

## Effect of Different Concentrations of Seaweed Extract and Some Nutrient Elements Mixture on Growth and Fruiting of Baldy Mandarin Trees

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**Abstract:** This study was carried out during three successive seasons (2018, 2019 & 2020) to examine the effect of spraying with a mixture of seaweed extract plus some nutrient elements at 0.1, 0.2, 0.3, 0.4 and 0.5 % on vegetative growth, nutritional status, yield and fruit quality of Baldy mandarin trees. The experimental trees were sprayed three times; just after fruit setting (the 1<sup>st</sup> week of May), mid of July and mid of August. The promotion obvious and positive effects were related to the increase in concentrations of seaweed extract and mixture of micronutrients from 0.1 to 0.5%. Most of investigated parameters had significant differences for both 0.4 and 0.5 %. Carrying out three sprays of seaweed extract and micronutrients as a mixture each at both 0.4% and 0.5 % was responsible for improving Baldy mandarin tree yield and fruit quality.

**Key words:** Seaweed • Nutrient- Elements • Baldy mandarin • Fruit quality

### INTRODUCTION

Citrus is world's subtropical fruits and very important part of human diet for their nutritional value, antioxidant activity, vitamin C and photochemical compounds [1]. The world production of citrus fruits reached 125 million ton; it ranks the third position between fruit crops [2]. Moreover, Baldy mandarin (*Citrus reticulata*) is one of the most important citrus species that Egyptian consumers and export market due to its sugar content, good taste and easy peeling characteristics. Additionally, mandarin cv., occupy the 2<sup>nd</sup> area after orange which reached 27.2 % of citrus cultivated area gave 21.7 % of total citrus production [3].

Foliar fertilization has been increased in nutrition of fruit trees especially where the loss through leaching or fixation of the applied fertilizers seemed higher. Therefore foliar application of nutrients to fruit trees in new reclaimed sandy or sandy calcareous soils is suggested also. Their application decreased the different nutritional disorders in fruit crops [4]. In Addition, the enhancement effect of macro-elements may be attributed to the important role of potassium in nutrient and sugar translocation in plant and turgor pressure of plant cells. Also potassium active numerous enzyme systems

involved in the formation of organic substances and in the buildup of compounds such as starch or protein. Potassium is involved in cell enlargement and in triggering the young tissues or be due to that potassium is involved in plant meristematic growth and improves fruit quality by enhancing fruit size, juice contents, color, size and juice Flavor [5].

Micronutrients play an important role in flowering and fruiting processes. Moreover, Zinc (Zn) is one of the micronutrient required for normal plant growth. It's an important element essential of plant due to its participation in the synthesis of tryptophan which is a precursor of IAA synthesis. It is well known that zinc acts a co-factor of many enzymes and affects many biological processes such as photosynthesis reactions, nucleic acids metabolism, protein and carbohydrate biosynthesis [6].

The use of seaweed extracts is suggested to be one possibility to restore the natural conditions seaweed extracts have long been recognized as excellent natural fertilizers and sources of organic matter, natural hormones, amino acids, vitamins B and different essential nutrients. They were responsible for improving yield and quality of citrus trees Desai [7]; Mohsen [8]; Rabeh [9]; Salem [10]; Sayed [11]; Abo El-Komsan [12] and

Sayed [13]. Also, seaweeds extract considers a basic bio-fertilizer and has been generally considered due to its commercial significance as a source of proteins, vitamin B-12, basic amino acids and antioxidants [14]. It can progress plant development and crop yield due to their release of different growth regulator substances such as gibberellin, auxin and cytokinins [15].

Doubtless, foliar spraying of seaweed extract which in rich with several bio-organic, amino acids, antioxidant, growth assimilations and ...etc. Moreover, some of macro and micro elements which help in plant nutrient balance. This will improve tree vegetative growth and fruit setting, improve of Baldy mandarin tree production and fruit quality under Middle Egypt Region" Bany-Suef Governorate" conditions. Moreover, Baldy mandarin trees suffer from alternate bearing phenomenon which negatively reflected on vegetative tree growth yield, fruit quality and Producers' returns.

Finally, the main purpose of the present study was aimed to investigate the effect of seaweed extract and different concentrations of micronutrients on growth and fruiting of Baldy mandarin trees.

## MATERIALS AND METHODS

The present study was carried out during three successive seasons of 2018, 2019 and 2020 on 16-year-old Baldy mandarin trees budded on sour orange rootstock. Selected trees were at "ON" year during the three studied seasons and grown in a private citrus orchard located at Ahnasia district, Bany-Suef Governorate. The trees were planted at 5x5m apart. The texture of the soil is clay and the water depth is not less than two meters. Soil analysis was conducted according to the procedures that outlines by Wilde *et al.* [16] Table (1). Surface irrigation system was carried out using Nile water.

Selected trees were subjected to the normal horticultural practices that already applied in the orchard (as the recommendations of the Ministry of Agriculture "Horticulture practices"). This experiment included the following treatments:

- T<sub>1</sub> - The control (spraying with water).
- T<sub>2</sub> - Spraying with a mixture of seaweed extract plus some nutrient elements at 0.1%.
- T<sub>3</sub> - Spraying with a mixture of seaweed extract plus some nutrient elements at 0.2%.
- T<sub>4</sub> - Spraying with a mixture of seaweed extract plus some nutrient elements at 0.3%.

T<sub>5</sub> - Spraying with a mixture of seaweed extract plus some nutrient elements at 0.4%.

T<sub>6</sub> - Spraying with a mixture of seaweed extract plus some nutrient elements at 0.5%.

A mixture of seaweed extract plus some nutrient elements under trade name "Leopardo" contain Seaweed extract plus macro- elements" ie.": N (7%), P (5%) & K (5%) and macro- elements ie.: Fe (0.80%), Zn (0.40 %), Mn (0.35 %) & B (0.04 %). "Leopardo" made in Vellsam Materias, S.L. Agrivell sal "SPIAN" Sold by Green Force Company for Agriculture Development In Egypt. This component "Leopardo" rates were sprayed at three times; i" after petal fall stage (the 1<sup>st</sup> week of May), ii" at mid of July and iii" at mid of August. Triton B as a wetting agent at 0.05% was added to the solutions. Spraying was carried out till run off followed. Randomized complete block design (RCBD) was followed and each treatment was replicated three times with one tree per each replicate.

**The Following Measurements Were Recorded:** Shoot length (cm) and leaf area (cm<sup>2</sup>) for the spring growth cycle at the mid of September according to Hiscox *et al.* [17].

Chlorophylls a & b and total carotenoids (mg/g F.w) were estimated according to Ahmed *et al.* [18]. Leaves total carbohydrates % as described in A.O.A.C., [19] and C/N ratio was calculated.

Leaf N, P, K, Mg and Ca (%) and Zn, Fe, B and Mn (ppm) contents according to Summer [20] and Wilde *et al.* [21].

Initial fruit set (%): At the 1<sup>st</sup> week of March four sub-main branches (about ½ inch) were tagged one by one of the original geographical locations, at full bloom stage total number of flowers were determined. Then, on the same branches the number of fruitlets has been counted two times the 1<sup>st</sup> date at the 1<sup>st</sup> week of April, the 2<sup>nd</sup> date at the end of June. Both initial fruit setting and fruit retention was calculated according to the following equations:

$$\text{Initial fruitset (\%)} = \frac{\text{Number of fruits - let per tree}}{\text{Total number of flowers per tree}} \times 100$$

$$\text{Fruit retention (\%)} = \frac{\text{Number of fruits - let per tree}}{\text{Total number of flowers per tree}} \times 100$$

Yield was harvest at mid of December for all seasons and expressed in weight (kg/ tree) and number of fruits per tree was counted.

Table 1: Analysis of the experimental soil

Sand (%)	Silt (%)	Clay (%)	Texture	pH (1:2.5 extract)
9.3	12.4	78.3	Clay	7.9
E.C.(1:2.5 extract) (mmhos/cm/25c)	CaCO <sub>3</sub> (%)	Organic matter (%)	Total N (%)	Available P (ppm)
0.79	1.66	2.11	0.14	6.18
Available K (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)	---
408	23.6	19.2	4.9	---

**Physical and Chemical Fruit Characteristics:** Fruit weight (g), fruit peel % (w/w), fruit peel thickness (cm), juice (%): TSS (%), titratable acidity (%) and TSS/acidity ratio was calculated. Vitamin C content was determined according to A.O.A.C [19] and total sugars % according to Lane and Eynon [22].

**Statistical Analysis:** The investigation was planned out as a simple experiment in a complete randomized block design. Each treatment was represented in three replicates with 2 trees per a replicate. The statistical analysis of the present data was carried out as indicated by Snedecor *et al.* [23]. Significant differences among the means of various treatments were established by new LSD at 5% level of probability parameter for elucidating the differences between various treatments means according to Mead *et al.* [24].

## RESULTS AND DISCUSSIONS

**Vegetative Growth:** Concerning the effect of different concentrations of seaweed extract and some nutrient elements mixture foliar applications on Baldy mandarin spring cycle shoot length and leaf area. Data in Table (2) clear that spraying seaweed extract plus some nutrient elements positively increased both shoot length or leaf area in compared to the control treatments during the three studied seasons. Whereas, spraying with a mixture of seaweed extract plus some nutrient elements at 0.4% or 0.5 %, significantly gave the highest values when compared with the other treatments. Meanwhile, the control recorded the lowest values.

**Leaf Pigments:** Regard to the effect of seaweed extract and some nutrient elements foliar spraying at different concentrations on leaf pigments (Chlorophyll a & b and total Carotenoids) of Baldy mandarin. Data in Table (3) revealed that, foliar spraying of seaweed extract and some nutrient elements at 0.1 and 0.2% slightly effect on leaf pigments content in compared to the control treatment during the three seasons. In contrary, both Seaweed + some nutrient elements at 0.4 or 0.5% significantly gave the highest leaf Chl. a & b and Carotenoids values and the control was the lowest. Leaf area and leaf pigments plays

an important part to improve yield , fruit quality and quantity according to Abo El-Komsan *et al.* [12]; Sayed *et al.* [13]; Hegab [25] and El-Sayed *et al.* [26] on citrus trees.

**Leaf Photosynthesis Components:** Data presented in Table (4) illustrate that seaweed extract and some nutrient elements component at different concentrations fluctuated in their effect from season to another. While, spraying with seaweed extract and some nutrient elements component at 0.5 % was the superior and significantly increased leaf carbohydrates, total sugars and C/N ratio for the three studied seasons in compared to other treatments. It was confirmed that the control treatment was the lowest.

Seaweed extracts play as important role in enhancing the biosynthesis of all organic foods antioxidants and plant pigments. Seaweed extract is also responsible for enhancing the resistance of tree to all stresses [27-30].

### Leaf Mineral Content

**Macro-Elements:** Tables (5 & 6) disclosed cleared that all seaweed extract and some nutrient elements component spraying at different concentrations improved Baldy mandarin leaf mineral contents for all studied seasons. Moreover, both 0.4 % and 0.5% significantly increased N (%); P (%); K (%); Ca (%) & Mg (%) values in compared to other concentrations. On the other hand, the lowest leaf mineral content was recorded with the control.

**Micro - Elements:** Data in Table (7) show that, in spite of all seaweed extract and some nutrient elements component positively improved Baldy mandarin leaves Fe, Zn, Mn and B contents for all seasons when compared to the control treatment. But both 0.4 and 0.5% concentrations statistically increased these elements in leaves when compared to other treatments. Meanwhile, the lowest values were recorded with the control during the three studied seasons. Micro - elements plays an important role in growth, flowering and fruiting processes they were responsible for improving yield and quality of citrus trees Hegab [25, 30]; Abo El-Komsan *et al.* [12]; Sayed *et al.* [13] and El-Sayed *et al.* [26, 31].

Table 2: Effect of different concentrations of seaweed extract and some nutrient elements on shoot length and leaf area of Baldy mandarin trees during (2018/ 019 & 020) seasons

Treatments	Shoot length (cm)			Leaf area (cm) <sup>2</sup>		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	7.33d	6.00d	8.67f	6.64d	7.07d	6.74d
Seaweed + some nutrient elements at 0.1%	8.33c	7.32c	9.33e	7.27c	7.12 cd	6.94c
Seaweed + some nutrient elements at 0.2%	10.30b	8.00b	10.67d	7.41bc	7.25 bc	7.03c
Seaweed + some nutrient elements at 0.3%	11.70ab	8.30b	11.33c	7.53b	7.36 ab	7.04c
Seaweed + some nutrient elements at 0.4%	12.00a	9.00a	12.67b	8.83a	7.50a	7.26b
Seaweed + some nutrient elements at 0.5%	12.00a	9.00a	14.33a	8.72a	7.37 ab	7.95a
L.S.D at 5%	0.45	0.52	0.61	0.16	0.15	0.14

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

Table 3: Effect of different concentrations of seaweed extract and some nutrient elements on leaf pigments of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	Chl. a (mg/ 1.0 g f. w.)			Chl. b (mg/ 1.0 g f. w.)			Total Carotenoids (mg/ 1.0 g f. w.)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	0.54b	0.57c	0.53c	0.22c	0.21d	0.22a	0.23b	0.29b	0.23b
Seaweed + some nutrient elements at 0.1%	0.59ab	0.62b	0.54c	0.23bc	0.24cd	0.24a	0.25b	0.30b	0.25b
Seaweed + some nutrient elements at 0.2%	0.62ab	0.65b	0.57bc	0.23bc	0.26bc	0.24a	0.25b	0.32b	0.25b
Seaweed + some nutrient elements at 0.3%	0.63ab	0.67ab	0.63b	0.26ab	0.28bc	0.26a	0.25b	0.34b	0.27b
Seaweed + some nutrient elements at 0.4%	0.67a	0.71ab	0.65b	0.26ab	0.30ab	0.27a	0.27ab	0.35ab	0.28b
Seaweed + some nutrient elements at 0.5%	0.68a	0.76a	0.77a	0.28a	0.34a	0.28a	0.32a	0.41a	0.40a
L.S.D at 5%	0.11	0.09	0.08	0.03	0.04	NS	0.05	0.06	0.07

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

Table 4: Effect of different concentrations of seaweed extract and some nutrient elements component on leaf: total carbohydrates, total sugars and C/N ratio of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	Total Carbohydrates %			Leaf Total sugars (%)			Leaf C/N ratio		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	13.78d	14.57b	13.73e	7.26d	7.21d	7.27e	7.53e	8.47b	8.92c
Seaweed + some nutrient elements at 0.1%	14.13d	14.77b	14.27d	7.94c	7.24d	7.50d	7.63d	8.02c	8.80a
Seaweed + some nutrient elements at 0.2%	14.60c	16.50a	14.50 cd	8.33b	7.42c	7.66d	7.3c	9.17b	8.89c
Seaweed + some nutrient elements at 0.3%	14.85bc	16.30a	14.70bc	8.51a	7.55 bc	8.10c	7.13b	8.31b	8.80b
Seaweed + some nutrient elements at 0.4%	15.30a	16.50a	15.03b	8.62a	7.74a	8.36b	7.05a	9.94c	9.00a
Seaweed + some nutrient elements at 0.5%	15.07ab	16.40a	16.67a	8.58a	7.61ab	8.62a	7.14a	9.16a	8.86a
L.S.D at 5%	0.38	0.41	0.42	0.17	0.14	0.18	0.02	0.06	0.03

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

Table 5: Effect of different concentrations of seaweed extract and some nutrient elements component on leaf N, P, K (%) of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	N %			P %			K %		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	1.83d	1.72c	1.54c	0.19d	0.17a	0.15b	1.24c	1.22b	1.23d
Seaweed + some nutrient elements at 0.1%	1.85d	1.84b	1.62b	0.22c	0.18a	0.16b	1.40a	1.19b	1.33c
Seaweed + some nutrient elements at 0.2%	2.00c	1.80b	1.63b	0.27b	0.16a	0.17b	1.32b	1.19b	1.37 bc
Seaweed + some nutrient elements at 0.3%	2.08b	1.96a	1.67b	0.25bc	0.17a	0.17b	1.33b	1.22b	1.41b
Seaweed + some nutrient elements at 0.4%	2.17a	1.66c	1.67b	0.31a	0.18a	0.18ab	1.43a	1.46a	1.41b
Seaweed + some nutrient elements at 0.5%	2.11a	1.79b	1.88a	0.31a	0.19a	0.21a	1.41a	1.43a	1.63a
L.S.D at 5%	0.06	0.06	0.05	0.03	NS	0.03	0.04	0.04	0.04

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

Table 6: Effect of different concentrations of seaweed extract and some nutrient elements component on leaf Ca and Mg (%) of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	Ca (%)			Mg (%)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	2.32e	2.38a	2.34d	0.66b	0.59b	0.63b
Seaweed + some nutrient elements at 0.1%	2.36de	2.34a	2.40cd	0.66b	0.61a	0.65b
Seaweed + some nutrient elements at 0.2%	2.43cd	2.40a	2.40cd	0.68b	0.62a	0.65b
Seaweed + some nutrient elements at 0.3%	2.46bc	2.37a	2.47bc	0.68b	0.63a	0.67b
Seaweed + some nutrient elements at 0.4%	2.53b	2.36a	2.64b	0.80a	0.65a	0.70b
Seaweed + some nutrient elements at 0.5%	2.76a	2.40a	2.87a	0.78a	0.63a	0.83a
L.S.D at 5%	0.08	NS	0.09	0.04	0.05	0.09

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

Table 7: Effect of different concentrations of seaweed extract and some nutrient elements component on leaf Fe, Zn, Mn and B (ppm) of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	Fe (ppm)			Zn (ppm)			Mn (ppm)			B (ppm)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	57.65b	45.00c	52.60d	61.61c	58.17c	58.87e	64.47d	62.73c	62.90d	39.15e	40.22d	40.68e
Seaweed + some nutrient elements at 0.1%	58.80b	51.60Ab	55.40c	61.73c	62.83a	61.20d	66.82c	63.20 bc	65.83c	41.00d	42.16c	42.88d
Seaweed + some nutrient elements at 0.2%	59.32b	51.67Ab	57.60 bc	62.27c	59.97bc	62.07cd	68.38bc	65.93b	66.37 bc	42.05c	43.35b	43.95c
Seaweed + some nutrient elements at 0.3%	59.57b	53.37a	58.40b	66.46b	59.99bc	63.80bc	69.98b	63.87b	66.80 bc	43.00b	44.70a	44.99b
Seaweed + some nutrient elements at 0.4%	64.73a	49.87b	60.37b	67.33b	60.60abc	65.47b	69.98b	67.27a	68.97b	44.45a	45.60a	46.18a
Seaweed + some nutrient elements at 0.5%	67.13a	54.07a	69.03a	70.03a	61.37ab	72.63a	74.73a	68.20a	76.53a	44.90a	45.88a	46.50a
L.S.D at 5%	2.55	2.68	2.71	2.63	2.55	2.48	3.03	2.81	2.77	0.88	0.95	0.99

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability.

**Initial Fruit Set, Fruit Retention (%) and Yield:** Data in Table (8) indicate that, spraying seaweed extract plus some nutrient elements at different concentrations improved both initial fruit set and fruit retention percentage of Baldy mandarin trees when compared to the control during the three seasons.

The highest initial fruit set and fruit retention was found with spraying seaweed extract plus some nutrient elements at 0.4% or 0.5 % for the three studied seasons. As for Baldy mandarin tree productivity during the three successive seasons, data presented in Table (8) reveal that all different concentrations of seaweed extract and some nutrient elements component treatments improved yield as kg/tree or number of fruits per tree. Generally both 0.4 and 0.5% concentrations significantly gave the highest values in compared to the other treatments under study. Meanwhile, the control treatment recorded the lowest values during the three successive seasons. It's recommended spraying seaweed extract and some nutrient elements 0.4% to get better results. These results are in harmony with those obtained by Ismaiel [31] on Balady oranges, Gamal [32] on Washington Navel oranges and Ahmed *et al.* [33] on Valencia oranges.

**Yield and Fruit Quality:**

**Physical characters:** Concerning fruit physical characteristics data in Table (9) indicated that spraying Baldy mandarin trees with seaweed extract and some nutrient elements component at 0.4 % or 0.5 % significantly increased fruit weight, peel % (w/w) and peel

thickness when compared to the other treatments under study and the control.

It's recommended spraying seaweed extract and some nutrient elements 0.4% to get better yield and fruit quality. Foliar spraying of seaweed extracts which in rich with several bio-organic, amino acids, antioxidant, growth assimilations and ....etc. plus some macro and micro elements. This will improve tree vegetative growth and fruit setting, so that improving of Baldy tree production, fruit quality and yield under Middle Egypt Region” Bany-Suef Governorate” conditions. These results are in agreement to those obtained by Nijjar [4]; Desai *et al.* [7]; Augusti *et al.* [34]; Salem *et al.* [10]; Abo El-Komsan *et al.* [12] and Sayed *et al.* [13].

**Chemical Characters:** Data in Table(10) clear that most of treatments at concentrations 0.2 %, 0.3 %, 0.4 % and 0.5 % significantly increased fruit Juice TSS (%); Juice TSS / acid ratio and Juice Vitamin C (mg/ 100 ml juice) during the three seasons and reduced fruit Juice acidity (%). In contrary, the control treatment gave the lowest fruit Juice TSS (%); Juice TSS / acid ratio and Juice Vitamin C (mg/ 100 ml juice) and the highest titratable acidity values. It's recommended under the conditions of our study to spray mandarin trees with spraying seaweed extract and some nutrient elements 0.4% to get better yield and fruit quality. These results are in harmony with those obtained by Gamal [32] on Washington Navel oranges, Ismaiel [31] on Balady oranges and Ahmed *et al.* [33] on Valencia oranges.

Table 8: Effect of different concentrations of seaweed extract and some nutrient elements component on fruit setting and yield of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	Initial fruit set %			Fruit retention %			Yield (kg/ tree)			Yield (Number of fruits / tree)		
	1 <sup>st</sup> Season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	11.87c	7.40b	11.93c	0.73e	0.92c	0.75e	39.7d	21.9f	35.3e	341.00d	179.00f	275.00f
Seaweed + some nutrient elements at 0.1%	15.70b	7.40b	13.50bc	0.80d	0.96ab	0.81d	43.0c	24.3e	42.0d	336.00d	194.00e	321.00e
Seaweed + some nutrient elements at 0.2%	16.17ab	7.30b	15.34b	0.83c	0.95bc	0.89c	51.1b	26.6d	44.8c	381.00b	207.00d	335.00d
Seaweed + some nutrient elements at 0.3%	16.80ab	7.40b	17.63b	0.93b	0.93bc	0.95b	52.6b	28.1c	51.9b	363.00c	213.00c	415.200b
Seaweed + some nutrient elements at 0.4%	18.66a	8.80a	19.27a	0.99a	0.99a	1.10a	57.3a	30.0b	61.1a	395.00a	228.00b	446.00a
Seaweed + some nutrient elements at 0.5%	18.20a	7.60b	21.33a	0.95b	1.02a	1.05a	56.6a	31.7a	58.5a	390.00a	241.00a	415.00b
L.S.D at 5%	2.35	0.99	2.11	0.02	0.03	0.05	2.1	1.61	2.3	5.4	2.2	5.1

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

Table 9: Effect of different concentrations of seaweed extract and some nutrient elements component on fruit weight (g), fruit peel (%) and peel thickness (cm) of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	Fruit weight (g)			Fruit peel % (w/w)			Peel thickness (cm)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	116.3d	122.3d	128.3 cd	19.20c	21.30f	24.30e	0.21d	0.19c	0.21b
Seaweed + some nutrient elements at .1%	128.0c	125.3c	130.7c	19.73b	24.70e	25.30d	0.24d	0.20 bc	0.22b
Seaweed + some nutrient elements at 0.2%	134.0b	128.7b	133.7bc	19.79b	25.70d	26.30c	0.25d	0.21b	0.22b
Seaweed + some nutrient elements at 0.3%	145.0a	131.7a	125.0d	20.61a	27.30c	27.30b	0.28c	0.21b	0.22b
Seaweed + some nutrient elements at 0.4%	145.0a	131.7a	137.0ab	20.97a	28.30b	29.00a	0.30b	0.23a	0.24a
Seaweed + some nutrient elements at 0.5%	145.0a	131.3a	141.0a	20.67a	29.00a	29.00a	0.33a	0.24a	0.25a
L.S.D at 5%	5.8	2.3	5.6	0.44	0.56	0.61	0.19	0.16	0.17

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

Table 10: Effect of different concentrations of seaweed extract and some nutrient elements component on juice TSS, titratable acidity, TSS/Acid ratio and Juice Vitamin C of Baldy mandarin during (2018/ 019 & 020) seasons

Treatments	TSS (%)			Titratable acidity (%)			TSS/Acid ratio			Vitamin C (mg/ 100 ml juice)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season	1 <sup>st</sup> season	2 <sup>nd</sup> season	3 <sup>rd</sup> season
The control (spraying with water)	11.4c	10.4e	11.73e	1.29a	1.20b	1.27a	8.8c	8.6c	9.2e	37.0d	31.5c	37.6e
Seaweed + some nutrient elements at 0.1%	11.4c	10.9d	12.03d	1.24b	1.25a	1.24b	9.2b	8.7c	9.7d	38.1d	31.8c	38.5 de
Seaweed + some nutrient elements at 0.2%	12.2b	11.2c	12.27 cd	1.21c	1.24a	1.21c	10.1a	9.0b	10.1c	39.9c	32.2c	39.4 cd
Seaweed + some nutrient elements at 0.3%	12.7a	11.4b	12.50c	1.22bc	1.26a	1.23bc	10.4a	9.0b	10.2c	40.6c	35.2b	40.3c
Seaweed + some nutrient elements at 0.4%	12.4b	11.6a	12.87b	1.20c	1.21b	1.24b	10.3a	9.6a	10.4b	42.9b	37.2a	41.5b
Seaweed + some nutrient elements at 0.5%	12.2b	11.7a	13.23a	1.20c	1.21b	1.24b	10.2a	9.7a	10.7a	44.2a	37.2a	42.8a
L.S.D at 5%	0.2	0.1	0.30	0.02	0.02	0.02	0.30	0.02	0.02	1.1	1.0	1.1

Means designated with the same letter (s) within column in each season are not significantly different according to LSD at 5% level of probability

### CONCLUSION

It can be conclude that, spraying of Baldy mandarin grown under middle Egypt region “Bany-Suef Governorate“ with seaweed extract and some nutrient elements component at 0.4% concentration three times; i” after petal fall stage (the 1<sup>st</sup> week of May), ii” at mid of July and iii” at mid of August, significantly improved tree growth , fruit setting , tree productivity and fruit quality.

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