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Influence of Foliar Application with Some Natural Extracts and Nutrients Compounds on Nutritional Status of Washington Navel Orange Transplants

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research was conducted during the two consecutive seasons of 2018 and 2019 at the Fruit Nursery Department of Horticulture, Faculty of Agriculture at Moshtohor, Benha University of Qalyubeia Governorate, Egypt, to study the effect of some natural treatments, e.g. Algae, Bread Yeast extract, Moringa leaves extract and nutrients as a compound containing both macro (N , P, K) and micro (Fe , Zn, Mn, Fe, Cu) elements and a compound containing macro and microelements and some growth regulators. These materials (natural extracts and nutrient compounds) were applied as a foliar spray to study their effect on nutritional status of Washington navel orange transplants budded on sour orange rootstock. at one-year-old plant. These materials were applied with different concentrations once a month started from the last week in April to the last week in September.as follows: Blue-green algae extract (1, 2 and 3 ml/L), Yeast extract (10, 20 and 30 ml/L), Moringa leaves extract (2.5, 5 and 7.5 g/L). Nitro active 20: 20: 20 (commercial name) (0.5, 1 and 1.5 g/L) and Estima green (commercial name) (0.5, 1 and 1.5 g/L). In this study, the foliar application of Blue-green algae at 3 ml/L and Estima green at 0.5g/L resulted in a significant

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increase in nutritional status of Washington navel orange transplants i.e., total chlorophyll content and Leaf mineral composition (N%, P%, K%, Ca%, Mg%, Mn (ppm), Zn (ppm) and Fe (ppm). On the contrary, the lowest values of the above-mentioned Leaf chemical composition were typically in concomitance with T1-Control (water sprayed) which ranked statistically last during both study seasons.

Keywords: Washington navel orange; transplants; nutritional status; natural extracts; nutrients compounds.

1. INTRODUCTION

Citrus is considered one of the most important fruit crops grown in many tropical and subtropical countries. At the moment there is about 1.5 million hectares of Citrus species cultivated at a commercial scale in the world yielded nearly 40 million metric tons of oranges, lemons, limes, etc [1].

Oranges are a winter fruit well-suited to the Egyptian climate. Orange production represents half of the total fruit production in Egypt. Navel oranges are the predominant variety. Smaller amounts of local (Balady), Sweet, Valencia, and other varieties are also produced. The harvest of Navel oranges begins in October, but starts later for other cultivars in November, December up to March / April.

Cultivation is centered in two large geographic regions: The fertile Delta area and the newly reclaimed lands.

Sour orange *(Citrus aurantium* L.) is a universal rootstock for citrus and widely used in the Mediterranean region [2].

Sour orange rootstock is reported to be suitable for heavy moist soil, gives good yield and quality fruits, but with smaller fruit size, thin and smooth skin, high TSS and acidity [3].

An interesting trend in foliar nutrition of plants is the enrichment of fertilizers with substances of bio-stimulation activity (syn. stimulators, bio-activators, growth stimulants) for plant growth and development as well as selected metabolic processes.

These compounds can be foliar applied separately or together with mineral nutrients. One cause of the requirement for bio-stimulators is that they pose no risk for human, animal, or natural environment due to its application. Depending on legislation in a particular country, various classification of this group of compounds is provided. It is often that substances of stmulative character are included into the formulation of fertilizers for foliar nutrition, soil fertilization or products designed for the nutrient solution preparation in the hydroponics. Foliar application of bio-stimulators can be particularly effective during unfavorable environmental or stress conditions.

Nowadays, new bio stimulating materials such as Seaweed extract (SWE) or Algae extract is a new generation of natural organic fertilizers containing highly effective nutritious and promotes faster germination of seeds and increase yield and resistant ability of many crops. Unlike, chemical fertilizers, extracts derived from seaweeds are biodegradable, nontoxic, nonpolluting and non-hazardous to human, animals and birds [4]. Liquid fertilizers derived from natural sources like seaweed are found to be viable alternatives to fertilizing input for agricultural crops due to its high level of organic matter, micro and macro elements, vitamins, fatty acids, also rich in growth regulators [5].The growth promoting effect of liquid extract of seaweeds on germination, vegetative growth and biochemical characteristics are being carried out in some economic vegetables and fruits [6].

Yeast as a natural source of cytokinins-stimulates both division and enlargement of cell as well as the synthesis of protein, nucleic acid and chlorophyll [7].

Fresh *Moringa oleifera* leaves have been shown to have high zeatin content. Moringa leaves gathered from various parts of the world were found to have high zeatin concentrations (up to 200 mcg/g) of leaves [8].

Many investigations studied the effect of spraying macro and micronutrients on growth, yield and fruit quality. Such nutrients as nitrogen, phosphorus, potassium and magnesium [9,10,11,12]. However, zinc [13,14] cupper, iron and boron [15] and manganese [16]. were highly

effective in improving nutritional status, yield and quality of different pear and apple trees.

The present study aimed to investigate the foliar spray effects of some natural extracts and nutrients compounds on nutritional status of Washington navel orange transplants budded on sour orange rootstock. The tested natural extracts and nutrients included extracts of algae, bread yeast and moringa leaves, and nutrients as a compound that contains both macro (N, P, K) and micro (Fe, Zn, Mn, Fe, Cu) elements alone or together and some growth regulators.

2. MATERIALS AND METHODS

This investigation was carried out on one-year-old Washington navel orange potted transplants budded on sour orange rootstock grown at nursery of Horticulture department, faculty of agriculture, Benha University, at Moshtohor, Toukh region Kalubia Governorate. during 2018 and 2019 experimental seasons.

The investigated of transplants were subjected to the fertilizer doses adopted in the region according to the Ministry of Agriculture recommendation (10:6:6) units N, P, K respectively. Those transplants were devoted to investigate the influence of foliar application with some natural extracts (blue-green algae extract, yeast extract, moringa extract) and nutrient compounds contain (macronutrients, micronutrients and some growth regulators).

2.1 Experiment Layout

On the last week of April 2018 and 2019 experimental seasons, 144 one-year-old nearly uniform Washington navel orange transplants budded on sour orange rootstock were planted individuality in plastic pots of 35 cm in diameter, filled with about 10 Kg of culture mixture media of (sand and clay at equal proportions by volume).

Before the experiment had been conducted in the first season, both physical and chemical analysis of the culture medium were done as shown in Table 1 according to the methods described by [17].

Irrigation was carried out twice weekly along the season (started from the last week of April to the last week of September) by adding one liter of tap water for each pot.

Transplant growth stimulants which were suggested to build up the skeleton of this investigation were as follows:

Blue-green algae extract.
Yeast extract.
Moringa leaves extract.
Nitro active 20: 20: 20 (commercial name).

Contains (N 20%, P20%, K 20%, ZN 0.2%, Fe 0.03%, Mn 0.02%, Cu 0.002 and Mg 2.6%).
Estima green (commercial name).

Contains a mixture of N 25%, P 16%, K 12%, Zn 0.5%, Fe 0.5 %, Mn 0.5%, Cu 0.3%, cytokinines, gibberellines, auxins, amino acids and Vitamins.

2.2 Preparation of the Tested Natural Extracts

2.2.1 Blue-green algae extract

The ready-made algae extract was obtained from Algal Biotechnology Unit, National Research Centre (NRC), Giza, Egypt. The blue-green algae, Spirulina platensis, belonging to Cyanophyta, and Amphora cofeaeformis were massively produced at the Algal Biotechnology Unit, (NRC) in continuous cultures. Algal extracts were prepared and analyzed as shown in Table 2 previously as described by [18].

2.2.2 Yeast extract preparation

Yeast extract, species Saccharomyces cerevisiae, was prepared by using a technique that allowed yeast cells (pure active dry yeast

Table 1. Chemical and physical analysis of culture medium: A-Chemical analysis

Soluble cations (meq/L)				Soluble anions (meq/L)				$CaCo_3$	PH	EC(ds/m)
Mg^{++}	Ca^{++}	K^{+}	Na^{+}	HCO_3^{-}	CO_{3--}	SO_{4--}	Cl^{-}			
2.13	8.77	0.50	7.80	3.01	-	9.19	6.70	1.50	8.70	1.01

B-Physical analysis

Partial distribution		
Total sand (%)	Silt (%)	Clay (%)
60.00	10.00	30

100 gram/liter) to be grown and multiplied efficiently during conducive aerobic and nutritional conditions that allowed to produce denovo beneficial constituents (carbohydrates, sugars, proteins, amino acids, fatty acids, hormones, etc.) then these constituents could be released out of yeast cells in readily form by two cycles of freezing and thawing for disruption of yeast cells and releasing their content. Such technique for yeast preparation was modified after [19]. Chemical analysis of yeast extract according to [20] is presented in Table 3.

2.2.3 Moringa leaves extract preparation

Fresh green leaves were obtained from *Moringa oleifera* plant from ornamental plants Farm, Hort. Depart., Fac. of Agric., Benha Univ. The extract was prepared according to [21] with slight modification. Fresh Moringa leaves were dried in the air at room temperature (22 ± 2°C) for 7 days and then ground to maintain powder form. The extract was prepared with a weight of (2.5, 5, 7.5) g of Moringa leaves powder each. Individually, one liter of distilled water was added to each of them and Leave at room temperature for 24 hours with occasional shaking. then filtered through four layers of cheesecloth to remove the fibers, then through Whatman No.1 paper, and sprayed directly on the transplants.

Those materials and water (control) were applied as a foliar spray with different concentrations once monthly started from the last week of April to the last week of September as follows:

T1= Control (water spray).	T8= Moringa Leaves extract at 2.5 g/L.
T2= Blue-green algae extract at 1 ml/L.	T9= Moringa Leaves extract at 5 g/L.
T3= Blue-green algae extract at 2 ml/L.	T10= Moringa Leaves extract at 7.5 g/L.
T4= Blue-green algae extract at 3 ml/L.	T11= Nitro active at 0.5 g/L.
T5= Yeast extract at 10 ml/L.	T12= Nitro active at 1 g/L.
T6= Yeast extract at 20 ml/L.	T13= Nitro active at 1.5 g/L.
T7= Yeast extract at 30 ml/L.	T14= Estima green at 0.5 g/L.
	T15= Estima green at 1 g/L.
	T16= Estima green at 1.5 g/L.

Table 2. Chemical composition of some macro and micro-nutrients of algae, according to [18]

Elements	N	P	K	Mg	Na	Ca	Fe	Zn	Mn	Cu
Concentrations	(%)						(ppm)			
	11.2	1.65	0.88	0.22	0.01	0.33	1936	21	68	18

Table 3. Chemical analysis of yeast extract

Amino acid (%)		Vitamins (mg/100 g DW)		Growth regulators ppm	
Alanine	1.69	Vit.B1	23.33	Adenine	31
Arginine	1.49	Vit.B2	21.04	Betaines	56
Aspartic acid	2.32	Vit.B6	20.67	**Minerals**	
Cystine	0.63	Vit.B12	19.17	Nitrogen	6.88%
Glutamic acid	3.76	Thiamin	23.21	Phosphorus	0.66 %
Glycine	1.45	Riboflavin	27.29	Potassium	0.95 %
Histidine	0.71	Inositol	20.43	Magnesium	0.19 %
Isoleucine	0.85	Biotin	20.04	Calcium	0.17 %
Leucine	1.91	Nicotinic acid	73.92	Sulfur	0.48 %
Lysine	1.13	Panthothenic acid	38.43	Iron	107 ppm
Phenyl alanine	1.18	P amino benzoic acid	29.49	Zinc	77 ppm
Proline	1.29	Folic acid	26.22	Copper	5 ppm
Serine	1.98	Pyridoxine	22.09	Manganese	13 ppm
Threonine	1.54			**Others (%)**	
Tryptophan	0.25			Crude Protein	43.00
Tyrosine	0.99			Crude Fat	2.20
Valine	1.4			Carbohydrates	33.21
Methionine	0.4			Crude Fiber	7.20
				Ash	3.80

Table 4. Moringa leaves extracts analysis per 100 grams

Elements contents		Anti-oxidants		Amino-acids	
Minerals (g)	2.3	Oxalic acid (mg)	101	Araginine (mg)	402
Ca (mg)	440	Vitamin B carotene (mg)	808	Histidine (mg)	141
Mg (mg)	24	Vitamin B choline (mg)	423	Lysine (mg)	288
P (mg)	70	Vitamin B thiamin (mg)	0.21	Tryptophan (mg)	127
K (mg)	259	Vitamin B riboflavin	0.05	Phenylanalin (mg)	429
Cu (mg)	1.1	Vitamin B nicotinic acid (mg)	0.8	Methionine (mg)	134
Fe (mg)	7	Vitamin C ascorbic acid (mg)	220	Threonine (mg)	328
S (mg)	137	Vitamin E tocopherol acetate (mg)	----	Leucine (mg)	623
------	----	----------	-----	Isoleucine (mg)	422
				Valine (mg)	476

**from the miracle tree: edited by [8]*

The complete randomized block design with three replicates was employed for arranging the Sixteen investigated treatments, whereas each replicate was represented by three transplants, consequently, 144 Washington navel orange transplants budded on Sour orange rootstock were carefully selected as being healthy, uniform, disease-free and one-year-old for investigating the tested growth stimulants.

The procedures Methodology which have been followed in this investigation were summarized as follows:

After the experiment had been terminated in October early of 2018 and 2019, the impact of the investigated treatments was evaluated through determining the following growth measurements:

2.3 Leaf Chemical Composition

2.3.1 Total chlorophyll content

Total chlorophyll content in fresh leaves was determined by using Minolta meter SPAD-502 according to [22].

2.3.2 Leaf mineral composition

Representative samples of the fourth and the fifth leaf from the base of the shoots were collected from each replicate in September during both seasons. The samples were thoroughly washed with tap water, followed by distilled water. Samples were dried in an oven at 70 o C for constant weight and ground. Then, 0.5g. of dried samples was digested using the H_2SO_4 and H_2O_2 as described by [23]. The extracted samples were used to determine the following minerals content of leaves follows:

Total Nitrogen: Total leaf (N) was determined by the modified micro-kjelelahl method mentioned by [24].

Total phosphorus: Total leaf (P) was determined by wet digestion of plant materials using sulphoric and perichloric acids according to [25].

Total potassium: Total leaf (K) was determined photometrically in the digested material according to the method described by [26].

Mg percentage as well as microelements (iron, manganese and zinc) were determined using the atomic absorption spectrophotometer "Perkin Elmer–3300" according to [27].

2.4 Statistical Analysis

All data obtained during both seasons were subjected to statistical analysis of variance and significant differences among means were determined according to [28]. Besides, significant differences among means were differentiated according to the Duncan's, multiple range [29].

3. RESULTS AND DISCUSSION

3.1 Leaf Total Chlorophyll Content (Mg/G F.Wt)

Fig. 1 displays that all investigated treatments of using natural extracts and nutrients resulted significantly in increasing leaf total chlorophyll level comparing with T1 (control) except T5 (Yeast extract at 10 ml/L) which recorded a lower value than the control. Where T13 (Nitro active at a rate of 1.5 g/L.) was statistically the superior and showed the highest total chlorophyll level i.e. (85.00 and 79.00 mg/g). during 2018 and 2019 experimental seasons respectively. Moreover,

T15 (Estima green at a rate of 1 g/L.) and T16 (Estima green at a rate of 1.5 g/L) ranked statistically 2nd and 3rd after the aforesaid superior treatment during 2018 While the T16 ranked 4th during 2019 on contrary the T3 (Blue-green algae extract at a rate of 2 ml./L) ranked 4th during 2018 season while it ranked 3rd during 2019 season. Besides, other investigated treatments were in-between the aforesaid extremes i.e. (T13) superior and (control) inferior during both 2018 and 2019 experimental seasons.

3.2 Leaf Mineral Composition

3.2.1 Leaf nitrogen content

Regarding the response of leaves N (%) content to the differential investigated treatments, data in Table 5 display that Washington navel orange transplants subjected to T5 (Yeast extract at 10 ml/L) had statistically the richest in this regard i.e. (2.3800 and 2.4500) during 2018 and 2019 experimental seasons, respectively. However, T8 (Moringa Leaves extract at a rate of 2.5 g/L), T9 (Moringa Leaves extract at a rate of 5 g/L) and T7 (Yeast extract at a rate of 30 ml./L) ranked statistically 2nd ,3rd and 4th respectively during the two experimental seasons. On the contrary, T13 (Nitro active at a rate of 1.5 g/L.), was significantly the inferior comparing with all investigated treatments followed by T11 (Nitro active at a rate of 0.5 g/L) in both seasons whereas T14 (Estima green at a rate of 0.5 g/L) and T10 (Moringa Leaves extract at a rate of 7.5 g/L) were Less than the control in the second season only.

Besides, other investigated treatments were in-between the abovementioned two extremes during both 2018 and 2019 experimental seasons.

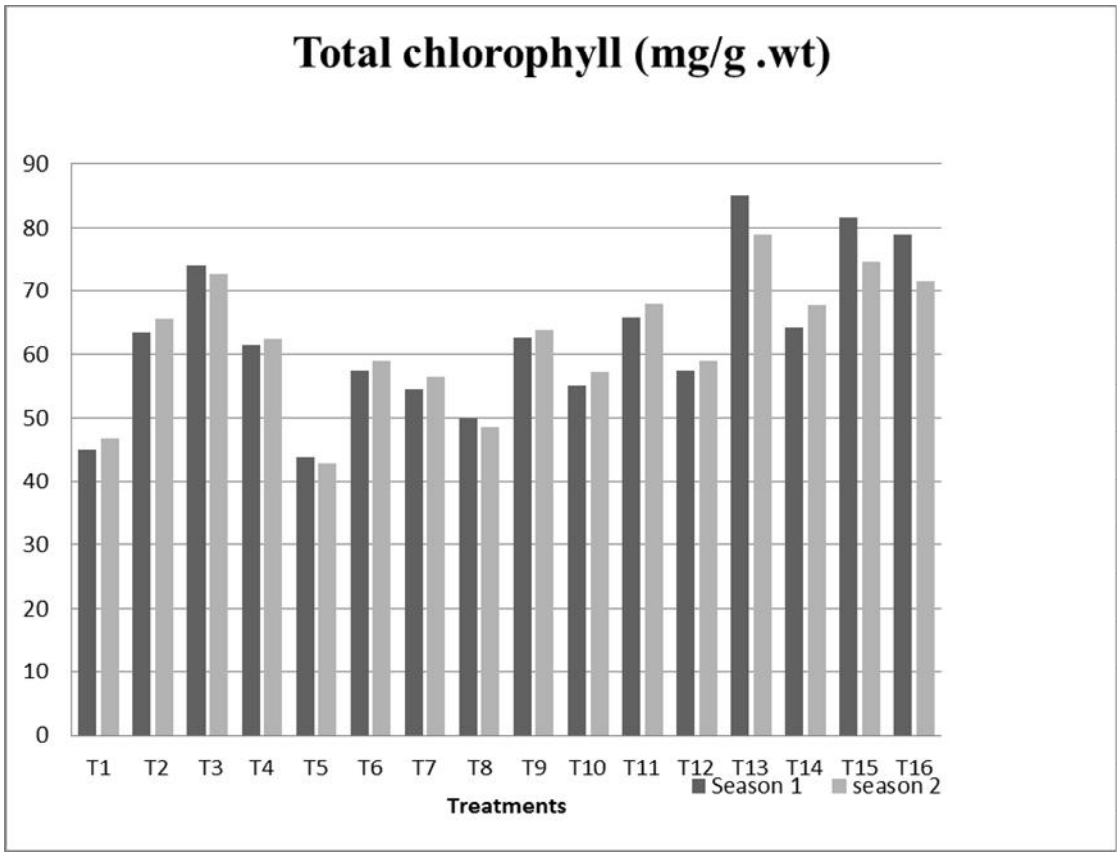

Fig. 1. Effect of some natural extracts and nutrients compounds as foliar application on Total chlorophyll (mg/g F.Wt) of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

Table 5. Effect of some natural extracts and nutrients compounds as foliar application on leaf N and P content of Washington navel orange transplants during 2018 and 2019 experimental seasons

Parameters	N (%)		P (%)	
Treatments/Seasons	**2018**	**2019**	**2018**	**2019**
T1. Control (water spray).	1.200 gh	1.40 ef	0.1700 bc	0.1900 ab
T2. Blue-green algae extract at a rate of 1 ml./L.	1.48 def	1.53 de	0.2500 a	0.1000 d
T3. Blue-green algae extract at a rate of 2 ml./L.	1.39 efg	1.40 ef	0.2100 b	0.2200 ab
T4. Blue-green algae extract at a rate of 3 ml./L.	1.50 de	1.54 de	0.1200 cd	0.1400cd
T5. Yeast extract at a rate of 10 ml./L.	2.38 a	2.45 a	0.19 b	0.2100 ab
T6. Yeast extract at a rate of 20 ml./L.	1.60 de	1.68 cd	0.12 cd	0.14 cd
T7. Yeast extract at a rate of 30 ml./L.	1.89 bc	1.95 b	0.10 d	0.11 d
T8. Moringa Leaves extract at a rate of 2.5 g/L.	1.99 b	2.100 b	0.11 cd	0.13 d
T9. Moringa Leaves extract at a rate of 5 g/L.	1.99 b	2.100 b	0.10 d	0.11 d
T10. Moringa Leaves extract at a rate of 7.5 g/L.	1.23 fgh	1.2600 fg	0.11 cd	0.13 d
T11. Nitro active at a rate of 0.5 g/L.	1.11 h	1.1200 gh	0.20 b	0.22 ab
T12. Nitro active at a rate of 1 g/L.	1.39 efg	1.40 ef	0.12 cd	0.14 cd
T13. Nitro ac00tive at a rate of 1.5 g/L.	1.02 h	1.05 h	0.22 b	0.23 a
T14. Estima green at a rate of 0.5 g/L.	1.22 gh	1.25 fg	0.16 bcd	0.1800 bc
T15. Estima green at a rate of 1 g/L.	1.39 efg	1.40 ef	0.16 bcd	0.1800 bc
T T16.Estima green at a rate of 1.5 g/L	1.69 cd	1.74 c	0.17 bc	0.1900 ab

Means followed by the same letter/s within each column did not significantly differ at a 5% level

Table 6. Effect of some natural extracts and nutrients compounds as foliar application on leaf Zn and Fe content of Washington navel orange transplants during 2018 and 2019 experimental seasons

Parameters	Zn (ppm)		Fe (ppm)	
Treatments/Seasons	**2018**	**2019**	**2018**	**2019**
T1. Control (water spray).	31.200 e	31.500 f	45.00 b	45.65 b
T2. Blue-green algae extract at a rate of 1 ml./L.	47.167 a	49.500 a	35.00 e	36.10 de
T3. Blue-green algae extract at a rate of 2 ml./L.	48.00 a	51.000 a	32.00 fg	33.35 fgh
T4. Blue-green algae extract at a rate of 3 ml./L.	39.00 bc	41.00 c	33.80 ef	34.05e-h
T5. Yeast extract at a rate of 10 ml./L.	18.00 g	23.00 g	41.40 c	41.60 c
T6. Yeast extract at a rate of 20 ml./L.	36.00 d	38.00 d	33.90 ef	34.65 efg
T7. Yeast extract at a rate of 30 ml./L.	22.00 f	24.00 g	34.80 e	35.65 ef
T8. Moringa Leaves extract at a rate of 2.5 g/L.	15.200 h	16.50 h	27.00 h	28.40 i
T9. Moringa Leaves extract at a rate of 5 g/L.	38.00 cd	40.00 c	26.80 hi	25.10 j
T10. Moringa Leaves extract at a rate of 7.5 g/L.	39.00 bc	41.00 c	45.80 ab	46.433 ab
T11. Nitro active at a rate of 0.5 g/L.	41.00 b	44.00 b	47.00 a	48.133 a
T12 . Nitro active at a rate of 1 g/L.	18.00 g	23.00 g	33.90 ef	34.65 efg
T13. Nitro active at a rate of 1.5 g/L.	29.00 e	35.00 e	32.10 fg	32.40 gh
T14 . Estima green at a rate of 0.5 g/L.	39.300 bc	41.50 c	37.30 d	38.40d
T15. Estima green at a rate of 1 g/L.	14.00 h	13.00 i	24.90 i	25.85 j
T16.Estima green at a rate of 1.5 g/L.	13.00 h	11.50 i	31.20 g	31.650 h

Means followed by the same letter/s within each column did not significantly differ at a 5% level

3.2.2 Leaf phosphorus content

Regarding the influence of the differential investigated treatments on leaves p (%) content of Washington navel orange transplants data tabulated in the Table 5 revealed that superiority T2 (Blue-green algae extract at a rate of 1 ml./L) compared with all investigated treatments during 1st. However, it was inferiority in this regard during 2nd season on another hand T13 (Nitro active at a rate of 1.5 g/L), T3 (Blue-green algae extract at a rate of 2 ml./L), T11 (Nitro active at a rate of 0.5 g/L) and T5 (Yeast extract at a rate of 10 ml./L) in increasing as compared to T1(control) Without significant difference between them. Such trend was true during two seasons except for T5 at 2nd season and T16 (Estima green at a rate of 1.5 g/L) in both experimental seasons they had non-significant difference compared to the control treatment on the contrary other investigated treatments were significantly the inferior compared with T1 during both 2018 and 2019 seasons.

3.2.3 Leaf potassium content

Tabulated data in Fig. 2 refer to the influence of differential investigated treatments on Leaf potassium content T6 (Yeast extract at a rate of 20 ml./L) showed the highest percentage i.e.(2.38 and 2.43) respectively followed by T1 (Control) and T12 (Nitro active at a rate of 1 g/L.) ranked statistically 2nd an 3rd ranks Without significant difference between them. Such trend was true during two seasons. on the contrary The remaining thirteen treatments had a negative impact in this regard, as the T14 (Estima green at a rate of 0.5 g/L) gave less values, followed by T8 (Moringa Leaves extract at a rate of 2.5 g/L) respectively In addition, other investigated treatments were in-between the aforesaid extremes superior and inferior during both 2018 and 2019 experimental seasons.

3.2.4 Leaf calcium content

Concerning the response of Leaf Ca % content to the differential investigated treatment, Fig. 3 shows variation in this respect. resulted that statistically superior in T4 (Blue-green algae extract at rate of 3 ml./L) followed by T11 (Nitro active at a rate of 0.5 g/L), T12 (Nitro active at rate of 1 g/L), T6 (Yeast extract at rate of 20 ml./L)compared with T1 (Control). Which has reached statically ranked 2nd,3rd and 4th in both seasons study In addition to there was non-significant difference between T4, T11 and T12 in the first season only, however The opposite was true in the second season on the contrary the treatments T7 (Yeast extract at a rate of 30 ml./L) , T3 (Blue-green algae extract at a rate of 2 ml./L), T5 (Estima green at a rate of 1 g/L) ,T13 (Nitro active at a rate of 1.5 g/L) came in the last position respectively and results were obtained lower values compared with control treatment As for the rest of the investigated treatments were in-between the aforesaid extremes superior and inferior during both 2018 and 2019 experimental seasons.

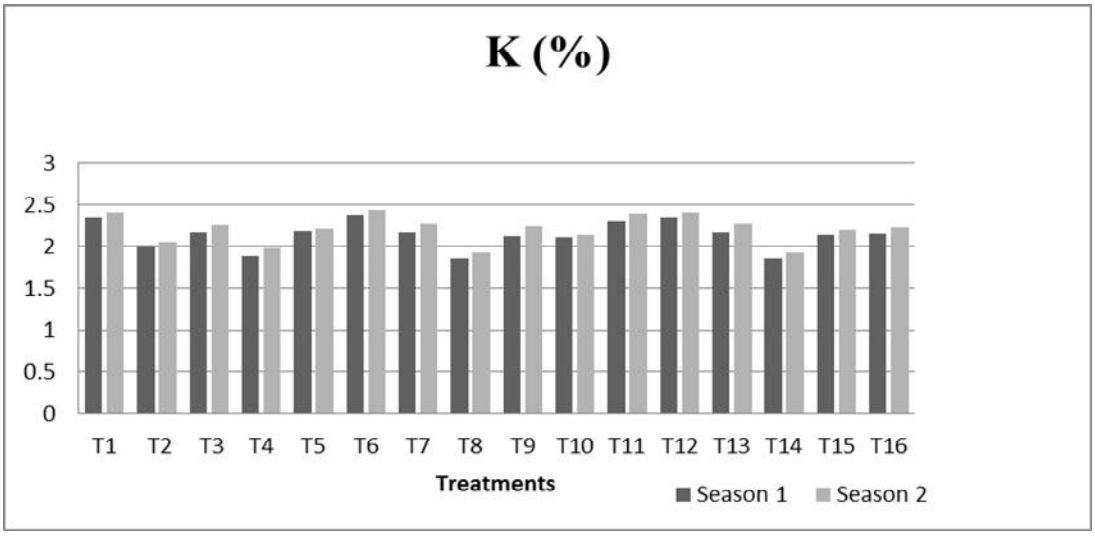

Fig. 2. Effect of some natural extracts and nutrients compounds as foliar application on Leaf potassium (%) content of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

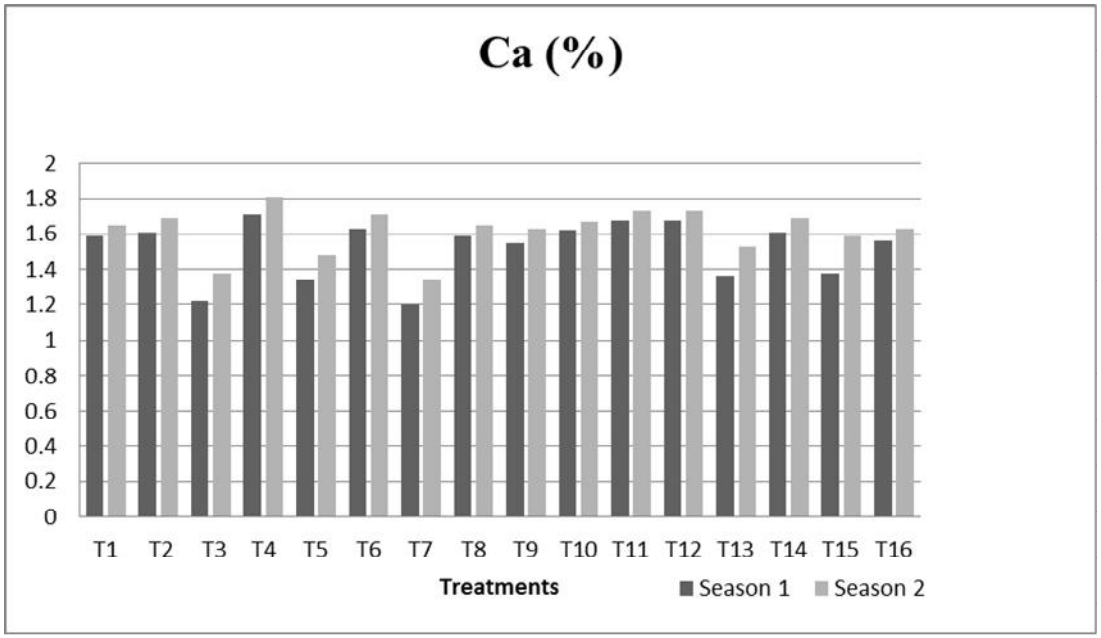

Fig. 3. Effect of some natural extracts and nutrients compounds as foliar application on Leaf calcium (%) content of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

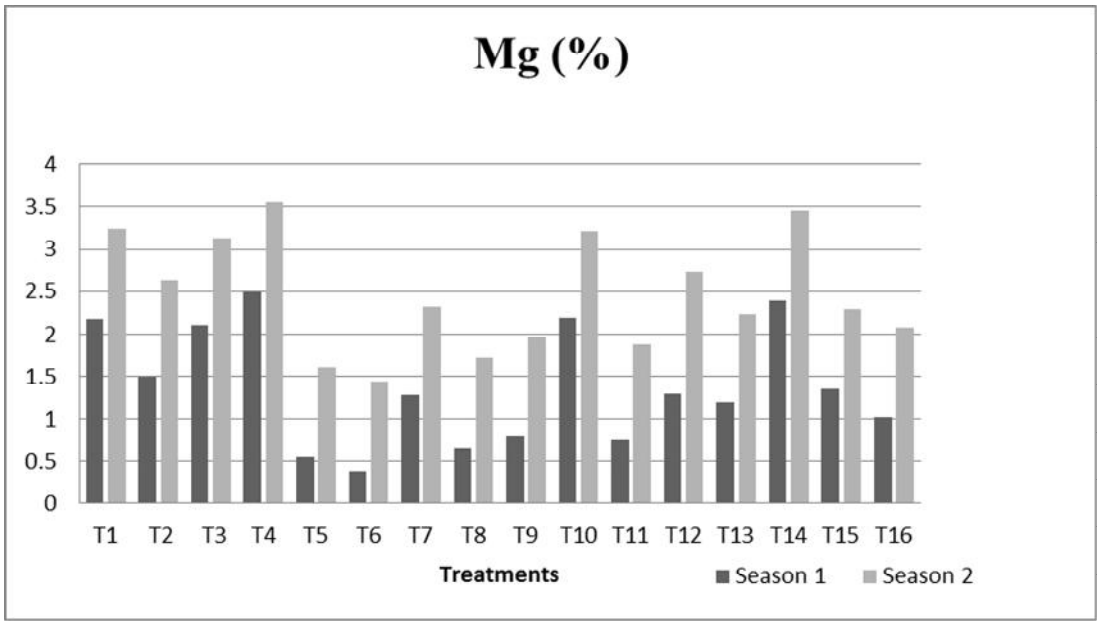

Fig. 4. Effect of some natural extracts and nutrients compounds as foliar application on Leaf Magnesium (%) content of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

3.2.5 Leaf magnesium content

Regarding the influence of the differential investigated treatments on Mg (%) of Washington navel orange transplants tabulated data in the Fig. 4 displays obviously that all investigated treatments of using natural extracts and nutrients resulted significantly in increasing

leaf Mg content compared with T6 (Yeast extract at rate of 20 ml./L) whereas T4 (Blue green algae extract at rate of 3 ml./L) came 1st rank from statically side with height value in this regard followed by T14 (Estima green at rate of 0.5 g/L) in the 2nd rank whereas the T6 (Yeast extract at rate of 20 ml./L), T5 (Yeast extract at rate of 10 ml./L), came in the last statically ranks As for the rest of the investigated treatments were in-between the aforesaid extremes superior and inferior Such trend was true during both 2018 and 2019 experimental seasons.

3.2.6 Leaf manganese content (ppm)

Concerning the response of leaf Mn content of Washington navel orange transplants to the differential investigated treatments, Fig. 5 reveals obviously that all treatments resulted in increasing its level than T9 (Moringa Leaves extract at rate of 5 g/L). Anyhow, T2 (Blue green algae extract at rate of 1 ml./L) was significantly the superior, descendingly followed by, T5 (Yeast extract at rate of 10 ml./L) Without significant difference between these two treatments, followed by T16 (Estima green at rate of 1.5 g/L), T15 (Yeast extract at rate of 10 ml./L),With significant difference between them during both seasons . On the one hand, the transactions that led to a decrease in the leaf content of manganese the T9 was the most influential in this regard, followed by T6 (Yeast extract at rate of 20 ml./L), T13 (Nitro active at rate of 1.5 g/L),T7 (Yeast extract at rate of 30 ml./L) and T4 (Blue green algae extract at rate of 3 ml./L) respectively. As for the rest of the investigated treatments were in-between the aforesaid extremes superior and inferior such trend was true during both 2018 and 2019 experimental seasons.

3.2.7 Leaf zinc content (ppm)

Table 6 displays obviously that two investigated treatments increased significantly the Leaf zinc content ppm compared with all treatments and T1 (control)These T3 (Blue-green algae extract at 2 ml/L.) and T2 (Blue-green algae extract at 1 ml/L.) were statistically the superior Where ranked 1st and 2nd respectively Without significant differences. Whereas, the greatest values in Washington navel orange transplants i.e. (48.00, 51.00, and 47.17, 49.50) were exhibited during 2018 and 2019 experimental seasons, respectively. However, T11 (Nitro active at 0.5 g/L) ranked statistically 3rd. descendingly followed by T14, T4, T10, T9, and T6 during both seasons. On the contrary T16, T15 , T8, T12, T5, and T7 respectively were the least effective as both came just later to control (T1) during both 2018 and 2019 experimental seasons. Concerning the T13 (Nitro active at 1.5 g/L) Exceeded the control in 2nd season however the opposite is true in the 1st season.

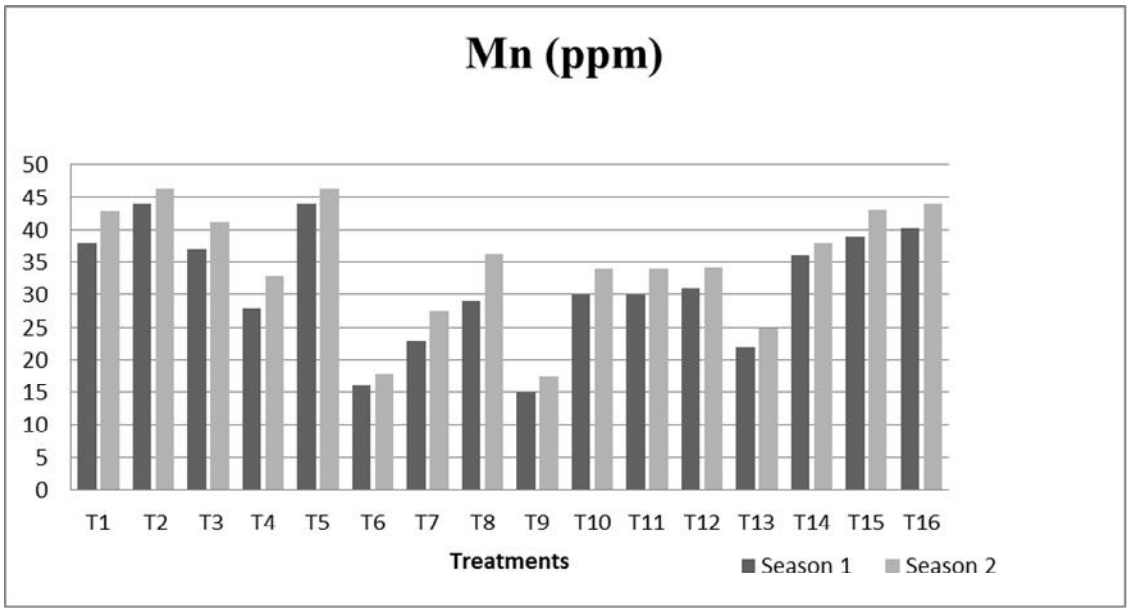

Fig. 5. Effect of some natural extracts and nutrients compounds as foliar application on Leaf Manganese (ppm) content of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

3.2.8 Leaf iron content (ppm)

Regarding the response of leaves iron ppm content to the differential investigated treatments, data in Table 6 displayed that Washington navel orange transplants subjected to T11 (Nitro active at 0.5 g/L.) statistically the Best in this regard which ranked 1st followed by T10 (Nitro active at 0.5 g/L.) during 2018 and 2019 experimental seasons, respectively. However, T1 (water spray), ranked statistically 3rd on the contrary Thirteen investigated treatments did not exceed the control where they caused the decline in the content of iron leaf compared with control in both experimental seasons.

An interesting trend in foliar nutrition of plants is the enrichment of fertilizers with substances of bio-stimulation activity (syn. stimulators, bio-activators, growth stimulants) for plant growth and development as well as selected metabolic processes. These compounds can be foliar applied separately or together with mineral nutrients. One of the requirements for bio-stimulators is that they pose no risk for the human, animal, or natural environment due to its application. Depending on the legislation in a particular country, various classification of this group of compounds is provided. It is often that substances of simulative character are included in the formulation of fertilizers for foliar nutrition, soil fertilization, or products designed for the nutrient solution preparation in the hydroponics. Foliar application of bio-stimulators can be particularly effective during unfavorable environmental or stress conditions.

The obtained results of foliar sprays with the mixture of macronutrients (N, P, and K) on some vegetative growth parameters of Washington navel orange trees are following earlier reports of [30]. on Washington Navel orange, [31]. on mango, [32]. on *'Cadoux' Clementine* mandarin, [33] and [34] on Valencia orange, [35] on Zebda mango, [36] on Keitt mango and [37] on Washington navel orange. They reported that spraying the aforementioned fruit crop species with N, P, and K lonely or in combinations were effective in improving the studied growth characteristics of the transplant.

Moreover, data disclosed showed that bio-stimulated substances (Yeast extract and GA_3) may stimulate the organic components (N etc contents) in plant tissues. While, the other organic materials as Algae or Moringa leaves extract has a close relation with elements as (P; K; Ca; Mg; Fe; Zn etc). These foundations are harmony with those obtained by [38-46] whom indicated that : yeast, increased N, P and K content of leaves, algal extract gave favorable effects on chemical properties parameters ; bio-stimulants as a foliar spray have positive effects on some micro-nutrients (Fe, Zn, Cu and Mn) content of fruits tissues and the algae extraction treatment recorded the highest values of phosphorus. On the other hand, [47] noticed that no significant differences between SO (*C.aurantium*) and VOL (*C.Volkameriana*) leaf N and P contents. In spite of leaf K content was increasing as a result for spray of GA_3, but, leaf Fe content was decreased, and there were significant differences between treatments for leaf Zn and Mn. Also**,** [48]. Found that Diatoms and biofertilizer treatments on citrus seedlings .The differences between treatments were low to be significant and the lowest value were obtained by control treatment .Moreover, the results did not show any significant between all treatments for leaf P content (%) also.

4. CONCLUSION

From the results of this study, it can be suggested that the foliar application of blue-green algae at 3 ml / L and Estima green at 0.5g / L improves the nutritional status of the Washington navel orange transplants budding on the sour orange rootstock.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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