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EFFECT OF FOLIAR SPRAYING WITH SEAWEEDS CONCENTRATE ON FRUIT SET, YIELD, FRUIT QUALITY AND LEAF CHEMICAL COMPOSITION OF VALENCIA AND WASHINGTON NAVEL ORANGE TREES

Hikal, A.R.F.
Agric. Res. Center, Giza, Egypt.

ABSTRACT

This investigation was conducted in (2012 and 2013) seasons on 14 years old Valencia and Washington navel orange trees(*Citrus sinensis* L.) on sour orange (*Citrus aurantium* L.) rootstocks and spaced at 5 × 5 m in a private orchard. Its aim to study the effect of foliar spraying with seaweed extract at 200, 250 and 300 cm /100 liter in 2 stages (before flowering and after initial fruit set).

Foliar spraying with seaweeds extract on Valencia and Washington navel orange trees were significantly increased almost studied characters. The tested data of fruit set, yield, fruit quality and leaf chemical composition were max - in Washington navel orange trees compared to Valencia orange trees, where seaweeds extract gave maximized in Washington navel orange trees than in Valencia orange trees.

Trees sprayed with it gained that the longest shoot length as compared with untreated control trees. The largest leaf surface area/ area was recorded for trees that sprayed with seaweeds extract in both study seasons. Spraying seaweeds extract (300 / 100 liter which added before flowering) significantly affected initial fruit set % in both study seasons. Treat. (7) sprayed trees gained the highest initial fruit set percentage, followed by Treat. (4) compared with control trees.

Trees sprayed with seaweeds extract (300 cm / 100 liter) after initial fruit set led to reduce June drop % in both seasons than untreated ones. Tree yield (fruits number and kg/ tree) were significantly increased as compared to the control treatment.

Data revealed that fruit weight, fruit L/D ratio, T.S.S, T.S.S /acid ratio and vitamin C were significantly increased by foliar spraying with seaweeds extract associated with increasing concentration, where the highest values were obtained from (Treat. 7) followed by (Treat. 4) in both seasons compared to control. In contract, total acidity was reduced with all treatments compared to control in both seasons.

In addition, Treat. (7) gave significant increment of leaf (mineral content) as N, P, K, Ca, Mg, Fe, Zn, and Mn followed by Treat. (4) in both seasons compared to control.

Also, data indicated that leaf content of chlorophyll (a & b) and carotenoids were increased when applied 300 cm seaweeds extract/ 100 liter after initial fruit set fallowed by the same concentration before flowering in both seasons compared to the control trees.

Generally, it could be concluded that applying seaweeds extract to Valencia and Washington navel orange trees at 200, 250 and 300 cm /100 liter in 2 stages/ season (before flowering and after initial fruit set) enhanced shoot length and leaf surface area and increased initial fruit set %, increased yield/ tree, improved fruit quality, increased leaf mineral content and decreased June drop comparing with control treatment. While 300 cm seaweeds extract/ 100 liter after initial fruit set gave the best net profit.

INTRODUCTION

In Egypt, because of the importance of citrus production, it is natural for the citrus workers to be mindful of the factors which my positively influence the productivity such as bio-natural extracts.

Valencia orange is an important fresh fruit for exports and local markets and for making juice during summer season; however the trees tend to have poor crop. Navel orange is a popular fresh fruit due to seedless and its high content of total soluble solids. It is considered as reported by many growers, the first crop cv. among the different of citrus in Egypt, leading local market and exports (El-Shobaky and Mohamed, 2000). So, the improvement of fruit yield and quality are very important objective to be achieved by different management practices, nutrients imbalance or deficiency of micronutrients, considered one of the major limiting factors of plant growth and production (El-Fouly and Fawzi1982).

In citrus, massive abscission of developing ovaries, generally occurs shortly after anthesis. Cultural practices were tied to overcome this problem mostly including application of exogenous growth regulators (GA_3) and some foliar nutrients applications (Talon *et al*., 2000). Desai *et al*., (1991) mentioned that increased leaf chlorophyll content, average fruit weight and T.S.S and vitamin C concentration of fruit. In addition, auxin may either delay or stimulate this process and ethylene acts as a trigger agent responsible for the expression of cell wall degrading enzyme according to Zacarias and Stead (2000).

Bio-natural extracts are considered very important to enhance the yield of citrus trees and recently it became a positive alternative to chemical fertilizer. Bio-natural extracts are safe for human, animal and environment and using them is accompanied with lowering the great pollution occurred in our environment. Producing organic or healthy citrus fruits was not achieved without using natural extracts. They may help in improving crop producing by increasing biological N fixation, the availability and uptake nutrients and content of stimulate natural hormones. El-Nawawy *et al*., (1958) started a series of trials as early as 1960, to study the possibility of using blue green algae, and found that the promising results of these trials, where open a new route to further examination of algalization on a somewhat large scale in the pomology fields. Venkataraman and Neelakantan (1963) reported that algae extract is a biofertilizer having a promotive effect on growth through the secretion of natural hormones (cytokinins, vitamin B_{12} and essential amino acids) such as tyrosine and phenylalanine. Foliar application of micronutrients or biostimulant solution has an effective role in fruit trees nutrition (Awad, 1988 & Mansour, 2004).

Hanna and Adams (1993) noticed that Weekly foliar fertilization with a seaweed extract containing 9% N, 9% P and 7% K (Response 9-9-7) at 0.2 gallons/acre for 8 weeks increased premium and total yields in 2 out of 3 spring crops. Yesiloglu and Acikalin (2002) showed that girdling, GA_3, seaweeds extract, and Fe-chelate in the Clementine mandarin trees were increased fruit yield and fruit size. Hegab *et al*., (2005) reported that single or combined applications of Algae extract on Balady orange trees at 0.125 to

0.5 % and mono potassium phosphate at 0.5 to 2.0 % were effective in improving the leaf surface area, content of N, P and K in leaves, yield, fruit weight, total soluble solids content %, and vitamin C content and reducing total acidity % compared to the check treatment. Moreover, they noticed that combined application of Algae extract and mono potassium phosphate was favourable rather than using each material alone in all the previous tested parameters. Abbas *et al*., (2008) reported that seaweed extract foliar spray at (3, 6 or 10 ml/L) significantly increased N, P and K content in leaf compared with the control and the high concentration of seaweed (10 ml/L) was found to gave the best results, all used treatments significantly increased shoot length and leaf surface area in both seasons under study. Also, all treatments of seaweed foliar spray significantly increased yield, cluster weight, berry size, TSS, TSS/acid and anthocyanin. On the other hand, seaweed extract foliar spray treatments significantly decreased total acidity. Seaweed extract concentration of (6 ml/L) gave the highest productivity which reached about 23%.

The aim of this investigation was to study the effect of foliar spraying with seaweed concentrate on fruit set, yield, fruit quality and leaf chemical composition of Valencia and Washington navel orange trees.

MATERIALS AND METHODS

This investigation was carried out through two successive seasons of (2012 and 2013) on 14-years old Valencia and Washington navel orange trees (*Citrus sinensis* L.) grafted on sour orange (*Citrus aurantium* L.) rootstocks, in a private orchard near Aga city. The trees were planted at 5 ×5 m in a clay soil. All trees of both variety (42 tree each variety) were selected and grouped to a seven treatments with three replicates including two trees for each treatment. The trees were sprayed with seaweeds extract at (0,200,250 and 300 cm /100 liter in 2 times/ season (before flowering and after initial fruit set). The composition of seaweeds extract containing:-

Dry matter 95% , Organic matter 45% , Ash (minerals) 45% , Total Nitrogen 1% , P 1% , K 14% , S 1% , Zn 50 ppm ,Ca 0.1% ,Cu 30 ppm , Fe 150 ppm , Mn 8 ppm , Mg 0.3% , Na 3% and contains naturally occurring plant growth promoters: cytokinins, auxins, gibberellins. contains naturally occurring amino acid. The treatments were as follows:-

Treat. 1 : Control (water tap).
Treat. 2 : 200 cm / 100 liter added before flowering.
Treat. 3 : 250 cm / 100 liter added before flowering.
Treat. 4 : 300 cm / 100 liter added before flowering.
Treat. 5 : 200 cm / 100 liter added after initial fruit set.
Treat. 6 : 250 cm / 100 liter added after initial fruit set.
Treat. 7 : 300 cm / 100 liter added after initial fruit set.

The following aspects were studied:

Vegetative growth

1- Shoot length (cm).
2- Leaf surface area/ leaf (cm^2) was measured (using mature leaf at the second week of

September) by laser leaf area meter (model CI-203CA from CID. Inc. company).

3- Initial fruit set % (after petals fall) and June drop % were estimated during both seasons as formula:-

$$\text{Initial fruit set \%} = \frac{\text{Number of setted fruits}}{\text{Total number of flowers}} \times 100 .$$

$$\text{June drop \%} = \frac{\text{Number of fruits which dropped}}{\text{Total number of initial fruit set}} \times 100.$$

Yield components:-

The yield (fruits number and weight (kg) /tree) was recorded at harvest time in April and December in Valencia orange and Washington navel orange, respectively.

Fruit quality:-

Sampled of each treatment at harvest time from trees in both seasons were taken to determine fruit quality:-

1- Fruit physical and chemical properties:-

Average of fruit weight (g) and L/D were recorded.

2- Fruit chemical properties:-

Total soluble solids (T.S.S) was determined by using Carl Zeiss hand referactometer, total acidity as gm of citric acid and Vitamin C as mg ascorbic acid were determined / 100 ml juice, according to A.O.A.C. (1990). Moreover, T.S.S./ acid ratio was estimated.

Leaf nutrient minerals content were determined as follows:-

From each replicate, a sample of about 60 leaves was taken in the first week of October (each year) for the chemical analysis.

The collected leaf samples were washed with tape water, rinsed three times with distilled water and then oven dried at 70 ^{0}C to a constant weight. Leaf dried materials were ground in a stainless steel rotary knife with a mill 20 mesh. The dried ground sample was digested with sulphuric acid and hydrogen peroxide according to Evenhuis and De Waard (1980). Suitable aliquots were taken for the determination of N, P, K, Ca, Mg, Fe, Zn and Mn.

1- **Total nitrogen percentage:** by using the microkjeldahal method as described by A.O.A.C. (1990).
2- **Phosphorus:** by using ammonium venedate method as described by Chapman and Pratt (1961).
3- **Potassium:** by flame photometer according to Brown and Lilleland (1946).
4- **Calcium and magnesium:** were determined according to Koch and Meekin (1924) by using atomic absorption spectorphotometer .
5- **Zinc:** according to Chapman (1961) directly in the original solution by using atomic absorption spectorphotometer .
6- **Fe and Mn:** according to Evenhuis and De Waard 1980).

7- **Chlorophyll a and b:** were determined using Carl–Zeiss spectrocolorimeter at the wave length of 662, 644 and 440 mu for chlorophyll a & b, respectively. The concentrations were calculated according to Wettstein (1957) equations:-

- Chl. a = ،9.784 x E, 662 – 0.99 x E 644 = mg/L.
- Chl. b = 21.426 x E, 644 – 4.65 x E 662 = mg/L.
- Carotenoids = 4.695 x E 440 – 0.264 (a +b) = mg/L.
- Where E: optical density at the wave length indicated.

Statistical analysis:-

Experimental design was a complete randomized Blocks design according to Snedecor and Cochran (1967). The averages were compared using L.S.D. at 5% parameter.

RESULTS AND DISCUSSIONS

Vegetative growth

1-Shoot length and leaf surface area/ leaf:-

The data in Table (1) indicated that all tested treatments significantly increased shoot length and leaf surface area / leaf in the two studied citrus with foliar spraying by seaweeds extract compared with the control in both seasons. They were maximized in Washington navel orange trees than in Valencia orange trees. The trees sprayed with 300 cm seaweeds extract / 100 liter which added after initial fruit set gave significant increase of shoot length and leaf surface area/ leaf for Washington navel and Valencia orange trees in the two studied seasons as compared with control trees. The significant values of shoot length and leaf surface area / leaf were cleared for Washington navel trees (23.13, 24.08) and (27.18, 27.68) in both study seasons, respectively.

These results are harmony with those obtained by Awad (1988), Mansour (2004), Hegab *et al*., (2005) and Abbas *et al*., (2008).

2- Initial fruit set % and June drop%:-

Data in Table (1) showed that treatments applied before flowering significantly increased initial fruit set compared with the control for Washington navel and Valencia orange trees in the two studied seasons. The trees sprayed with 300 cm seaweeds extract/ 100 liter before flowering gave the largest initial fruit set in the two studied seasons as values were (56.94, 55.73) in the first season and (59.76, 58.87) in the second season for the two citrus scions respectively.

Also, the results in Table (1) cleared that June drop significantly decreased compared with the control in both seasons for all experiment treatments. Also, it could be observed that, Valencia orange trees which sprayed with 300 cm seaweeds extract/ 100 liter after initial fruit set significantly decreased June drop than the other treatments, but Washington navel orange trees which sprayed with 300 cm seaweeds extract/100 liter before flowering significantly decreased June drop than the other treatments.

1

3-Yield components:-

Yield of Valencia orange and Washington navel orange trees as fruits number and weight per tree significantly increased by applied treatments.

It is evident from data presented in Table (1) that average number of fruits per tree was increased significantly by all treatments compared with the control trees. The two citrus scions with foliar spraying with 300 cm seaweeds extract/ 100 liter which added after initial fruit set gave the highest number of fruit per tree (364.04 , 354.62) and(171.07, 159.99) respectively.

Also, yield by kg per tree significantly increased in all foliar sprays of seaweed compared with the control trees. The best values were by treatment 7 (57.01, 55.84 kg) and (52.87, 46.67 kg), respectively.

The obtained results are in accordance with those obtained by Hanna and Adams (1993); Yesiloglu and Acikalin (2002); Hegab *et al*., (2005) and Abbas *et al*., (2008).

4- Fruit quality:-

Data in (Table 2) obviously indicated that all physical and chemical characters of fruits had significant increase, except L/ D ratio in the two seasons among the tested two citrus under the study.

Fruit weight significantly increased by all treatments compared with the control for Valencia and Washington navel orange trees in both seasons. The increases were obtained from foliar spray of 300 cm seaweeds extract/ 100 liter after initial fruit set (158.60, 157.46) and (309.05, 295.71 g), respectively.

Data regarding fruit shape (L/ D ratio) presented in (Table 2), it is clear that, all treatment including control did not significantly affect for Valencia and Washington navel orange trees in both seasons.

Chemical fruit quality of both Washington navel orange and Valencia orange were significant increase when tested application seaweeds extract comparing to control in both season of the study. TSS %, TSS/ acid ratio and ascorbic acid content were increased by foliar spray with seaweeds extract, but total acidity % was decreased. Treatment (4) gave the best results of Washington navel orange fruits in the first and second seasons (TSS: 12.76, 12.73 % and TSS/ acid ratio: 10.678, 10.635), respectively. Foliar spraying with 300 cm seaweeds extract/ 100 liter after initial fruit set gave the highest values of ascorbic acid in Valencia and Washington navel orange trees (53.4, 52.4) and (55.8, 56.2) in both seasons, respectively.

These findings are partially in harmony with those obtained by Yesiloglu and Acikalin (2002), Hegab *et al*., (2005) and Abbas *et al*., (2008).

5-Leaf minerals content:-

Table (3) showed that all treatments of foliar spraying with seaweed extract significantly increased leaf content of N, P, K, Ca, Mg and Fe of Valencia and Washington navel orange trees as comparing to the control trees during the two study seasons. Foliar spray of 300 cm seaweeds extract / 100 liter which added after initial fruit set gave the high values followed by foliar spray of 300 cm seaweed extract / 100 liter which added before flowering with leaf minerals content as compared to the control trees under this study.

From the data obtained in both seasons of study (Table, 4) it could be concluded that foliar spraying with seaweeds extract gave significant increase in leaf Zn and Mg content. The clear significant of values were recorded by spraying with 300 cm seaweeds extract /100 liter which added after initial fruit set as compared with adding before flowering and check trees during both seasons of study.

2

3

4

The results presented in (Table, 4) it is quite obvious that leaf chlorophyll's a, b and carotenoids content of Valencia and Washington navel orange trees significantly increased when compared to control trees in both seasons, while Treat. (5) in both seasons of the study did not give significant increase on carotene in Valencia and in the first season of Washington navel orange trees, respectively. The marked significant values of chlorophyll a, b and carotenoids content in fruits were recorded by 300 cm seaweeds extract/ 100 liter at after initial fruit set. However, the control trees alone had the lowest effect in the two seasons.

These findings are partially in harmony with those obtained by Hegab *et al*., (2005) and. Abbas *et al*., (2008).

It could be generally concluded that foliar sprayed with seaweed extract on Valencia and Washington navel orange trees with seaweed extract, gave the highest yield / tree and the best fruit quality.

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تأثير الرش الورقي بمستخلص الطحالب البحرية على عقد الثمار والصفات الثمرية والمحتوى المعدني لأشجار البرتقال الفالنشيا وأبوسره

علي رزق فرحات هيكل
مركز البحوث الزراعية – الجيزة- مصر

أجريت هذه الدراسه خلال عامي ٢٠١٢ & ٢٠١٣على أشجار البرتقال الفالنشيا وأبو سره عمر ١٤ سنه مطعومه على أصل النارنج منزرعه غلى مسافة ٥ ٥ في مزرعه خاصه. لدراسة تأثير الرش الورقي لمستخلص الطحالب البحرية بتركيز ٢٠٠, ٢٥٠, ٣٠٠سم /١٠٠لتر ماء مرتين (قبل التزهير وبعد العقد الإبتدائي).

* الرش الورقي بمستخلص الطحالب البحرية علي أشجار البرتقال الفالنشيا وأبو سره زاد من غالبية الصفات المدروسة معنويا. وكانت مع أشجار البرتقال أبو سره عن الفالنشيا بدرجه ملحوظه.
* رش الأشجار به أعطى أفرع أكثر طولاً بالمقارنه بأشجار الكنترول. وأكبر مساحه للورقه سجلت مع الرش بالمستخلص في موسمي الدراسه. الرش بالمستخلص (٣٠٠سم / ١٠٠لتر قبل التزهير) أثر معنوياً علي النسبه المئويه للعقد الإبتدائي في كلا موسمي الدراسة. المعاملة (٣٠٠سم/ ١٠٠لتر بعد العقد الإبتدائي) أعطت أعلى نسبة للعقد الإبتدائي يليها المعاملة (٣٠٠سم/ ١٠٠لتر قبل التزهير) بالتتابع بالمقارنة مع أشجار الكنترول.
* رش الأشجار ب ٣٠٠سم بعد العقد الإبتدائي قلل النسبه المئويه لتساقط يونيه في الموسمين لمعاملات التجربة عن معاملات الكنترول. زاد محصول الأشجار (عدداً ووزناً) معنوياً بالمقارنه بأشجار المقارنه.
* زادت كلا من وزن الثمره , النسبة بين قطر وإرتفاع الثمره , النسبه المئويه لمحتوى المواد الصلبة الكلية , النسبة بين المواد الصلبة الكلية والحموضة الكلية وفيتامين ج معنوياً بالرش بالمستخلص بزيادة التركيزات. وكانت أعلى القيم للمعاملة (٧) تلتها المعامله (٤) في موسمي الدراسة بالمقارنه بالكنترول. في حين قلت الحموضة الكلية في كل المعاملات بالمقارنة بالكنترول في موسمي الدراسة.
* أعطت المعاملة (٧) أعلى زيادة معنوية في المحتوى الورقي للعناصر تلتها المعاملة (٤) في الموسمين مقارنة بالكنترول.
* أوضحت النتائج أيضا أن معاملة ٣٠٠ سم من المستخلص بعد العقد أعطت أعلى القيم من الكلوروفيل أ , ب والكاروتينات يليها نفس التركيز قبل التزهير في الموسمي بالمقارنه بأشجار الكنترول.
* توصي التجربةإضافة مستخص الطحالب البحرية لأشجار البرتقال الفالنشيا وأبو سره بتركيزات ٢٠٠ , ٢٥٠ , ٣٠٠سم /١٠٠لتر مرتين قبل التزهير وبعد العقد الإبتدائي. هذه المعاملات حسنت الثمار وزودت % للعقد الإبتدائي ومحصول الشجرة وحسنت صفات جودة الثمار وزودت المحتوى المعدني للورقه وقللت % لتساقط يونيه. نستطيع القول أن الرش ب ٣٠٠سم مستخلص قبل العقد الإبتدائي أعطت
أحسن فائده مرجوه.

(Table- 1): Effect of foliar spraying with seaweeds extract on shoot length, leaf surface area/ leaf, initial fruit set, June drop and yield of Valencia and Washington navel orange trees during 2012 and 2013 seasons

Treat.	Valencia orange						Washington navel orange					
	Shoot Length (cm)	Leaf area (cm^2)	Initial fruit set %	June drop %	Fruits yield / tree		Shoot Length (cm)	Leaf area (cm^2)	Initial fruit set %	June drop %	Fruits yield / tree	
					Numb-er	Weight (kg)					Numb-er	Weight (kg)
Season 2012												
Control	13.87	20.97	50.34	89.00	301.02	32.14	18.21	23.18	52.71	87.34	134.63	30.54
Treat.2	14.62	22.34	54.64	86.14	321.14	43.69	20.67	25.31	56.90	84.87	147.04	39.96
Treat.3	14.87	23.18	55.91	85.00	340.54	49.87	21.01	26.87	58.14	84.17	155.32	43.72
Treat.4	15.25	23.77	56.94	84.21	356.67	56.65	22.07	26.98	59.76	83.14	164.19	49.47
Treat.5	14.90	22.37	53.32	85.64	336.27	45.34	22.89	25.88	56.48	84.64	149.67	42.40
Treat.6	15.21	23.80	54.47	84.01	351.48	52.27	20.09	26.69	57.70	83.58	159.73	46.61
Treat.7	15.42	23.96	56.39	83.17	364.04	57.01	23.13	27.18	57.21	83.19	171.07	52.87
LSD 5%	0.61	1.72	2.04	2.33	18.21	8.01	1.44	2.06	2.41	2.61	11.24	8.45
Season 2013												
Control	12.75	19.92	49.51	91.68	294.94	29.64	19.01	22.97	51.41	87.90	124.64	26.67
Treat.2	14.54	21.27	52.49	88.94	316.57	38.19	22.31	25.67	56.19	84.76	137.08	36.01
Treat.3	14.97	22.12	54.09	87.09	332.14	46.10	23.55	26.37	57.74	83.14	143.64	41.17
Treat.4	15.64	23.20	55.73	86.01	349.31	53.64	23.45	27.08	58.87	82.34	156.74	46.31
Treat.5	14.66	22.24	51.87	88.34	325.42	40.17	22.99	25.54	54.35	84.23	139.87	39.77
Treat.6	15.62	23.17	53.27	87.00	337.14	48.44	23.64	26.43	57.44	83.37	147.67	42.40
Treat.7	15.89	24.34	54.41	85.93	354.62	55.84	24.08	27.68	58.76	83.31	159.99	46.67
LSD 5%	1.21	1.63	2.07	2.42	16.34	7.64	1.97	2.17	2.23	2.54	11.17	7.84

Control.

Treat. 2: 200 cm / 100 liter added before flowering. Treat. 3: 250 cm / 100 liter added before flowering.

Treat. 4: 300 cm / 100 liter added before flowering. Treat. 5: 200 cm / 100 liter added after initial fruit set.

Treat. 6: 250 cm / 100 liter added after initial fruit set. Treat. 7: 300 cm / 100 liter added after initial fruit set.

(Table- 2): Effect of foliar spraying with seaweeds extract on fruit quality {Vitamin C (mg/ 100 ml juice)} of Valencia and Washington navel orange trees during 2012 and 2013 seasons

Treat.	Valencia orange						Washington navel orange					
	Fruit weight (g)	L/D ratio	TSS %	Total acidity %	TSS / acid ratio	Vitam. C	Fruit weight (g)	L/D ratio	TSS %	Total acidity %	TSS / acid ratio	Vitam. C
Season 2012												
Control	106.77	0.98	11.84	1.446	8.188	48.3	226.84	1.08	12.46	1.462	8.523	49.8
Treat.2	136.05	1.01	12.06	1.320	9.136	50.4	271.76	1.09	12.69	1.323	9.592	53.4
Treat.3	146.44	1.02	12.14	1.294	9.382	52.6	281.48	1.10	12.74	1.205	10.573	54.1
Treat.4	156.83	1.04	12.20	1.286	9.487	53.0	301.30	1.11	12.76	1.195	10.678	55.4
Treat.5	134.83	1.00	12.11	1.332	9.092	50.0	283.29	1.10	12.59	1.322	9.523	52.2
Treat.6	148.71	1.02	12.20	1.297	9.406	52.8	291.80	1.11	12.70	1.210	10.496	54.4
Treat.7	158.60	1.03	12.28	1.194	10.285	53.4	309.05	1.12	12.73	1.199	10.617	55.8
LSD 5%	11.35	N.S.	0.13	0.030	0.72	0.9	18.67	N.S.	0.15	0.033	0.75	1.0
Season 2013												
Control	100.50	0.96	11.75	1.432	8.205	46.9	233.98	1.07	12.38	1.415	8.749	48.4
Treat.2	120.64	0.99	11.97	1.301	9.201	49.3	262.69	1.09	12.56	1.343	9.352	52.8
Treat.3	138.80	1.02	12.04	1.272	9.465	50.4	286.62	1.10	12.67	1.200	10.558	54.9
Treat.4	153.56	1.03	12.11	1.180	10.263	51.6	292.46	1.10	12.73	1.197	10.635	56.0
Treat.5	123.44	1.00	12.00	1.305	9.195	50.0	284.34	1.09	12.53	1.350	9.281	52.9
Treat.6	143.68	1.02	12.09	1.264	9.565	51.8	287.13	1.11	12.61	1.211	10.413	55.0
Treat.7	157.46	1.03	12.17	1.186	10.261	52.4	295.71	1.11	12.67	1.195	10.603	56.2
LSD 5%	10.23	N.S.	0.12	0.031	0.81	0.8	15.94	N.S.	0.14	0.029	0.74	0.9

Control.
Treat. 2: 200 cm / 100 liter added before flowering. Treat. 3: 250 cm / 100 liter added before flowering.
Treat. 4: 300 cm / 100 liter added before flowering. Treat. 5: 200 cm / 100 liter added after initial fruit set.
Treat. 6: 250 cm / 100 liter added after initial fruit set. Treat. 7: 300 cm / 100 liter added after initial fruit set.

(Table- 3): Effect of foliar spraying with seaweeds extract on leaf chemical composition of Valencia and Washington navel orange trees during 2012 and 2013 seasons

Treat.	Valencia orange						Washington navel orange					
	N %	P %	K %	Ca %	Mg %	Fe ppm	N %	P %	K %	Ca %	Mg %	Fe ppm
Season 2012												
Control	1.88	0.10	0.85	3.13	0.36	98	1.68	0.12	1.08	3.06	0.28	89
Treat.2	2.29	0.18	1.08	4.53	0.43	108	1.80	0.17	1.19	4.24	0.39	102
Treat.3	2.35	0.18	1.09	4.87	0.44	112	1.93	0.21	1.24	4.78	0.46	108
Treat.4	2.44	0.19	1.11	5.15	0.45	116	2.03	0.24	1.32	4.86	0.52	112
Treat.5	2.26	0.18	1.07	4.51	0.43	110	1.78	0.18	1.17	4.20	0.37	105
Treat.6	2.35	0.18	1.09	4.68	0.44	118	1.94	0.22	1.22	4.67	0.45	110
Treat.7	2.46	0.20	1.12	5.13	0.46	120	2.04	0.26	1.35	4.89	0.55	119
LSD 5%	0.30	0.07	0.18	0.87	0.06	6.35	0.05	0.02	0.05	0.78	0.05	5.98
Season 2013												
Control	1.91	0.12	0.93	3.30	0.35	95	1.63	0.13	1.10	3.14	0.40	94
Treat.2	2.34	0.20	1.19	4.78	0.43	107	1.84	0.17	1.22	4.37	0.57	112
Treat.3	2.47	0.20	1.25	4.97	0.44	108	1.99	0.20	1.29	4.85	0.64	121
Treat.4	2.52	0.21	1.28	5.24	0.45	119	2.06	0.21	1.34	5.02	0.66	125
Treat.5	2.32	0.19	1.20	4.73	0.43	110	1.80	0.17	1.20	4.31	0.55	110
Treat.6	2.49	0.20	1.26	4.96	0.44	118	1.94	0.19	1.28	4.79	0.63	119
Treat.7	2.54	0.22	1.29	5.29	0.47	126	2.08	0.22	1.36	5.07	0.71	129
LSD 5%	0.29	0.07	0.20	1.04	0.05	6.74	0.04	0.03	0.06	0.81	0.06	6.04

Control.
Treat. 2: 200 cm / 100 liter added before flowering. Treat. 3: 250 cm / 100 liter added before flowering.
Treat. 4: 300 cm / 100 liter added before flowering. Treat. 5: 200 cm / 100 liter added after initial fruit set.
Treat. 6: 250 cm / 100 liter added after initial fruit set. Treat. 7: 300 cm / 100 liter added after initial fruit set.

(Table- 4): Effect of foliar spraying with seaweeds extract on leaf chemical composition of Valencia and Washington navel orange trees during 2012 and 2013 seasons

Treat.	Valencia orange					Washington navel orange				
	Zn ppm	Mn ppm	Chlo. A	Chlo. B	Carot.	Zn ppm	Mn ppm	Chlo.A	Chlo.B	Carot.
			Mg / g fresh weight					Mg / g fresh weight		
Season 2012										
Control	35	32	6.908	5.124	0.412	32	29	5.872	4.846	0.423
Treat.2	54	56	8.954	5.546	0.435	49	49	7.654	5.324	0.448
Treat.3	59	62	9.164	5.601	0.442	56	54	8.672	5.431	0.454
Treat.4	64	68	9.478	5.687	0.450	63	60	9.004	5.506	0.459
Treat.5	55	58	8.924	5.534	0.432	50	41	8.573	5.301	0.444
Treat.6	62	64	9.034	5.597	0.444	54	50	8.893	5.478	0.456
Treat.7	67	71	9.495	5.703	0.457	66	63	9.021	5.516	0.461
LSD 5%	15.3	17.1	0.871	0.246	0.021	13.1	14.3	0.764	0.286	0.022
Season 2013										
Control	30	28	6.876	5.204	0.421	25	21	7.021	4.793	0.415
Treat.2	49	52	8.843	5.584	0.448	38	37	9.064	5.304	0.439
Treat.3	56	58	9.017	5.613	0.457	44	44	9.547	5.500	0.451
Treat.4	58	60	9.397	5.630	0.461	53	49	9.602	5.504	0.457
Treat.5	46	51	8.804	5.579	0.443	36	40	8.672	5.309	0.435
Treat.6	53	59	9.154	5.612	0.450	45	45	9.326	5.469	0.442
Treat.7	60	64	9.423	5.634	0.469	57	53	9.670	5.512	0.460
LSD 5%	12.8	14.7	0.863	0.238	0.023	12.3	13.8	0.834	0.269	0.019

Control.
Treat. 2: 200 cm / 100 liter added before flowering. Treat. 3: 250 cm / 100 liter added before flowering.
Treat. 4: 300 cm / 100 liter added before flowering. Treat. 5: 200 cm / 100 liter added after initial fruit set.
Treat. 6: 250 cm / 100 liter added after initial fruit set. Treat. 7: 300 cm / 100 liter added after initial fruit set.