by using the potassium ferricyanide method according to **Forcee (1936).** C/N ratio was calculated.

1.5. Total phenols and total indols in transplants stem and root

2.3.1 Extraction of total indoles and phenols

One gram of fresh samples in three replicates were sectioned into minute pieces and extracted with 5 ml cold methanol 80 % and stored in cold condition for 24- 48 h. The combined extracts were collected and filtered. Then, the volume of sample was raised up to known volume with cold methanol.

2.3.2. Determination of total indoles

The total indols were determined in the methanolic extract using p-dimethyl amino benzaldehyde (PDAB, 1 g was dissolved in 50ml HCl conc. and 50 ml ethanol 95 %) test according to **Selim et al (1978).**

2.3.3. Determination of total phenols

Phenols determination was carried out according to **Folin and Ciocalteu (1972).**

Statistical analysis

The obtained data of the experiments were statistically analyzed using the analysis of variance method according to **Snedecor and Cochran (1980).** Duncan's multiple range test at 5% level was used for means comparing **Duncan (1955).**

RESULTS AND DISCUSSION

Vegetative growth parameters

Data in **Table (1)** showed that scion height of Navel orange scions budded on sour orange rootstockT1,T5 andT6 achieved the highest scion height significantly compared toT4 only in the first season; While in the second season Navel orange scion budded on volkamer lemon interstock grafted on volkamer lemon rootstock (T6) was the highest significantly. Concerning Leaf number in the first season, Navel orange scion budded on sour orange rootstock (T1) achieved the highest valuesignificantly while the second season Navel Orange scion budded on volkamer lemon interstock grafted on volkamer lemon rootstock (T6) achieved the higher significantleaf number compared to T2 and T4. While recorded dataconcerning stem thickness above graft union in the first season, Navel orange scions budded on sour orange rootstock T1 and T2 achieved the highest significant values, but values in the second season Navel orange scion budded on volkamer lemon rootstock (T2) achieved the best values compared to the other treatments. Regarding stem thickness below graft union in the first season; the best treatment was Navel orange scion budded on sour orange rootstock (T1) and volkamer lemon (T2) while, in the second season Navel orange scion budded on volkamer lemon rootstock (T2) achieved the best value compared to the other treatments. While above/below stem thickness ratio in the first and second seasons Navel orange scion budded on sour orange and volkamer lemon rootstock were the highest.

These results are generally agreed with those found by **Zayan et al (2004) and Ibrahim (2005)** who reported that scion height Navel orange on Volkamer lemon rootstock was the higher compared to other rootstocks. Also, our findings went in parallel with those of **Kamilogu and Yesiloglu (2014)** they reported that,Navelina orange budded on Citrumelo interstock grafted on sour orange rootstock were gave largest stem diameter of the scion.

Table 1. Effect of interstock on scion height, leaf number and stem thickness of Navel orange transplantsscion at 2015 - 2016 and 2016-2017 seasons.

Treatments	Scion height (cm)	Leaf number	Stem thickness(cm)		
			Above graft union	below graft union	Above/ below
The first season(2016)					
T1 (NO/SO)	26.91 a	46.50 a	0.48 a	0.65 a	0.73 a
T2 (NO /VL)	24.95 a	26.50 cd	0.41 a	0.56 a	0.73 a
T3 (NO/ VL/SO)	21.75 ab	35.50 bc	0.23 b	0.45 b	0.51 b
T4 (NO/SO/VL)	17.30 b	23.80d	0.28 b	0.41 b	0.68 ab
T5 (NO/SO/SO)	26.36 a	40.50 ab	0.23 b	0.38 b	0.60 ab
T6 (NO/ VL / VL)	25.61 a	34.00 bc	0.26 b	0.38 b	0.68 ab
The second season (2017)					
T1 (NO/SO)	24.60 bcd	38.00 ab	0.35 ab	0.48 a	0.72 a
T2 (NO /VL)	24.13 cd	34.30 b	0.38 a	0.50 a	0.76 a
T3 (NO/ VL/SO)	21.50 d	37.80 ab	0.31 b	0.36 b	0.86 a
T4 (NO/SO/VL)	25.30bc	29.80 c	0.35 ab	0.45 a	0.77 a
T5 (NO/SO/SO)	27.81 b	39.60 a	0.30 b	0.36 b	0.83 a
T6 (NO/ VL / VL)	31.48 a	41.50a	0.31 b	0.36 b	0.86 a

Values having the same letter(s) in each column for each season are not significantly different at 0.05 level.

Data presented in **Table (2)** showed that, leaf area (cm^2) in the first season Navel orange scion budded on Volkamer Lemon rootstock (T2, T1 and T4) achieved the higher significant compared to T3,T5 and T6 while in the second season leaf area Navel orange scions budded on Sour orange interstock grafted on volkamer lemon rootstock (T4) achieved the highest value compared to the other treatments. Regarding the scion vegetative growth fresh weight in the first and second season Navel orange scion budded on sour orange rootstock (T1) got the highest value significantly compared to the other treatments. Whereas the scion vegetative growth dry weight in the first season was in favor of Navel orange scion budded on sour orange rootstock (T1) which achieved the higher value significantly compared to T2 but in the second season Navel orange scion budded on sour orange rootstock(T1) gave the higher value significantly compared to T3 and T4. Root fresh weight in the first and second seasons was in favor of(T1) which gave the highest value significantly compared to most of the other treatments. Also, root dry weight in the first season was in favor of(T1 and T3) which achieved the highest but in the second season (T1)was the highest value significantly compared to the other treatments. Root length in the first season was not significantly affected by any treatments while in the second season, Navel orange scion budded on sour orange interstock grafted on sour orange rootstock (T5) gave the highest root length significantly compared to the other treatments.

Similar findings were recorded by **Abd El-Rahman 2002** he found that, leaf area of Navel orange budded on volkamer lemon rootstock was highly affected by rootstock type. Also, our findings were in contrary with those of **Somaia El-Sayed, 1999** who proved that volkamer Lemon rootstock has higher values of all vegetative growth measured for Washington Navel orange than other rootstocks**.**

Data in **Table (3)** indicated that, Navel orange scion budded on volkamer lemon interstock grafted on volkamer lemon rootstock (T6) got the highest nitrogen concentration in the first season significantly compared to the other treatments but had lowest significant value in the second season. Phosphorus concentration in the first season was in favor of T1and T5 which were equal (0.11) with significant difference compared to other treatments but, in the second season Navel orange scion had insignificant difference among treatments. Potassium in the first season was in favor of T6 which gave the highest significantly compared to the other treatments except T4 while the second season

Table 2. Effect of interstock on leaf area and fresh, dry weights of vegetative growth and roots % and root length of Navel Orangetransplantsat 2016 and 2017seasons.

Treatments	Leaf area (cm^2)	Scion V.g.f.w (g)	Scion V.g.d.w (%)	Root.f.w (g)	Root.d.w (%)	Root length(cm)
The first season (2016)						
T1 (NO/SO)	24.62 a	37.61 a	43.89 a	43.59 a	50.49 a	37.83 a
T2 (NO /VL)	24.78 a	16.94 c	29.50 b	20.96 b	42.94 b	32.26 a
T3 (NO/ VL/SO)	16.91 c	14.03 d	43.04 a	22.48 b	51.69 a	43.13 a
T4 (NO/SO/VL)	23.55 a	10.05 e	43.86 a	24.43 b	38.38 c	34.43 a
T5 (NO/SO/SO)	21.35 b	19.15 b	43.30 a	31.57 ab	44.14 b	34.80 a
T6 (NO/ VL / VL)	18.16 c	14.55 d	30.23 b	31.09 ab	43.02 b	34.93 a
The second season (2017)						
T1 (NO/SO)	28.80ab	38.80 a	51.84 a	38.08 a	50.38 a	33.94 ab
T2 (NO /VL)	29.51 a	18.05 bc	45.17 ab	25.73 c	44.24 b	28.42 c
T3 (NO/ VL/SO)	18.06 c	19.17 bc	41.35 b	29.35 bc	45.67 b	28.92 c
T4 (NO/SO/VL)	29.80 a	14.45 c	41.04 b	28.25 c	43.66 b	31.11 bc
T5 (NO/SO/SO)	26.33 b	23.22 b	47.21 ab	35.92 ab	45.17 b	34.98 a
T6 (NO/ VL / VL)	27.66 ab	15.19 c	46.03 ab	26.73 c	44.03 b	31.00 bc

Values having the same letter(s) in each column for each season are not significantly different at 0.05 level

Table 3. Effect of interstock on leaf macro elements concentration of Navel orangetransplants at 2016 and2017 seasons.

Treatments	N	P	K	Ca	Mg
The first season (2016)					
T1 (NO/SO)	2.63 b	0.11 a	0.96 d	3.13 a	0.72 a
T2 (NO /VL)	2.64 b	0.09 b	1.15 c	2.36 c	0.20 c
T3 (NO/ VL/SO)	2.30 d	0.08 b	1.21 c	3.13 a	0.34 b
T4 (NO/SO/VL)	2.66 b	0.08 b	1.60 ab	2.16 d	0.46 b
T5 (NO/SO/SO)	2.50 c	0.11 a	1.52 b	2.83 b	0.49 b
T6 (NO/ VL / VL)	2.77 a	0.09 b	1.68 a	2.46 c	0.37 b
The second season (2017)					
T1 (NO/SO)	2.50 ab	0.13 a	1.35 a	3.70 ab	0.63 b
T2 (NO /VL)	2.50 ab	0.14 a	1.44 a	3.03 c	0.44 c
T3 (NO/ VL/SO)	2.63 b	0.12 a	1.33 a	3.83 a	0.36 c
T4 (NO/SO/VL)	2.66 ab	0.12 a	1.48 a	2.70 c	0.61 b
T5 (NO/SO/SO)	2.60 ab	0.16 a	1.33 a	3.63 ab	0.86 a
T6 (NO/ VL / VL)	2.80 a	0.17 a	1.48 a	3.23 bc	0.91 a
Standard level	**2.4 - 2.6 %**	**0.12 -0.16 %**	**0.70 – 1.09%**	**3 – 5.5 %**	**0.26 –0.96%**

Values having the same letter(s) in each column for each season are not significantly different at 0.05 level.

not significantly affected by any treatments. Calcium in the first season, T1and T3gave the highest significant value but in the second season Navel orange scion budded on volkamer lemon interstock grafted on sour orange rootstock (T3) was the highest significant compared to the other treatments except T1 and T5. Regarding magnesium concentration in Navel orange scion leaves; Navel orange scion budded on Sour Orange rootstock(T1)accomplished the highest significantly value in the first season compared to the other treatments but in the second season, the highest concentration of Mg was in favor of was T6 followed by T5 significantly compared to the other treatments.

The obtained results indicated that Navel orange scion leaves on Volkamer Lemon rootstock had the highest levels ofN, P, K, Ca and Mg concentration in their leaves compared with other rootstocks, on the same trend; **Faiz et al (1993)**

and **Somaia El-Sayed (2008)** reported that Washington Navel orange budded on volkamer lemon rootstock had significantly higher N, K and Mg**.**

Available data in **Table (4),** Iron in showed that it was in favor of the first season T3,T4 and T6 which gave the highest values significantly compared to the other treatments while in the second season T3 and T6 achieved the highest values significantly. Zinc in the first season was in favor of T3,T4 and T6 which gave the highest values significantly but the second season T6 had the higher value significantly compared to T1 only. Manganese T4 showed highest value significantly whereas in the second season T6 had the highest value significantly compared to the other treatments.

Our findings went in parallel with those of **Fallahi and Rodney (1992)** who reported that, Fairchild mandarin budded on volkamer lemon rootstock gave highest levels of Fe and Zn content in leaf**.**

Table 4. Effect of interstock on leaf micro elements concentration of Navel Orange transplants at 2016 and2017 seasons.

Treatment	Fe	Zn	Mn
The first season (2016)			
T1 (NO/SO)	179.33bc	24.80c	152.66 e
T2 (NO /VL)	167.93c	31.06b	148.00 c
T3 (NO/ VL/SO)	239.66a	35.00a	171.33 d
T4 (NO/SO/VL)	248.40a	34.46a	246.00 a
T5 (NO/SO/SO)	183.93b	25.93c	152.00 e
T6 (NO/ VL / VL)	250.26a	36.00a	216.66 b
The second season (2017)			
T1 (NO/SO)	187.13c	25.10b	114.00b
T2 (NO /VL)	173.43c	27.00ab	136.66b
T3 (NO/ VL/SO)	250.63a	33.46ab	135.33b
T4 (NO/SO/VL)	227.43ab	32.10ab	156.66b
T5 (NO/SO/SO)	191.40bc	28.20ab	158.00b
T6 (NO/ VL / VL)	242.06a	34.81a	212.66a
Standard level	**60 –200 ppm**	**20– 100 ppm**	**25–200 ppm**

Values having the same letter(s) in each column for each season are not significantly different at 0.05 level.

Data in **Table (5)** showed that, in the first seasontotal carbohydrates of Navel orange scion stem budded on volkamer lemon interstock grafted on sour orange rootstock (T3) was the highest value significantly compared to the other treatments. Whereas the second season, T3, T4 and T5 were the highest treatments in carbohydrates content significantly. Total nitrogen in scion stem in the first season was in favor of T5 which gave highest value significantly compared to the other treatments while the second season, T6 was the highest value significantly compared to the other treatments. C/N ratio in scion stem in both two seasons was in favor of T3which gave the highest value significantly compared to the other treatments.

In this trend**, Manal Abo-Eid et al (2010)** found that Baladi lime budded on troyarcitrange got on the greatest value of total carbohydrates followed by that budded on sour orange rootstock. While, Baladi lime budded on volkamer lemon rootstock gave the lowest values**.**

Table 5. Effect of interstock on total carbohydrates, total nitrogen and C/N ratio in scion stem of Navel Orange transplants at 2016 and2017 seasons.

Treatments	Total carbohydrates (mg)	Total nitrogen (%)	C/N ratio
The first season (2016)			
T1 (NO/SO)	22.64b	0.88b	25.96cd
T2 (NO /VL)	19.39c	0.70c	27.61 bc
T3 (NO/ VL/SO)	44.99a	0.73c	59.82a
T4 (NO/SO/VL)	24.17b	0.77bc	31.53b
T5 (NO/SO/SO)	24.45b	1.16a	20.96d
T6 (NO/ VL / VL)	19.02c	0.82bc	22.85cd
The Second season (2017)			
T1 (NO/SO)	18.42c	0.70bc	26.53c
T2 (NO /VL)	18.08c	0.66 bc	27.26 c
T3 (NO/ VL/SO)	26.20a	0.53 c	48.05a
T4 (NO/SO/VL)	24.53a	0.60bc	41.49ab
T5 (NO/SO/SO)	25.64a	0.76ab	33.58bc
T6 (NO/ VL / VL)	21.13 b	0.93a	23.05c

Values having the same letter(s) in each column for each season are not significantly different at 0.05 level

Data recorded in **Table (6)** showed that, (T1) achieved the highest total carbohydrates in root in the first season significantly compared to the other treatments except T6 whereas; in the second season T6 achieved the highest value significantly compared to the other treatments. Total nitrogen in root in the first season T1 gave the higher content significantly compared to the other treatment while in the second season T6 had the highest content significantly compared to T2 and T3. C/N ratio in root in the first season showed in favor of T2 and T6 which gave the highest percentage significantly but in the second season T1, T2 and T3 were the

highest percentage significantly compared to the other treatments except T6**.**

Table 6. Effect of interstock on total carbohydrates and total nitrogen and C/N ratio in the roots of Navel orange transplants at 2016 and 2017seasons.

Treatments	Total carbohydrates (mg)	Total nitrogen (%)	C/N ratio
The first season (2016)			
T1 (NO/SO)	122.45 a	0.98 a	127.10 b
T2 (NO /VL)	111.54 b	0.73 c	154.60 a
T3 (NO/ VL/SO)	80.16 c	0.89 ab	91.92 c
T4 (NO/SO/VL)	64.25 d	0.89 ab	71.23 d
T5 (NO/SO/SO)	44.88 e	0.88 ab	50.58 e
T6 (NO/ VL / VL)	118.41 ab	0.80 bc	155.64 a
The Second season (2017)			
T1 (NO/SO)	108.21 b	0.76 abc	141.78 a
T2 (NO /VL)	108.28 b	0.63bc	176.02 a
T3 (NO/ VL/SO)	79.33 c	0.53 c	163.30 a
T4 (NO/SO/VL)	62.00 d	0.73 abc	86.2 bc
T5 (NO/SO/SO)	53.45 e	0.80 ab	67.50 c
T6 (NO/ VL / VL)	120.50 a	0.90 a	134.99ab

Values having the same letter(s) in each column for each season are not significantly different at 0.05 level.

The results are in **Table (7)** indicated that, T4 had the highest total indols in scion stem in the first season significantly compared to the other treatments. While, the second season T4 and T5 were the highest values significantly compared to the other treatments. Total phenols in scion stem in the first season,T4, T5 and T6 gave the highest content significantly but in the second season was T6 recorded the higher value significantly compared to T1, T2 and T5 treatments. Indols/phenols ratio in scion stem in the first season T1, T4 and T5had the higher values significantly then T6. while in the second season, T1 and T5 showed the highest values significantly compared to T6 treatment.

Abo-Eid Manal et al 2010 at this matter, Baladi lime budded on volkamer lemon rootstock had the highest content of total indols and indols/ phenols ratio in vegetative system significantly compared with rangpur lime, sour orange and toyercitrange.

Data in **Table (8)** reported that, total indols in root system in the first season was the highest in T1 significantly compared to the other treatments. While in the second season, T5 was the highest content significantly compared to the other treatments except T6. Total phenols in roots in the first and second seasons were in favor of T2 which gave the highest value significantly compared to the other treatments. Indols / phenols ratio in root in the first season were the highest significantly in T3 compared to the other treatments but in the second season, T3, T5 and T6 had higher significant value Indols / phenols ratio**.**

Table 7. Effect of interstock on total indols, total phenols and indols /phenols ratio in vegetative growth of Navel orange transplants at 2016 and 2017seasons.

Treatment	Total indols (mg)	Total phenols (mg)	Indols/ phenols ratio
The first season (2016)			
T1 (NO/SO)	0.247 d	0.73 c	0.334 a
T2 (NO /VL)	0.312 cd	1.03 b	0.301 ab
T3 (NO/ VL/SO)	0.345 bc	1.12 b	0.308 ab
T4 (NO/SO/VL)	0.487 a	1.37 a	0.356 a
T5 (NO/SO/SO)	0.422 ab	1.29 a	0.327 a
T6 (NO/ VL / VL)	0.334 c	1.39 a	0.204 b
The Second season (2017)			
T1 (NO/SO)	0.293 c	0.75 c	0.393 a
T2 (NO /VL)	0.286 c	0.88 bc	0.343 ab
T3 (NO/ VL/SO)	0.333 b	1.03 abc	0.327 ab
T4 (NO/SO/VL)	0.390 a	1.17 ab	0.333 ab
T5 (NO/SO/SO)	0.406 a	1.15 b	0.363 a
T6 (NO/ VL / VL)	0.323 b	1.28 a	0.253 b

Values having the same letter(s) in each column for each season are not significantly different at 0.05 level

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تأثير الاصل الوسطي على النمو والمحتوى المعدني لاوراق شتلات البرتقال بسره

[67]

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الموجـــــز

فـــي هـــذه الدراســـة أســـتخدم أصـــلي (النـــارنج والفولكامريانـــا) كأصـــول وســـطية لأختبـــار تأثيراتهمـــا التبادلية على كل من الأصل و الطعم في مرحلة أنتاج الشتلات؛ وقد تم تقدير مواصفات النمو الخضري الناتج مـــن الطعـــم والمحتـــوى المعـــدني لأوراقـــه وكـــذلك الكربوهيدرات والاندولات والفينولات الكلية. وأيضاً تم تقدير صفات الأصل الجذري والمحتوى من النيتروجين والكربوهيدرات والاندولات والفينولات الكلية في الجذور.

وقد أشارت نتائج الدراسة الى تفوق المعامله السادسة معنويا وهى تطعيم البرتقال بسره على الفولكامريانا كأصل وسطي وجذري حيث أنها حققت أعلى القياسات في طول النمو الناتج عن الطعم وطول الجذور وعدد الأوراق وكذلك أعلى تركيز من النيتروجين والفوسفور والبوتاســـوم والماغنســـيوم والحديـــد والزنـــك والمنجنيـــز والفينولات في الطعم علاوه على ذلك حققت أعلى قيمة للكربوهيدرات في الجذور معنويا.

الكلمـات الدالـة: الأصـل الوسـطي، الأصـل الجـذري، برتقال بسرة، شتلات موالح، نارنج، فولكامريانا

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