

Impact of Some Natural Extracts and Nutrients on Different Growth Measurements 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 study was conducted throughout the two successive seasons of 2018 and 2019 at Fruit Nursery of Horticulture Department, Faculty of Agriculture at Moshtohor, Benha University Qalubia Governorate, Egypt., to study the impact of some natural treatments, i.e., Algae, Yeast extract, Moringa leaves extract and nutrients as compound that containing both macro (N, P, K) and micro (Fe, Zn, Mn, Fe, Cu) elements and compound containing macro and microelements and some growth regulators. These materials (natural extracts and nutrients) were applied as a foliar spray at different concentrations to evaluate their effect on different growth parameters of one year old Washington navel orange transplants budded on sour orange rootstock. These materials were applied once in a month started from the last week in April to the last week in September .as per the treatment as: 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 grade) (0.5, 1 and 1.5 g/L) and Estima green (commercial grade) (0.5, 1 and 1.5 g/L). The result indicated that the

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application of Blue-green algae at 3 ml/L and Estima green at 0.5g/L cause a significant increase in the different growth parameters under this study i.e., length, diameter, number of leaves, leaf area, fresh and dry weights. On the contrary, the least values of the abovementioned parameters were usually in concomitant to T1 - control (water sprayed) which ranked statistically last during both seasons of study.

Keywords: Washington navel orange; transplants; growth measurements; natural extracts; nutrients.

1. INTRODUCTION

Citrus is considered as one of the most important fruit crops grown mainly in tropical and subtropical countries. About the crop is cultivated in an area of 1.5 million hectares at commercial scale in the world with production of 40 million metric tons of oranges, lemons, limes, etc [1].

Among the different orange, 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], and it 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 stimulative 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 seed germination 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 leaves of *Moringa oleifera* 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 study showed the effect of spraying of macro and micronutrients (as a nutrient) on growth, yield and fruit quality. Such nutrients as nitrogen, phosphorus, potassium and magnesium [9-12,]. However, zinc [13,14], copper, iron, boron [15] and manganese [16] were reported to be highly effective in improving nutritional status, yield and quality of different pear and apple trees.

Plant growth regulators usually are defined as organic compounds, other than nutrients, that in small concentrations, affect the physiological

processes of plants". In practical purpose, they are defined as either natural or synthetic compounds that are applied directly to plant to alter its life processes/structure in some beneficial way so as to enhance yield, improve quality and facilitate harvesting [17].

The present study aimed to investigate the effects of some natural extracts and nutrients as foliar spray on different growth parameters 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 of 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 two successive 2018 and 2019 experimental seasons.

The investigated 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 (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 individually 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).

Prior to experiment 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 [18].

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 grade); 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 grade); 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

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

algae, *Spirulina platensis*, belonging to *Cyanophyta*, and *Amphora coffeaeformis* 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 [19].

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 100 g/L) 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 [20].

Chemical analysis of yeast extract according to [21], 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 [22] with slight modification. Fresh Moringa leaves were dried in the air at room temperature ($22 \pm 2^\circ\text{C}$) for 7 days and then ground to maintain powder form. The extract was prepared with a weight of (2.5, 5, and 7.5) g of Moringa leaves powder each. Individually, one liter of distilled water was added to each of them and left at room temperature for 24 hours with occasional shaking, and then filtered through four layers of cheesecloth to remove the fibers, and then through Whatman No.1 paper, and sprayed directly on the transplants.

These treatments 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 [19]

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

The complete randomized block design with three replicates was employed for arranging the sixteen 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 for 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 Vegetative Growth Measurements

In this regard, some growth measurements of Washington navel orange transplants budded on Sour orange were carried out:

- Transplant height (cm)
- Stem diameter (cm) at 10 cm above union zone by using Vernier caliper.
- No. of lateral shoots.
- No. of leaves per transplant.
- Leaf area.
- Total assimilation area/transplant was calculated as = number of leaves per transplant x average leaf area.
- Leaves fresh weight (g).
- Leaves dry weight (g).
- Root fresh weight(g).
- Root dry weight(g).
- Stem fresh weight (g).
- Stem dry weight(g).
- Total transplant fresh weight (g).
- Total transplant dry weight (g).
- Top (vegetative growth) dry weight (g).
- Top/root (w/w) ratio (g).

Four mature leaves from the middle position of the stem/transplant were taken at the last week of September and then average leaf area was estimated according to the following equation of [23].

$$\text{Leaf Area (cm}^2\text{)} = 2/3 (\text{leaf length} \times \text{leaf width}).$$

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	Panthenic 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	Arginine (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	Phenylalanin (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]*

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 [24]. Besides, significant differences among means were differentiated according to the Duncan's, multiple range [25].

3. RESULTS AND DISCUSSION

3.1 Growth Measurements

In this study, transplants height, stem diameter, No. of lateral shoots, No. of leaves/transplant, average leaf area, total assimilation area, total transplant, leaves, stem, roots fresh and dry weights (g), top (vegetative growth) dry weight (g) and top/root ratio, were the investigated growth measurements of Washington Navel orange transplants as influenced by the differential investigated treatments. Data obtained during both 2018 and 2019 experimental seasons are presented in followed tables and figures.

3.2 Plant Height (cm)

Concerning the response of plant height (cm) to the differential investigated treatment, Table 5 show a considerable variation in this respect. All investigated treatments resulted in increasing plant height as compared to control treatment (water spray). Where the T6 (Yeast extract at a rate of 20 ml./L) and T14 (Estima green at a rate of 0.5 g/L) were the best treatments in this regard without significant differences between them. While the T4 (Blue-green algae extract at a rate of 3 ml./L) and T13 (Nitro active at a rate of 1.5 g/L) came in the second and third rank respectively were are the least effective investigated treatments in this regard T1 (Control) followed by T3 (Blue-green algae extract at a rate of 2 ml./L) Besides, the other investigated treatments were in between the aforesaid two extremes during both experimental seasons.

3.3 Stem Diameter (cm)

Concerning the response of stem diameter to the differential investigated treatments Table 5 display obviously that differences in most cases were relatively not so pronounced to be taken into consideration from the statistical standpoint during the second experimental season.

Meanwhile, It is quite evident that the highest rate of stem diameter compared to other investigated treatments was significantly detected by the T7 (Yeast extract at a rate of 30 ml./L) and T8 (Moringa Leaves extract at a rate of 2.5 g/L) respectively, they recorded the highest values in stem diameter compared to all treatments during the first experimental season. On the contrary, the least value was significantly concomited to the water sprayed (control) treatment. In addition, other treatments were in between the aforesaid two extremes during first season.

3.4 No. of Lateral Shoots

Data obtained in Fig. 1 cleared that superior T8 (Moringa Leaves extract at a rate of 2.5 g/L.) was superior in lateral shoots number compared with other treatments, where this treatment recorded the first statistically rank while the T12 (Nitro active at a rate of 1 g/L) recorded the second rank followed by T13 (Nitro active at a rate of 1.5 g/L) in the third statistically rank followed by T11 (Nitro active at a rate of 0.5 g/L) in the fourth statistically rank. On the contrary T3 (Blue green algae extract at a rate of 2 ml./L) came in the last statistically rank followed by T9 (Moringa Leaves extract at a rate of 5 g/L), T10 (Moringa Leaves extract at a rate of 7.5 g/L) and T7 (Yeast extract at a rate of 30 ml./L), respectively also other investigated treatments were in-between two extremes the highest one T8 (Moringa Leaves extract at a rate of 2.5 g/L) and the least effective one T3 (Blue green algae extract at a rate of 2 ml./L) during the 2018 and 2019 seasons.

3.5 No. of Leaves/Transplant

Data obtained in the Fig. 2 showed that T4 (Blue-green algae extract at a rate of 3ml./L) excelled in leaves No./transplants compared with other treatments, such treatment came in the first statistically rank while the T12 (Nitro active at a rate of 1 g/L) came in the second statistically rank followed by T11 (Nitro active at a rate of 1.5 g/L) in the third statistically rank followed by T15 (Estima green at a rate of 1 g/L) in the fourth statistically rank. On the contrary, T3 (Blue-green algae extract at a rate of 2 ml./L) came in the last statistically rank followed by the two treatments T5 (Yeast extract at a rate of 10 ml./L) and T7 (Yeast extract at a rate of 30 ml./L) without significant differences between them and control in both seasons.

Besides other investigated treatments were in-between two extremes the highest one T4 (Blue-green algae extract at 3 ml/L) and the lowest effective one T3 (Blue-green algae extract at a rate of 2 ml/L) during the 2018 and 2019 seasons of study.

Table 5. Effect of some natural extracts and nutrients compounds as foliar application on plant height (cm) and stem diameter (cm) of Washington navel orange transplants during 2018 and 2019 experimental seasons

Parameters Treatments/Seasons	Plant height (cm)		Stem diameter(cm)	
	2018	2019	2018	2019
T1. Control (water spray).	70.00 hi	73.00 g	1.80 a	1.37 a
T2. Blue-green algae extract at a rate of 1 ml./L.	76.00 ef	78.25 d	1.16 d	1.18 a
T3. Blue-green algae extract at a rate of 2 ml./L.	73.00 fgh	75.00 f	1.19 cd	1.22 a
T4. Blue-green algae extract at a rate of 3 ml./L.	86.00 ab	87.00 b	1.32 b	1.38 a
T5. Yeast extract at a rate of 10 ml./L.	73.00 fgh	76.00 ef	1.17 d	1.18 a
T6. Yeast extract at a rate of 20 ml./L.	89.00 a	90.70 a	1.18 d	1.19 a
T7. Yeast extract at a rate of 30 ml./L.	70.67 ghi	72.50 g	1.80 a	1.13 a
T8. Moringa Leaves extract at a rate of 2.5 g/L.	68.00 i	70.00 h	1.80 a	1.13 a
T9. Moringa Leaves extract at a rate of 5 g/L.	77.50 def	78.00 d	1.28 bc	1.30 a
T10. Moringa Leaves extract at a rate of 7.5 g/L.	80.00 cde	82.50 c	1.17 d	1.18 a
T11. Nitro active at a rate of 0.5 g/L.	82.00 bcd	83.50 c	1.17 d	1.18 a
T12. Nitro active at a rate of 1 g/L.	80.00 cde	82.50 c	1.19 cd	1.20 a
T13. Nitro active at a rate of 1.5 g/L.	84.00 bc	85.50 b	1.17 d	1.18 a
T14. Estima green at a rate of 0.5 g/L.	89.00 a	90.22 a	1.21 cd	1.23 a
T15. Estima green at a rate of 1 g/L.	75.00 fg	77.00 de	1.22 cd	1.23 a
T16. Estima green at a rate of 1.5 g/L.	82.83 bc	85.50 b	1.16 d	1.18 a

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

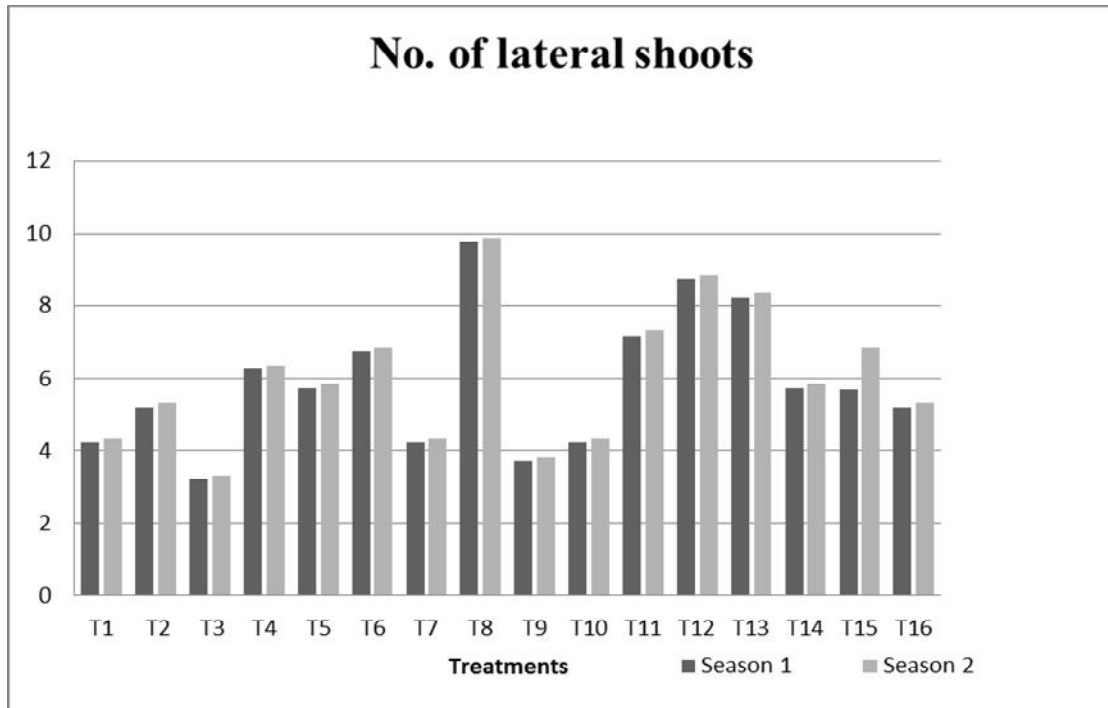


Fig. 1. Effect of some natural extracts and nutrients compounds as foliar application on No. of lateral shoots of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

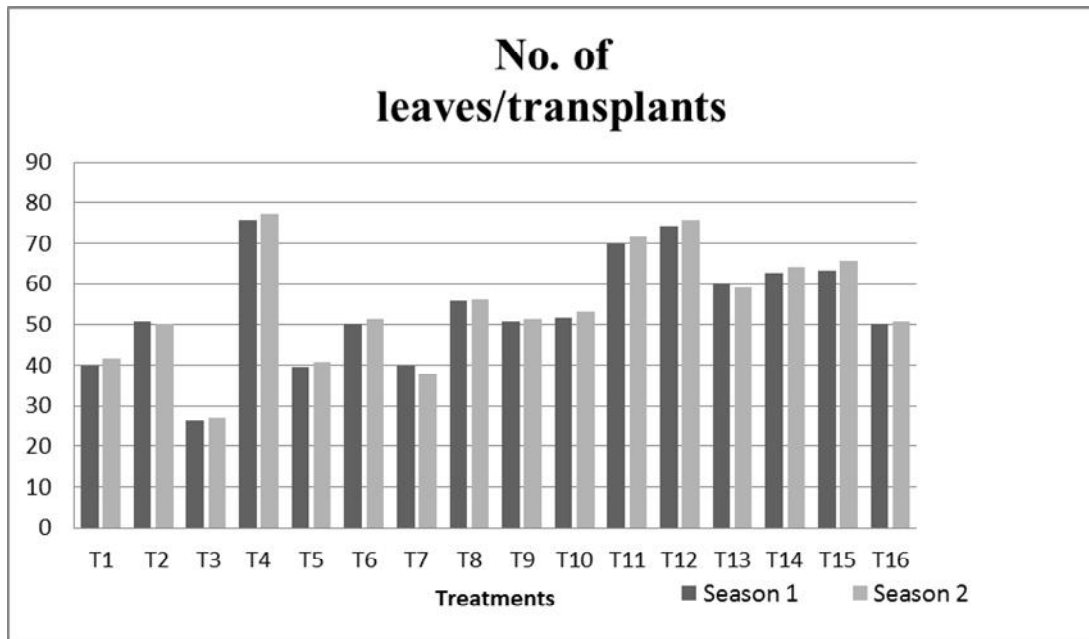


Fig. 2. Effect of some natural extracts and nutrients compounds as foliar application on No. of Leaves/transplant of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

3.6 Average Leaf Area (cm²)

Data in Fig. 3 exhibited that, the different investigated treatments had superior effects on the average leaf area (cm²) of Washington navel orange transplants in both experimental seasons. The results showed that, T6 (Yeast extract at rate of 20 ml./L.) came in the first rank superior from statically side where are the values (24.635 and 24.645 cm²) followed by in the second rank T14 (Estima green at rate of 0.5 g/L) with values (23.920 and 23.955 cm²) followed by in the third rank T8 (Moringa Leaves extract at rate of 2.5 g/L) with values (23.200and 23.215 cm²) followed by in the fourth rank T15 (Estima green at rate of 1 g/L) with values (21.905 and 21.975 cm²) followed by in the fifth rank T16 (Estima green at rate of 1.5 g/L) with values (21.898 and 21.965 cm²) respectively at two seasons study. On the contrary least effective investigated treatments in this regard T1 control (water spray) which came in the first rank from least values (14.280 and 14.330 cm²) followed by in the second rank T13 (Nitro active at rate of 1.5 g/L) with values (16.269 and 16.275 cm²) followed by in the third rank T2 (Blue green algae extract at rate of 1 ml./L) with values (16.700 and 16.793 cm²) followed by in the fourth rank T9 (Moringa leaves extract at rate of 5 g/L) with values (16.895 and 16.905 cm²) followed by in the fifth

rank T7 (Yeast extract at rate of 30 ml./L.) with values (16.899 and 16.955 cm²) respectively. On the other hand, other six investigated treatments were in-between the aforesaid two extremes.

3.7 Total Assimilation Leaf Area (cm²)

Data in Fig. 4 indicated that, the different investigated treatments had superiors effects on the total assimilation leaf area (cm²) of Washington navel orange transplants in both experimental seasons. The results showed that, using Blue green algae extract at rate of 3 ml./L (T4) came in the first rank and superior where recorded the values of 1626.7 and 1656. 5 followed by in the second rank T12 (Nitro active at rate of 1 g/L) with values (1540.7 and 1569.02 cm²) followed by in the third rank T14 (Estima green at rate of 0.5 g/L) with values (1498.6 and 1537.2 cm²) followed by in the fourth rank T11 (Nitro active at rate of 0.5 g/L) with values (1407.6 and 1443.8 cm²) followed by in the fifth rank T15 (Estima green at rate of 1 g/L) with values (1388.8 and 1443.1 cm²) respectively at two seasons study. On contrary the least effective investigated treatments in this regard T3 (Blue green algae extract at rate of 2ml./L) which came in the first rank with values (422.5 and 483.03 cm²) followed by in the second rank T1 control (water spray) with values (567.63 and

598.42 cm²) followed by in the third rank T7 (Yeast extract at rate of 30 ml./L) with values (670.90 and 640.9 cm²) followed by in the fourth rank T5 (Yeast extract at rate of 10 ml./L) with values (691.5 and 708.6 cm²) followed by in the fifth rank T2 (Blue green algae extract at rate of 1 ml./L.) with values (850.5 and 842.5 cm²) respectively. On the other hand, other six investigated treatments were in-between the aforesaid two extremes, in spite of the statistically varied as compared to the abovementioned superior and inferior treatments during two experimental seasons.

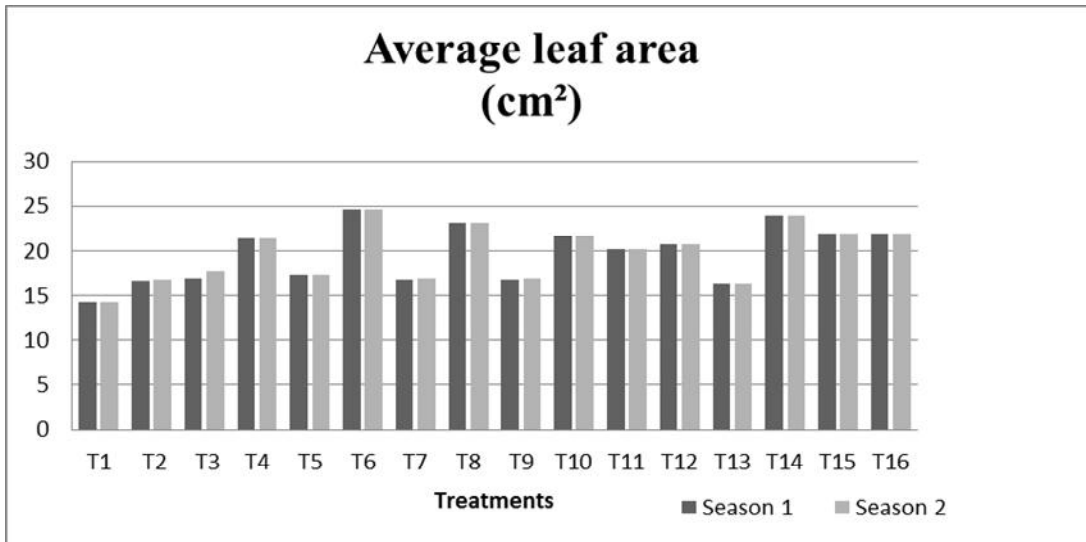


Fig. 3. Effect of some natural extracts and nutrients compounds as foliar application on average leaf area (cm²) of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

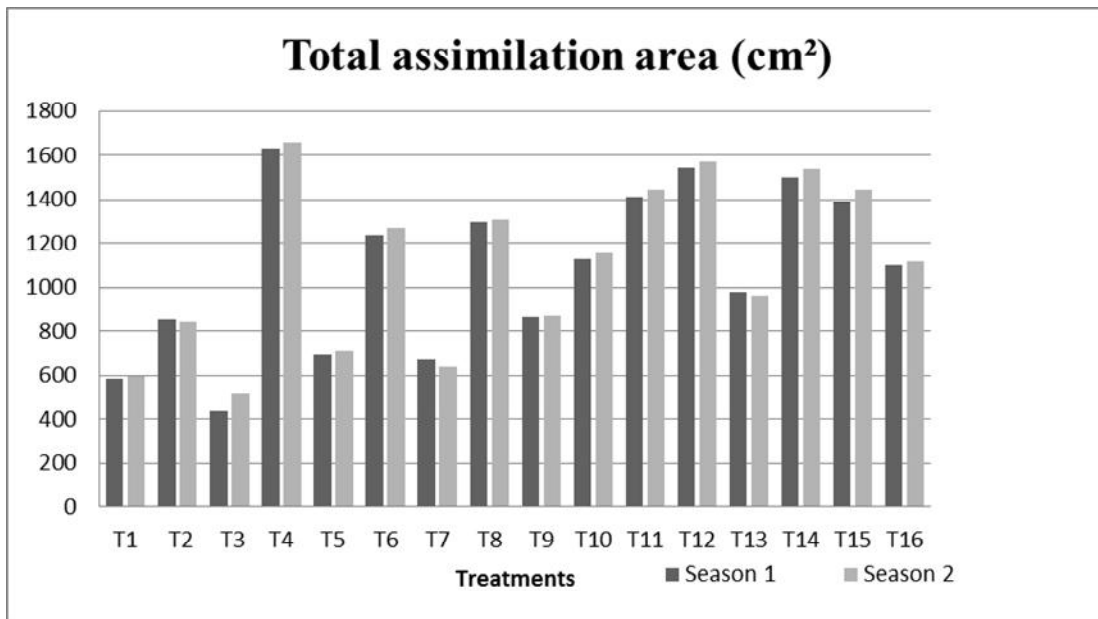


Fig. 4. Effect of some natural extracts and nutrients compounds as foliar application on total assimilation area (cm²) of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

3.8 Leaves Fresh Weight (g)

Referring to the influence of differential investigated treatments on leaves fresh weight, Table 6 display obviously that the effect was pronounced, whereas all investigated treatments resulted in effects on Washington orange transplants whether it is increasing or decrease in leaves fresh weight compared to control (water spray). such a trend was true during both 2018 and 2019 experimental seasons. However, T4 (Blue-green algae extract at the rate of 3 ml/L), T14 (Estima green at a rate of 0.5 g/L), T12 (Nitro active at a rate of 1 g/L) and T10 (Moringa Leaves extract at a rate of 7.5 g/L) Without significant difference in both seasons and T6 (Yeast extract at a rate of 20 ml./L), were statistically the superior respectively in this regard compared with T1 control (water spray) during 2018 & 2019 seasons. on the contrary, the lowest weights were recorded by T9 (Moringa Leaves extract at a rate of 5 g/L), T2 (Blue-green algae extract at a rate of 1 ml./L) and T13 (Nitro active at a rate of 1.5 g/L) respectively during both seasons. Besides, the other investigated treatments were in between the aforesaid two extremes during both experimental seasons.

3.9 Leave Dry Weight (g)

Referring the influence of differential investigated treatments on leaves dry weight, Table 6 display obviously that the effect was pronounced, whereas all investigated treatments resulted in increased on leaves dry weight during 2018 & 2019 seasons were are the T14 (Estima green at a rate of 0.5 g/L) was superior which came in the first rank. T4 (Blue-green algae extract at a rate of 3 ml./L) came in the second rank, T15 (Estima green at a rate of 1 g/L) came in the third rank .T12 (Nitro active at a rate of 1 g/L) came in the fourth rank T11 (Nitro active at a rate of 0.5 g/L) came in the fifth rank, T8 (Moringa Leaves extract at a rate of 2.5 g/L) came in the sixth rank compared T1 Control (water spray) on the other hand the T3 (Blue-green algae extract at a rate of 2 ml./L) recorded the lowest value of leaves dry weight which reached the first rank with values (22.000 and 23.335 g) respectively in both seasons compared with T1 control (water spray) while the T6 (Yeast extract at a rate of 20 ml./L) occupied the second rank and T9 (Moringa Leaves extract at a rate of 5 g/L) in the third rank in terms of reduction leave dry weight in the second season. Besides, the other investigated treatments were in between the aforesaid two extremes during both experimental seasons.

3.10 Stem Fresh Weight (g)

Concerning the response of stem fresh weight (g) to the differential investigated treatment, Table 7 show a considerable variation in this respect. All investigated treatments this resulted in an effect on the stem fresh weight as compared to control treatment where the T16 (Estima green at a rate of 1.5 g/l) and T12 (nitro active at a rate of 1 g/l) respectively were the best treatments Without significant differences between them in this regard while the T6 (yeast extract at a rate of 20 ml./l) came in the third rank followed by T4 (blue-green algae extract at a rate of 3 ml./l) came in the fourth rank followed by, T14 (Estima green at a rate of 0.5 g/l) came in the fifth rank at two experimental seasons were are the T1 control (water spray) came in sixth rank in seasons 2018 while came in the seventh rank in 2019 season and T13 (Nitro active at a rate of 1.5 g/L .) came in the sixth rank in season 2019 on contrary the other investigated treatments were in between the aforesaid extremes less than control treatment in this regard during both experimental season.

3.11 Stem Dry Weight (g)

Concerning the response of stem dry weight (g) to the differential investigated treatment, Table 7 show a considerable variation in this respect. resulted that statistically superior in T4 (Blue-green algae extract at a rate of 3 ml./L) during two seasons study while T12 (Nitro active at a rate of 1 g/L) came in the second rank at the first season were are came in the third rank at the second season and T16 (Estima green at a rate of 1.5 g/L) came in the third rank in the first season while came in the second rank in the second season. besides T14 (Estima green at a rate of 0.5 g/L) and T8 (Moringa Leaves extract at a rate of 2.5 g/L) came in fourth and fifth rank respectively in both seasons . on other hands T1 Control (water spray) came in the sixth rank in terms of reduction stem dry weight during two experimental seasons on contrary T3 (Blue-green algae extract at a rate of 2 ml./L), T5 (Yeast extract at a rate of 10 ml./L), T9 (Moringa Leaves extract at a rate of 5 g/L). T10 (Moringa Leaves extract at a rate of 7.5 g/L) and T7 (Yeast extract at a rate of 30 ml./L) were the lowest values compared with control treatment during tow aforesaid extremes seasons on another hand other treatments came between in T8 (Moringa Leaves extract at a rate of 2.5 g/L) and T1 Control (water spray) during two experimental seasons.

Table 6. Effect of some natural extracts and nutrients compounds as foliar application on leaves fresh and dry weights of Washington navel orange transplants during 2018 and 2019 experimental seasons

Parameters Treatments/Seasons	Leaves fresh weight (g)		Leaves dry weight (g)	
	2018	2019	2018	2019
T1. Control (water spray).	56.90 bcd	58.88 de	23.00 gh	25.33 cd
T2. Blue-green algae extract at a rate of 1 ml./L.	51.62 fg	52.86 g	23.50 fgh	25.68 cd
T3. Blue-green algae extract at a rate of 2 ml./L.	52.00 efg	53.81 g	22.00 h	23.34 cd
T4. Blue-green algae extract at a rate of 3 ml./L.	62.57 a	66.22 a	28.88 a	30.92 ab
T5. Yeast extract at a rate of 10 ml./L.	57.00 bcd	58.01 ef	25.00 def	26.03 bcd
T6. Yeast extract at a rate of 20 ml./L.	59.46 abc	60.52 cd	26.38 bcd	24.12 cd
T7. Yeast extract at a rate of 30 ml./L.	56.12 b-e	58.23 ef	23.50 fgh	25.63 cd
T8. Moringa Leaves extract at a rate of 2.5 g/L.	52.92 d-g	53.45 g	27.00 bc	27.80 a-d
T9. Moringa Leaves extract at a rate of 5 g/L.	51.00 g	52.75 g	23.03 gh	25.09 cd
T10. Moringa Leaves extract at a rate of 7.5 g/L.	59.99 ab	61.53 c	26.00 cde	27.10 a-d
T11. Nitro active at a rate of 0.5 g/L.	52.01 efg	53.84 g	27.90 ab	28.23 a-d
T12. Nitro active at a rate of 1 g/L.	60.00 ab	61.72 c	27.95 ab	28.68 abc
T13. Nitro active at a rate of 1.5 g/L.	51.84 efg	53.34 g	24.30 efg	25.97 cd
T14. Estima green at a rate of 0.5 g/L.	62.15 a	64.16 b	29.00 a	31.55 a
T15. Estima green at a rate of 1 g/L.	51.97 efg	53.63 g	28.00 ab	29.02 abc
T16. Estima green at a rate of 1.5 g/L.	55.42 c-f	56.64 f	24.80 d-g	26.61 bcd

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

Table 7. Effect of some natural extracts and nutrients compounds as foliar application on stem fresh and dry weights of Washington navel orange transplants during 2018 and 2019 experimental seasons

Parameters Treatments/Seasons	Stem fresh weight (g)		Stem dry weight (g)	
	2018	2019	2018	2019
T1. Control (water spray).	79.80 cde	85.08 ab	49.30 b-f	51.13 cde
T2. Blue-green algae extract at a rate of 1 ml./L.	77.60 ef	80.74 b	49.75 b-f	51.88 b-e
T3. Blue-green algae extract at a rate of 2 ml./L.	78.45 c-f	83.62 ab	48.62 c-f	50.59 cde
T4. Blue-green algae extract at a rate of 3 ml./L.	80.35 c	86.61 ab	54.68 a	56.79 a
T5. Yeast extract at a rate of 10 ml./L.	71.60 g	80.40 b	47.16 def	48.99 de
T6. Yeast extract at a rate of 20 ml./L.	84.38 b	87.43 ab	52.70 abc	51.68 b-e
T7. Yeast extract at a rate of 30 ml./L.	53.00 h	49.46 c	44.97 f	49.26 de
T8. Moringa Leaves extract at a rate of 2.5 g/L.	78.00 def	81.96 ab	52.72 abc	54.19 abc
T9. Moringa Leaves extract at a rate of 5 g/L.	77.95 def	79.48 b	47.13 d-f	48.79 de
T10. Moringa Leaves extract at a rate of 7.5 g/L.	77.45 f	80.30 b	45.80 ef	47.63 e
T11. Nitro active at a rate of 0.5 g/L.	78.00 def	82.60 ab	50.40 a-e	52.48 a-d
T12. Nitro active at a rate of 1 g/L.	88.50 a	90.63 a	53.95 ab	55.16 abc
T13. Nitro active at a rate of 1.5 g/L.	79.13 c-f	85.25 ab	51.90 a-d	53.46 a-d
T14. Estima green at a rate of 0.5 g/L.	79.83 cd	85.94 ab	52.75 abc	54.61 abc
T15. Estima green at a rate of 1 g/L.	77.80 def	83.12 ab	50.18 a-e	52.25 a-e
T16. Estima green at a rate of 1.5 g/L.	89.64a	90.83 a	53.85 ab	55.93 ab

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

Table 8. Effect of some natural extracts and nutrients compounds as foliar application on roots fresh and dry weights of Washington navel orange transplants during 2018 and 2019 experimental seasons

Parameters Treatments/Seasons	Roots fresh weight (g)		Roots dry weight (g)	
	2018	2019	2018	2019
T1. Control (water spray).	35.00 c-f	37.51 abc	23.00 gh	25.14 de
T2. Blue-green algae extract at a rate of 1 ml./L.	28.50 g	30.59 c	22.00 hi	23.05 fg
T3. Blue-green algae extract at a rate of 2 ml./L.	34.50 def	36.97 abc	23.80 g	25.27 d
T4. Blue-green algae extract at a rate of 3 ml./L.	43.00 a	45.30 a	29.50 a	31.63 a
T5. Yeast extract at a rate of 10 ml./L.	29.00 g	31.58 c	19.70 j	21.24 h
T6. Yeast extract at a rate of 20 ml./L.	36.50 c-f	38.73 abc	25.18 ef	27.12 c
T7. Yeast extract at a rate of 30 ml./L.	34.30 ef	36.11 abc	24.00 fg	24.12 def
T8. Moringa Leaves extract at a rate of 2.5 g/L.	28.60 g	30.63 c	22.92 gh	23.92 ef
T9. Moringa Leaves extract at a rate of 5 g/L.	31.70 fg	32.27 bc	20.95 ij	22.41 gh
T10. Moringa Leaves extract at a rate of 7.5 g/L.	37.67 b-e	43.33 a	27.85 bc	29.52 b
T11. Nitro active at a rate of 0.5 g/L.	39.53 a-d	41.40 ab	26.42 de	28.87 b
T12. Nitro active at a rate of 1 g/L.	42.60 ab	38.13 abc	28.82 ab	30.89 a
T13. Nitro active at a rate of 1.5 g/L.	42.28 ab	44.35 a	29.33 a	31.24 a
T14. Estima green at a rate of 0.5 g/L.	39.65abc	41.85 a	27.33 cd	29.41 b
T15. Estima green at a rate of 1 g/L.	38.16 a-e	44.20 a	27.87 bc	29.58 b
T16. Estima green at a rate of 1.5 g/L.	42.00 ab	42.99 a	29.05 ab	31.10 a

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

3.12 Roots Fresh Weight (g)

Data obtained in the Table 8 cleared the treatment T4 was significantly superior over rest of the treatments. In this regard where are this treatment came in the first superior statistically rank with values (43.00 and 45.296 g) respectively during both seasons compared to T1 control (water spray) With the following values (35.00 and 37.513 g) in addition to that T2 (Blue-green algae extract at a rate of 1 ml/L) As it reached the first rank in terms of the lowest values (28.500 and 2.30 g) Compared to the T1 (Control) as well followed by T8 (Moringa Leaves extract at a rate of 2.5 g/L), T5 (Yeast extract at a rate of 10 ml/L), T9 (Moringa Leaves extract at a rate of 5 g/L), T7(Yeast extract at a rate of 30 ml/L), T3 (Blue-green algae extract at a rate of 2 ml/L) in order. As for the rest of the treatments, they came between the first superior T4 (Blue-green algae extract at a rate of 3 ml/L) and the control treatments during two seasons study.

3.13 Roots Dry Weights (g)

Data tabulated in the Table 8 cleared that superior T4 (Blue-green algae extract at a rate of 3 ml/L) to the differential investigated treatments in Roots dry weights where is this treatment came in the first statistically rank with values (29.500 and 31.630 g) respectively, in both seasons. in addition to the following treatments: T13 (Nitro active at a rate of 1.5 g/L), T16 (Estima green at a rate of 1.5 g/L).T12 (Nitro active at a rate of 1 g/L), T15 (Estima green at a rate of 1 g/L), T10 (Moringa Leaves extract at a rate of 7.5 g/L), T14 (Estima green at a rate of 0.5 g/L), T11 (Nitro active at a rate of 0.5 g/L), T6 (Yeast extract at a rate of 20 ml/L) respectively They have come to whence superiority after the aforementioned treatment T4 in this regard during both seasons. On the contrary, the T5 (Yeast extract at a rate of 10 ml/L) ranked first whence of the lowest value compared to the control treatments in this regard, followed by treatments T9 (Moringa Leaves extract at a rate of 5 g/). T2 (Blue-green algae extract at a rate of 1 ml/L), T8 (Moringa Leaves extract at a rate of 2.5 g/L) in order in both seasons. On the other hand, concerning the remaining three treatments, they came between the T6 and T8 during experimental seasons.

3.14 Total Plant Fresh Weight (g)

Regarding the response of Total plant fresh weights (g) to the differential investigated

treatments. Fig. 5 display that seven treatments were statistically superior in both seasons compared to the control treatment with The following values (171.70 and 181.47 g) are for the two respective seasons. Where the T12 (Nitro active at a rate of 1 g/L) and T4 (Blue-green algae extract at a rate of 3 ml/L) recorded the best values ever, as the T12 ranked first in the 2018 season with value (191.10 g) while it ranked second in the 2019 season with value (197.14 g). On the contrary, T4 ranked the second in the season 2018 with value (189.40 g) while the same treatment ranked the first in the season 2019 with value (198.12 g). On another hand, the following treatments T16 (Estima green at a rate of 1.5 g/L), T14 (Estima green at a rate of 0.5 g/L), T6 (Yeast extract at a rate of 20 ml/L), T10 (Moringa Leaves extract at a rate of 7.5 g/L.) and T13(Nitro active at a rate of 1.5 g/L) recorded lower values in whence of superiority From the side of statistical analysis between the best of the aforementioned treatments and control treatment.

On the contrary, the other seven investigated treatments were in between the lowest value in whence of reducing Total plant fresh weight (g) Represented in the T7 (Yeast extract at a rate of 30 ml/L) and control treatment T1(control) during both experimental seasons.

3.15 Total Plant Dry Weight (g)

Referring the influence of differential investigated treatments on Total plant dry weight. Fig. 6 display superior T4 (Blue-green algae extract at a rate of 3 ml/L) on the one hand statistical analysis whence was the best in both seasons, it reached the first rank compared with all investigated treatments followed by T12 (Nitro active at a rate of 1 g/L) which came in the second rank in the first season while the same treatment came in the third rank at the second season. on other hand T14 (Estima green at a rate of 0.5 g/L) came in the third rank in the first season while the same treatment came in the second rank at the second season Besides, the following treatments: T16 (Estima green at a rate of 1.5 g/L), T15 (Estima green at a rate of 1 g/L),T13 (Nitro active at a rate of 1.5 g/L), T11 (Nitro active at a rate of 0.5 g/L),T6 (Yeast extract at a rate of 20 ml/L), T8 (Moringa Leaves extract at a rate of 2.5 g/L) and T10 (Moringa Leaves extract at a rate of 7.5 g/L.) they ranked 4th 5th 6th 7th 8th 9th and 10th respectively whence of superiority during both seasons. Moreover, The T7 (Yeast extract at a

rate of 30 ml./L) exceeded the control in the first season as it ranked 12th while it did not overtake the control in the second season. on the

contrary, the other investigated treatments were in less than control treatment in this regard during both experimental seasons .

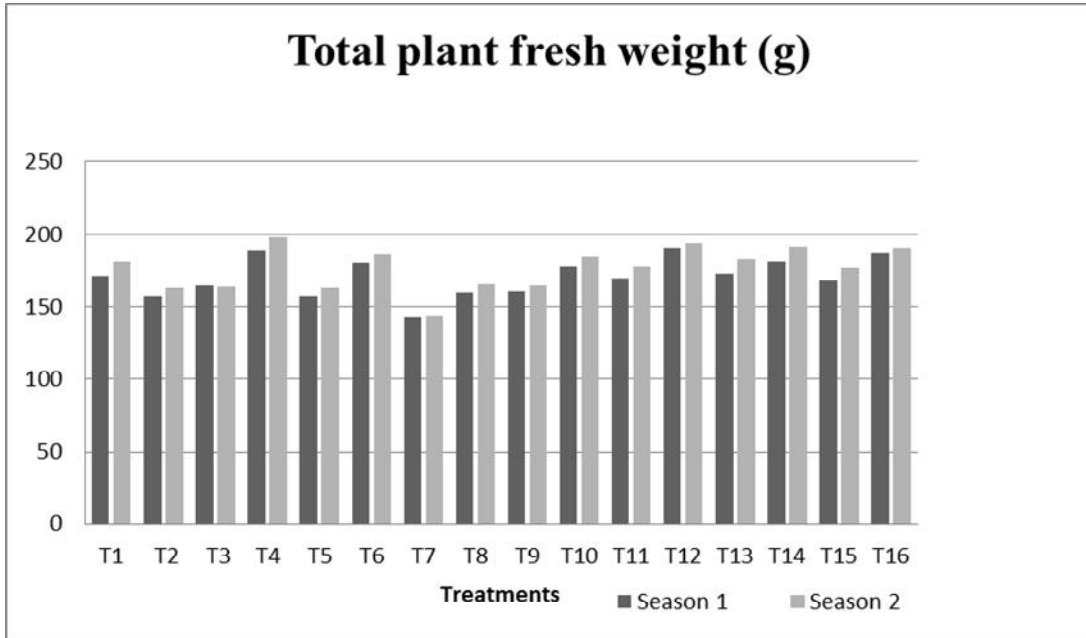


Fig. 5. Effect of some natural extracts and nutrients compounds as foliar application on total plant fresh weight (g) of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

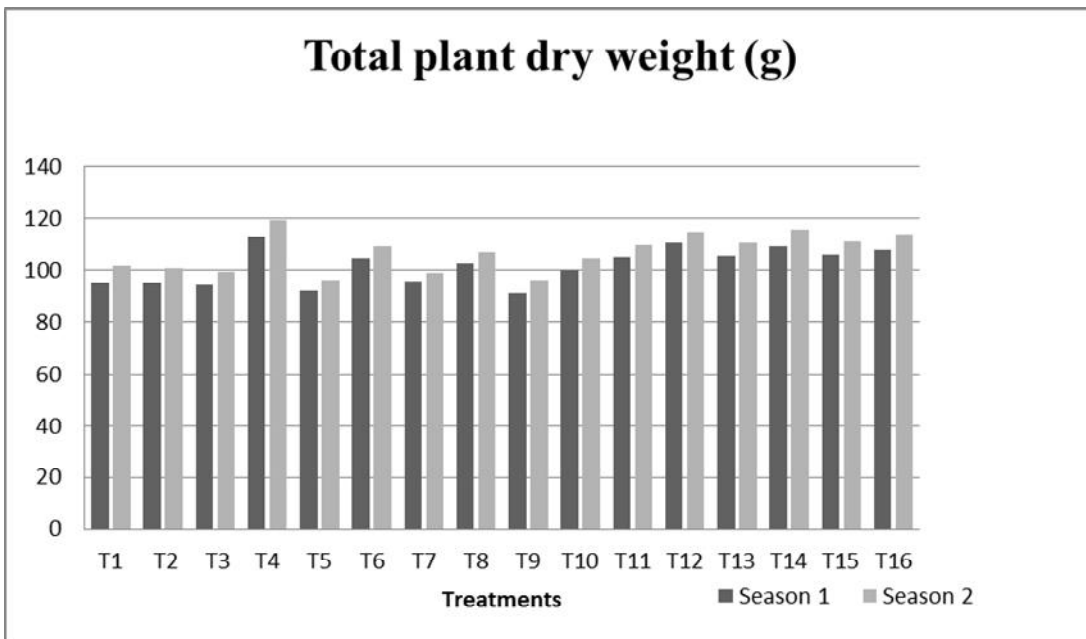


Fig. 6. Effect of some natural extracts and nutrients compounds as foliar application on total plant dry weight (g) of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

3.16 Top Dry Weight (g)

Referring to the influence of differential investigated treatments on Top dry weight. Fig. 7 displays superior T4 (Blue-green algae extract at a rate of 3 ml./L) on the one hand statistical analysis whence was the best in both seasons were reached the first rank compared with all investigated treatments.

Regarding the rest of the treatments that exceeded the control in this regard they differed in their statistical arrangement except for the T6 (Yeast extract at a rate of 20 ml./L.), according to the different seasons as shown below :

T12 (Nitro active at a rate of 1 g/L) which came in the 2nd rank at 1st season while the same treatment came in the third rank at the second season.

T14 (Estima green at a rate of 0.5 g/L) came in the 3rd rank at 1st season while the same treatment came in the second rank in the 2nd season.

T8 (Moringa Leaves extract at a rate of 2.5 g/L.) came in the 4th rank during 1st season whereas the was less value than control during 2nd season as well T5 (Yeast extract at a rate of 10 ml./L) came in the 6th rank in the 2nd season whereas was less value than control during 1st season also T9 (Moringa Leaves extract at a rate of 5 g/L) came in the 9th rank in the 1st season while was less value than control during 2nd season.

As for the following treatments T16 (Estima green at a rate of 1.5 g/L). T15 (Estima green at a rate of 1 g/L). T13 (Nitro active at a rate of 1.5 g/L). T11 (Nitro active at a rate of 0.5 g/L) and T2 (Blue-green algae extract at a rate of 1 ml./L) they were superior in both seasons on contrary The following treatments: T7 (Yeast extract at a rate of 30 ml./L), T10 (Moringa Leaves extract at a rate of 7.5 g/L.) and T3 (Blue-green algae extract at a rate of 2 ml./L) were the lowest values compared to the control in both experimental seasons.

3.17 Top/Root Ratio

Referring the influence of differential investigated treatments on Top/root ratio. Fig. 8 displays best two superior treatments, in this respect, compared with T1 (control) Where T5 (Yeast

extract at a rate of 10 ml./L) reached the first rank followed by T8 (Moringa Leaves extract at a rate of 2.5 g/L.) in the second statistically rank. followed by the treatments . T9 (Moringa Leaves extract at a rate of 5 g/L) and T2 (Blue-green algae extract at a rate of 1 ml./L) which differed in the statistical position according to the season difference in addition to T3 (Blue-green algae extract at a rate of 2 ml./L) which superior in the first season only and did not excel in the second season, T7 (Yeast extract at a rate of 30 ml./L.) which superior in the second season only and did not excel in the first season. On the contrary, T10 (Moringa Leaves extract at a rate of 7.5 g/L.) recorded the first rank from were reducing the ratio followed by T13(Nitro active at a rate of 1.5 g/L) followed by T16 (Estima green at a rate of 1.5 g/L) and the other investigated treatments were in between the T1(Control) and T16 (Estima green at a rate of 1.5 g/L) during both experimental season.

Nowadays, new bio stimulating materials such as Seaweeds 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 humans, animals, and birds [4]. Liquid fertilizers derived from natural sources like seaweed are found to be viable alternatives to fertilizing input for 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].

The obtained results concerning the effects of foliar sprays with yeast extract on growth parameters of different citrus rootstock seedlings go in line with the findings of [7,26-30].

The obtained results concerning the effects of foliar sprays with moringa extract on enhancing growth parameters go in line with an earlier report of [31-33]. They found that moringa extract at 2 and 4% were significantly effective on Le-Conte pear leaf area, shoot length, and shoot diameter. Also, the control was the lowest in shoot length and shoot diameter in both seasons.

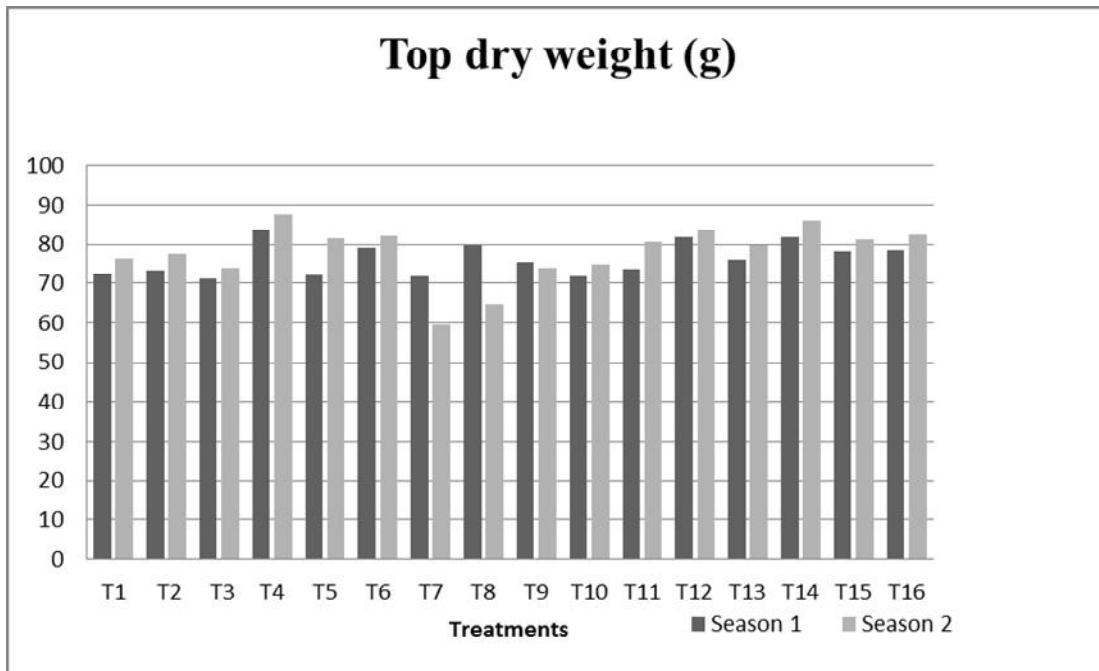


Fig. 7. Effect of some natural extracts and nutrients compounds as foliar application on top dry weight (g) of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

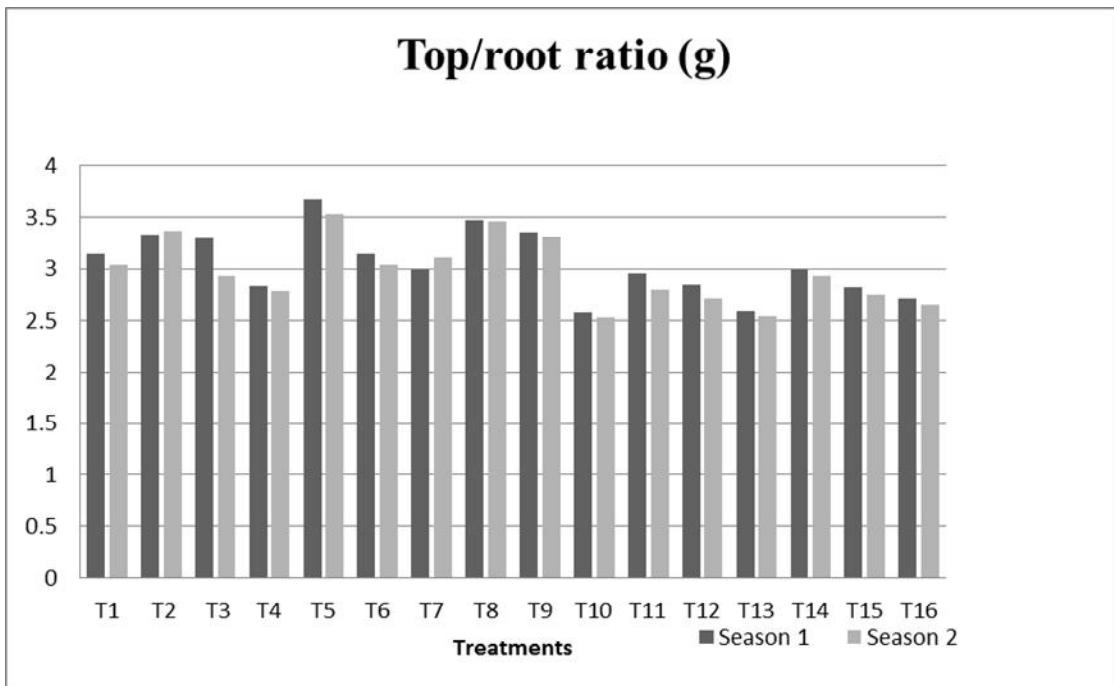


Fig. 8. Effect of some natural extracts and nutrients compounds as foliar application on Top/root ratio (g) of Washington Navel orange transplants budded on sour orange rootstock during 2018 and 2019 seasons

4. CONCLUSION

From the results obtained, it could be inferred that the use of Blue-Green Algae at 3 ml / L and Estima Green at 0.5g / L. This combined treatment provided the best results for most of the Washington navel orange transplant growth parameters budded on sour orange rootstock.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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