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Response of Some Citrus Rootstocks to Organic Fertilizers

Mohamed M. Ibrahim[1], Aly M. Ibrahim[2] and Magdi I. Saif[3]
[1] *Horticulture Department, Faculty of Agriculture, Zagazig University, Egypt.*
[2] *Citrus Research Department, Horticulture Research Institute, Agricultural Research Centre, Giza, Egypt.*
[3] *Horticulture Department, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt*.

THE present study was carried out as a pot experiment during the 2017 and 2018 seasons at the fruit nursery in Faculty of Agriculture, Zagazig University, Egypt to assess the mixing of two types of organic fertilizers (chicken manure and farmyard manure) with sandy soil at 10% by weight on growth and the physical and chemical characteristics of seedlings of six-month-old for three citrus rootstocks are Sour orange, Volkamer lemon and Troyer citrange to reach the suitable size of grafting in the shortest possible time. The results revealed that the highest values of leaf area and leaf fresh and dry weights were recorded for Sour orange seedlings, while the number of leaves/ plant, shoot numbers/plant and stem diameter gained by Vokamer lemon, followed by Troyer citrange. Seedlings treated with chicken manure achieved the largest leaf area, total number of leaves/ plant, leaf fresh and dry weights, stem height and diameter, photosynthetic pigments and N, Fe, Zn and Mn but shoot numbers/plant, P and K came by farmyard manure.

Keywords: Citrus, Organic fertilization, Rootstocks, Growth, Leaf Mineral.

Introduction

Pressures to sustain modern agricultural systems may agronomic quality caused progressive degradation of soil structure and depletion of soil fertility level as a result of organic matter reduction (Masciandaro et al. 1997). Orange production is of a great socio-economic interest in the world, in which soils with very low organic matter content are prevalent. These soils need organic matter application to improve and maintain their agronomic quality. The use of organic manure as a source of organic matter is a common practice to improve soil conditions. Organic matter improves soil physical properties such as water retention capacity, reducing the volume of water needed for irrigation (Entry et al. 1997) and soil enzymatic activity (Salam et al. 1999), as well as increases soil nutrients (Bellamy et al., 1995, Barker 1997 and Abdelaal et al., 2013).

Chicken manure and farmyard manure are relatively rich in content of nitrogen and has a low cost per pound of nitrogen (Granatstein, 2003). Application of this manure can improve chemical, biological and physical quality for soil and plant growth (Canali et al., 2004 and Hilimire et al., 2012), as well as contains both organic and inorganic forms of the plant nutrients.

Rootstock selection is a major consideration in all citrus-growing operations. Rootstocks have contributed to a very large extent to successes and failures in citrus industries (Spiegel-Roy and Goldschmidt, 1996). since, citrus rootstocks affect more than 20 horticultural and pathological characteristics including it is responsible for absorption of water and nutrients, adapting the scion to particular soil conditions, such as high salinity or pH, providing tolerance to some diseases, controlling tree vigor and size, depth of rooting and many others horticultural characteristics (Davies and Albrigo, 1994).

Sour orange (*Citrus aurantium* L.) was considered as a satisfactory rootstock in several

Corresponding author: Mohamed M. Ibrahim, E-mail: mohamednasr79@yahoo.com, Tel. 01005456118
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citrus producing areas such as Mediterranean Sea region, South Africa, South America, Florida, Texas and a part of California, it is grows best on heavy soils, moderately tolerant of calcareous and salt soils, but it is susceptible to citrus tristeza virus which have stimulated a search for alternative rootstocks (Gregoriou and Economides, 1994). Rootstock selection is a major consideration in all citrus-growing operations.

Volkamer lemon (*Citrus Volkameriana* Ten and Pasq.) is a lemon hybrid grows well on many types of soil but best on deep sandy soils. Drought tolerant, producesa large vigorous trees with high yields of low quality (Castle et al., 2010 and Martinez et al., 2012).

Troyer citrange (*Citrus sinensis* L. Osbeck x *Poncirus trifoliata* L. Raf.) reasonably vigorous rootstocks, resistant to *Phytophthora parasitica*, nematodes, and tristeza virus and with good cold tolerance. They also are highly poly embryonic, so growers can obtain multiple plants from a single seed. Citrange, however, does not do well in clay, calcareous or high-pH soils, and is sensitive to salinity. It is not feasible as rootstock for mandarin scions, as it overgrows them by producing branches of its own in competition with the grafted bud wood.

This study aimed to evaluated response of three citrus rootstocks seedlings to organic fertilizers i.e. chicken manure and farmyard manure to reach the suitable size of grafting in the shortest possible time.

Materials and Methods

This study was conducted during the two successive seasons of 2017 and 2018. Field work was carried out at the fruit nursery in Faculty of Agriculture, Zagazig University.

Six-month- old seedlings of three citrus rootstocks namely: Sour orange (*Citrus aurantium* L.), Volkamer lemon (*Citrus volkameriana* Ten and Pasq.) and Troyer citrange (*Citrus sinensis* L. Osbeck x *Poncirus trifoliata* L. Raf) were obtained for each season from the private nursery. The selected seedlings of each rootstock (45 seedlings) were uniform in size and height as possible. The experimental seedlings were planted in the first week of February of each season in plastic bags filled with 10 kg sandy soil thoroughly incorporated with one of two kinds of organic fertilizers, i.e. chicken manure (CM) and farmyard manure (FYM) at 10 % by weight. The chemical analyses of the tested organic manures are shown in Table 1. Plants were irrigated with tap-water to represent the field capacity of the sandy soil twice a week during the first three months (February, March and April) and 3 times a week during the period extended from May until the end of September.

A supplemental mineral nutrition was added to all treatments with irrigation water once a week using fertilizer (20 N – 20 P – 20 K with chelated elements) at 1 g / 5 litters water.

TABLE 1. Chemical composition of the used organic fertilizers.

Organic fertilizer	Chicken manure	Farmyard manure
Properties	**(CM)**	**(FYM)**
Organic matter %	17.30	13.9
EC Ms/cm (1:5 extracted)	11.87	7.31
pH (1:5 extracted)	7.14	6.65
Total N %	2.64	0.59
$NaHCO_3$-extractable-P (ppm)	657	473
NH_4OAC-extractable-K (ppm)	791	1182

Organic fertilizer	DTPA extractable			Cations (meq./l)				Anions (meq./l)			
	Fe ppm	Mn ppm	Zn ppm	Ca^{++}	Mg^{++}	^{+}Na	K^{+}	CO_3^{--}	HCO_3^{-}	So_4^{--}	Cl^{-}
CM	37.19	25.18	43.72	2.84	1.12	4.65	1.98	0.00	2.60	1.59	6.40
FYM	25.61	19.37	18.22	2.16	2.21	2.90	0.61	0.00	1.75	1.03	5.10

The response of the applied treatments was evaluated with the following characteristics

Morphological characteristics

At last week of August of each season, a sample of 25 mature leaves of spring growth cycle (about 6 months old) was collected from the medium position of the shoots and taken immediately to the laboratory to determine the following parameters:

- Leaf surface area (cm^2) using leaf apparatus (C1-203 Area Meter CID, Imc) as average of 10 leaves.
- Leaf fresh and dry weights (g) before and after drying leaf samples (20 leaves) at 70 °C until constant weight.
- At the fourth week of September of each season, plants of each replicate were taken up carefully from the bags to determine the following parameters:
- Stem height (cm) and diameter (mm), 5 cm above crown zone.
- Number of shoots and leaves per plant.
- Shoot/ root ratio: calculated by dividing the weight of aerial portion/ plant on weight of root system/ plant.

Chemical determinations

- Photosynthetic pigments were determined in the remainder 5 leaves of each leaf sample. Bothtotal chlorophyll and carotene pigments were estimated according to Wettestein (1957).
- Leaf mineral content: About 0.2 g of the finely ground dry matter of leaves was digested with 4 ml of mixture of concentrated sulfuric acid and perchloric acid (2:1 v/v) for 15 minutes until the digestive solution became colorless, then transferred quantitatively to 50 ml volumetric flask (Kitson and Mellon, 1964). Macro and micro-nutrients were determined as follows: Nitrogen and P were determined coloremetrically according to Naguib (1969) and Kitson and Mellon (1964), respectively. Potassium was estimated flamephotometrically as reported by Brown and Lilleland (1946). Micro nutrients (Fe, Zn and Mn) were determined in the digestive solution using atomic absorption spectrophotometer apparatus (Unic Perkin - Elmer 2380 atomic absorption spectrophotometer).

Statistical analysis

The obtained data were analyzed according to split plot design with three replicates and 5 nurslings per each replicate, in which the three rootstocks represent the main plot and the three organic fertilizers represent the subplot according to Snedecor and Cochran (1980) using the SAS system 9.2. The individual comparisons between the obtained means were carried out by Duncan's multiple range test at 0.05 level (Duncan, 1958).

Results and Discussion

Leaf characteristics

The obtained data in Table 2 showed that significant effect of the organic fertilizer and rootstock type on leaf characteristics in the two seasons. Seedlings of Sour orange rootstock had highest significant values of leaf area (13.94 & 1197 cm^2), leaf fresh (3.54 & 4.04 g) and dry weights (1.82 & 2.13 g) in first and second season, respectively. Seedlings of Volkamer lemon rootstock showed the highest significant leaf numbers/ seedling (189.94 & 132.06) in the two seasons respectively, but Sour orange rootstock had least leaf numbers/ seedling (86.17 & 87.63) in the two seasons, respectively.

Chicken manure (CM) fertilizer gave higher values of all leaf characteristics than farmyard manure (FYM) fertilizer in both seasons.

The interaction between organic fertilizer and citrus rootstock type was significant effect in the two seasons. The interaction Sour orange with CM fertilizer gave highest significant values of leaf area (16.92 & 13.72 cm^2), fresh (3.48 & 4.62 g) and dry weights (2.12 & 2.26 g) in first and second season, respectively. But The interaction Volkamer lemon with CM fertilizer had highest significant values of leaf numbers/ seedling (218.45 & 193.00) in the two seasons, respectively and also high leaf dry weight.

The obtained findings are in agreement with those reported by Salama and Saleh (1993) and El-Morshedy (1997) on Sour orange nurslings, Abou Sayed-Ahmed (1997) on Baladi mandarin trees and El-Shamma et al. (2013) and Ercan et al. (2013) on Valencia orange. They reported that application organic fertilizers increased leaf area and leaf fresh and dry weights. In this respect, Gregoriou and Economides (1994) and Valbuena (1994), they reported that *C. Volkmeriana* was generally considered the best rootstocks for Valencia orange in terms of tree height, canopy volume and cropping and also mentioned the most vigor growth of Dancy mandarin on *C. Volkameriana* as compared to Sour orange rootstock. Moreover, Kouka et al. (1998) found that organic-N (cattle dung) significantly increased number of leaves/ shoots of Baladi orange trees.

TABLE 2. Effect of CM and FYM fertilizer on leaf characteristics of Troyer citrange, Volkamer lemon and Sour orange rootstocks (2017 and 2018 seasons).

Studied factors		Leaf area (cm^2)		Leaf number/ plant		Leaf fresh weight (g)		Leaf dry weight (g)	
		2017	2018	2017	2018	2017	2018	2017	2018
A. Rootstocks									
Sour orange		13.94 a	11.97 a	86.17 c	87.63 c	3.54 a	4.04 a	1.82 a	2.13 a
Volkamer lemon		9.83 b	9.90 b	189.94 a	132.06 a	2.41 b	3.46 b	1.59 b	1.51 b
Troyer citrange		9.67 c	8.62 b	149.41 b	106.67 b	2.72 b	3.46 b	1.29 c	1.43 b
B. Organic fertilizers									
Cont.		8.08 c	7.83 c	115.50 c	64.56 c	2.54 b	2.82 c	1.02 c	1.35 c
CM		13.90 a	12.80 a	162.88 a	158.76 a	3.15 a	4.36 a	1.89 a	2.06 a
FYM		11.46 b	8.85 b	147.13 b	103.04 b	2.98 a	3.78 b	1.79 b	1.64 b
C. Interaction A x B									
Sour orange	Cont.	11.28 c	10.43 c	66.50 h	45.33 i	3.50 a	3.50 d	1.33 bc	1.95 bc
	CM	16.92 a	13.72 a	101.00 f	118.57 c	3.48 a	4.62 a	2.12 a	2.26 a
	FYM	13.64 b	11.77 bc	91.00 g	99.00 f	3.65 a	4.01 c	2.01 a	2.17 ab
Volkamer lemon	Cont.	5.77 e	6.68 d	163.50 d	94.67 g	1.77 d	2.33 f	0.67 e	1.02 f
	CM	12.35 bc	12.74 ab	218.45 a	193.00 a	2.96 b	4.32 b	2.06 a	2.06 abc
	FYM	11.38 c	7.28 d	187.87 b	108.50 d	2.51 c	3.72 d	2.05 a	1.44 d
Troyer citrange	Cont.	7.20 e	6.40 d	116.50 e	53.67 h	2.37 c	2.63 e	1.07 d	1.09 ef
	CM	11.44 bc	11.95 bc	169.18 c	164.70 b	3.01 b	4.14 bc	1.49 b	1.87 c
	FYM	9.37 d	7.52 d	162.53 d	101.63 e	2.78 bc	3.61 d	1.31 c	1.32 de

Means having the same letter (s) in each column are insignificantly different.

Stem characteristics

It is clear from Table 3 that the organic fertilizers and rootstock type significantly affected stem characteristics of the citrus rootstocks in the two seasons. Troyer citrange rootstock had highest significant values of stem height (81.52 & 70.57 cm) in the first and second season, respectively. While, Sour orange rootstock recorded least values of stem height (39.32 & 33.51 cm) in the two seasons, respectively. Volkameriana rootstock had highest significant values of stem diameter (9.39 & 8.39 cm) and shoots number/plant (15.49 & 24.81) in the first and second season, respectively.

CM fertilizer gave highest stem height (58.32 & 64.22 cm) and stem diameter (9.03 & 8.63 cm) in the two seasons, respectively. FYM fertilizer had higher significant values of shoot numbers/ plant (11.57 & 15.50) than other treatments in the first and second season, respectively.

The interaction between the two studied factors recorded uppermost value of stem height by Troyer citrange with CM fertilizer (17.74 & 29.37 cm) in first and second season, respectively. Interaction Volkamer lemon rootstock with FYM fertilizer recorded highest shoot numbers/plant (17.74 & 29.37) and also the same rootstock with CM fertilizer gave highest stem diameter (10.60 & 9.80 cm) in the two seasons, respectively. The lowermost values of all stem characteristics were from interactions of all citrus rootstocks with control in both seasons.

It is quite evident from Table 3, concerning rootstock, Troyer citrange had higher significant values of shoot/ root ratio (1.36 & 1.09) in both seasons and Volkamer lemon (1.09) in the second season only. FYM fertilizer gave highest values in the first season as well as CM fertilizer in the second one. The interaction between the two studied factors recorded highest significant value in first season by Troyer citrange with cont., but in the second season obtained the higher significant values by the CM fertilizer with Volkameriana and Troyer citrange.

The obtained results were in line with those found by Kassem et al. (1995), El-Morshedy (1997), Shafieizargar et al. (2012), El-Shamma

et al. (2013) and Le Thi Khoe & Tran Van Mi (2015). The working on seedlings of different fruit species reported that application of organic fertilizers significantly increased plant height and shoot numbers/ plant. Moreover, Salama et al. (1994) on Thompson Seedless grape nurslings and Ercan et al. (2013) on Valencia orange, who revealed that stem diameter was increased with application organic fertilizers.

Leaf photosynthetic pigments content

Data in Table 4 showed significant effect of organic fertilizer and rootstock type and their interactions on leaf photosynthetic pigments content. Troyer citrange rootstock recorded highest significant values of total chlorophyll (0.177 & 0.163 mg/ 100 mg fresh weight) and carotene (0.108 & 0.152 mg/ 100 mg fresh weight) in the two seasons, respectively. Volkamer lemon and Sour orange rootstocks were insignificant values of total chlorophyll and carotene between them in both seasons.

The highest significant leaf total chlorophyll (0.197 & 0.223 mg/ 100 mg fresh weight) and carotene (0.120 & 0.157 mg/ 100 mg fresh weight) were achieved by CM fertilizer in the first and second season, respectively. The least values were from control treatment in both seasons.

Interaction Troyer citrange with CM fertilizer was uppermost values in the two seasons, as well as Volkamer lemon rootstock with CM fertilizer in second season only.

These results are in harmony with those found by Abou Sayed-Ahmed (1997) and El-Shamma et al. (2013). They found that application of organic fetilizers to clay and sandy soils gave higher values of shoot/ root ratio and photosynthetic pigments in the leaves.

TABLE 3. Effect of CM and FYM fertilizer on stem characteristics of Troyer citrange, Volkamer lemon and Sour orange rootstocks (2017 and 2018 seasons).

Studied factors		Stem height (cm)		Shoots number/ plant		Stem diameter (mm)		Shoot/ root ratio*	
		2017	2018	2017	2018	2017	2018	2017	2018
A. Rootstocks									
Sour orange		39.32 c	33.51 c	10.09 b	9.72 b	5.41 c	5.48 c	1.03 b	0.87 b
Volkamer lemon		41.02 b	63.48 b	15.49 a	24.81 a	9.39 a	8.39 a	1.00 b	1.09 a
Troyer citrange		81.52 a	70.57 a	3.90 c	4.49 c	7.62 b	7.41 b	1.36 a	1.09 a
B. Organic fertilizers									
Cont.		50.44 c	50.11 c	7.98 c	10.26 c	5.32 c	5.44 c	1.14 a	0.94 b
CM		58.32 a	64.22 a	9.94 b	13.27 b	9.03 a	8.63 a	1.07 b	1.23 a
FYM		53.10 b	53.22 b	11.57 a	15.50 a	8.07 b	7.20 b	1.18 a	0.87 c
C. Interaction A x B									
Sour Orange	Cont.	33.50 g	30.33 f	6.42 e	6.72 e	4.23 g	4.63 f	0.80 e	0.86 def
	CM	46.07 c	39.60 e	11.00 d	10.67 d	6.60 e	6.30 d	1.30 b	0.92 cd
	FYM	38.40 f	30.60 f	12.86 c	11.78 d	5.40 f	5.50 e	0.99 d	0.83 ef
Volkamer lemon	Cont.	39.33 ef	60.33 d	13.83 c	20.50 c	7.37 d	7.17 c	0.91 de	1.05 b
	CM	43.17 d	66.50 b	14.90 b	24.57 b	10.60 a	9.80 a	0.93 d	1.42 a
	FYM	40.57 e	63.60 c	17.74 a	29.37 a	10.20 b	8.20 b	1.15 c	0.78 f
Troyer citrange	Cont.	78.50 b	59.67 d	3.68 f	3.55 g	4.35 g	4.53 f	1.83 a	0.92 de
	CM	85.73 a	86.57 a	3.93 f	4.57 fg	9.90 b	9.80 a	0.97 d	1.33 a
	FYM	80.33 b	65.47 bc	4.10 f	5.34 ef	8.60 c	7.90 b	1.29 b	1.01 bc

* Shoot/ root ratio: dividing the weight of aerial portion/ plant on weight of root system/ plant.
Means having the same letter (s) in each column are insignificantly different.

TABLE 4. Effect of CM and FYM fertilizer on leaf photosynthetic pigments content of Troyer citrange, Volkamer lemon and Sour orange rootstocks (2017 and 2018 seasons).

Studied factors		Total chlorophyll (mg/ 100 mg fresh weight)		Carotene (mg/ 100 mg fresh weight)	
		2017	2018	2017	2018
A. Rootstocks					
Sour orange		0.130 b	0.151 a	0.086 b	0.096 b
Volkamer lemon		0.132 b	0.147 a	0.091 b	0.102 b
Troyer citrange		0.177 a	0.163 a	0.108 a	0.152 a
B. Organic fertilizers					
Cont.		0.089 c	0.084 c	0.064 c	0.057 c
CM		0.197 a	0.223 a	0.120 a	0.157 a
FYM		0.153 b	0.153 b	0.100 b	0.137 b
C. Interaction A x B					
Sour orange	Cont.	0.090 e	0.073 d	0.057 e	0.047 f
	CM	0.170 c	0.230 a	0.110 b	0.130 c
	FYM	0.130 d	0.150 bc	0.090 c	0.110 d
Volkamer lemon	Cont.	0.087 e	0.090 d	0.063 de	0.067 e
	CM	0.170 c	0.220 a	0.110 b	0.130 a
	FYM	0.140 d	0.130 c	0.100 bc	0.110 d
Troyer citrange	Cont.	0.090 c	0.090 d	0.073 d	0.057 ef
	CM	0.250 a	0.220 a	0.140 a	0.210 a
	FYM	0.190 b	0.180 b	0.110 b	0.190 b

* Means having the same letter (s) in each column are insignificantly different.

Leaf mineral content

The results in Table 5 cleared that significantly effect of CM and FYM fertilizers on leaf mineral contents of the Sour orange, Volkamer lemon and Troyer citrange in the two seasons. The rootstock of Troyer citrange had highest significant values of N (2.45 & 2.71%) and Fe (157.56 & 157.30 ppm) in the first and second seasons, respectively, as well as Fe of Volkamer lemon in both seasons. The highest significant P% (0.291 & 0.359%) and K% (2.44 & 2.70%) showed in Volkamer lemon rootstock in the two seasons, respectively. Sour orange rootstock recorded higher Zn (38.00 & 32.78 ppm) and Mn (132.12 & 121.68 ppm) than other rootstocks in the first and second season, respectively.

CM fertilizer recorded highest significant values of N, Fe, Zn and Mn, while FYM fertilizer highest values of P (0.283 & 0.347%) and K% (3.25 & 3.74%) in the two seasons, respectively. The least values of all leaf minerals were from control treatment in both seasons.

The interactions between CM fertilizer with all rootstocks recorded highest significant values of N% in the two seasons. Also, interaction CM fertilizer with Volkamer lemon or Troyer citrange gave high value of Fe ppm in both seasons. The highest significant values of P and K% were from the interactions between FYM fertilizer with Volkamer lemon in the two seasons. The interactions between Sour orange with CM were higher of Zn and Mn% than other in both seasons.

The results confirmed those obtained by Solov'ev and Khomyakov (1989), Abou Sayed-Ahmed (1997), El-Morshedy (1997) and El-Shazly et al. (2015). They pointed out that N, P and K percentages of leaves in different tested fruit species were increased with application of organic fertilizers. The increment in leaf Fe, Zn and Mn contents as a result of organic fertilizers application confirmed the results of Sabey et al. (1990), Abdel-Sabour et al. (1996) and Abou Sayed-Ahmed (1997). On the other hand,Awad et al. (1992) stated that leaf Fe and Zn contents of olive nurslings were not increased more than normal range for untreated nurslings.

TABLE 5. Effect of CM and FYM fertilizer on leaf mineral content of Troyer citrange, Volkamer lemon and Sour orange rootstocks (2017 and 2018 seasons).

Studied factors		N (%)		P (%)		K (%)		Fe content (ppm)		Zn content (ppm)		Mn content (ppm)	
		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
A. Rootstocks													
Sour orange		2.08 a	2.23 c	0.177 b	0.220 c	1.75 c	1.98 c	139.96 a	109.53 b	38.00 a	32.78 a	132.12 a	121.68 a
Volkamer lemon		2.23 a	2.36 b	0.291 a	0.359 a	2.44 a	2.70 a	160.58 a	154.40 a	34.83 b	27.57 b	109.97 b	109.38 b
Troyer citrange		2.45 a	2.71 a	0.271 a	0.337 b	1.89 b	2.19 b	157.56 a	157.30 a	30.83 c	24.98 c	106.83 c	108.70 b
B. Organic fertilizers													
Cont.		1.32 b	1.58 c	0.218 b	0.272 c	1.14 c	1.30 c	118.73 c	97.60 c	18.21 c	15.21 c	58.63 c	51.63 c
CM		2.92 a	3.14 a	0.238 b	0.297 b	1.69 b	1.83 b	196.60 a	174.42 a	50.66 a	40.13 a	148.24 a	160.10 a
FYM		2.51 a	2.58 b	0.283 a	0.347 a	3.25 a	3.74 a	142.76 b	149.21 b	34.80 b	29.98 b	142.04 b	128.02 b
C. Interaction A x B													
Sour orange	Cont.	1.12 d	1.35 e	0.157 f	0.190 e	1.02 f	1.11 g	114.00 e	49.10 e	20.13 f	16.97 d	76.80 e	64.87 f
	CM	2.68 ab	2.83 b	0.173ef	0.230 d	1.53 d	1.70 e	185.63 ab	146.27bcd	55.23 a	45.20 a	164.93 a	168.57 a
	FYM	2.44 abc	2.52bc	0.200 de	0.240 d	2.71 b	3.12 c	120.23 de	133.23 cd	38.63 d	36.17 b	154.63 b	131.60 d
Volkamer lemon	Cont.	1.27 cd	1.61 de	0.243 cd	0.317 c	1.22 e	1.54 f	113.63 e	129.10 cd	18.23fg	15.47 d	58.87 f	52.50 g
	CM	2.91 a	2.94 ab	0.270bc	0.330 c	1.78 c	2.07 d	209.57 a	171.00 ab	50.10 b	38.63 b	136.47 d	148.70 c
	FYM	2.52 abc	2.52bcd	0.360 a	0.430 a	4.33 a	4.50 a	158.53bc	163.10bc	36.17 d	28.60 c	134.57 d	124.90 e
Troyer citrange	Cont.	1.57 bcd	1.78 cde	0.253bc	0.310 c	1.18 e	1.24 g	128.57cde	114.60 d	16.27 g	13.20 d	40.23 g	37.53 h
	CM	3.18 a	3.65 a	0.270bc	0.330 c	1.77 c	1.73 e	194.60 a	206.00 a	46.63 c	36.57 b	143.33 c	163.03 b
	FYM	2.59abc	2.72 b	0.290 b	0.370 b	2.71 b	3.60 b	149.50 cd	151.30bc	29.60 e	25.17 c	136.93 d	127.57 e

Means having the same letter (s) in each column are insignificantly different.

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استجابة بعض أصول الموالح للأسمدة العضوية

محمد محمود إبراهيم[1] ، علي محمد إبراهيم[2] و مجدي إسماعيل سيف[3]
[1]قسم البساتين - كلية الزراعة - جامعة الزقازيق – مصر
[2]قسم بحوث الموالح - معهد بحوث البساتين – مركز البحوث الزراعية - الجيزة – مصر
[3]قسم البساتين - كلية الزراعة - جامعة قناة السويس - الإسماعيلية – مصر

أجريت تجربة أصص خلال موسمي ٢٠١٧ و ٢٠١٨ في مشتل الفاكهة بكلية الزراعة ، جامعة الزقازيق، مصر وذلك لتقييم نوعين من الأسمدة العضوية (سماد الدواجن والسماد البلدي) بالتربة الرملية بمعدل ١٠٪ بالوزن علي النمو والخصائص الطبيعية والكيماوية لشتلات عمر ستة شهور لثلاثة أصول من الموالح هي النارنج ، ليمون الفولكامير والترويرسترانج للوصول إلى الحجم المناسب للتطعيم في أقصر وقت ممكن. أشارت النتائج إلي الحصول علي أكبر مساحة لسطح الورقة ووزن غض وجاف للأوراق في شتلات النارنج' بينما كان أكبر عدد للأوراق وللأفرخ/ نبات وقطر ساق مع شتلات ليمون الفولكامير تلتها في ذلك شتلات الترويرسترانج. حققت الشتلات المعاملة بسماد الدواجن أكبر مساحة ورقة، عدد للأوراق/ نبات، وزن غض وجاف للورقة، طول وقطر للساق، صبغات التمثيل الضوئي وأعلي محتوي من عناصر النيتروجين' الحديد' الزنك والمنجنيز بينما سجلت الشتلات المعاملة بالسماد البلدي أعلي عدد للأفرخ/ نبات ومحتوي كل من الفوسفور والبوتاسيوم بالورقة.
الكلمات الدالة: الموالح ، التسميد العضوي ، الأصول ، النمو ، المحتوي المعدني بالأوراق.