Response of Guava Transplants to Soil Fertilization and Foliar Spray with Algae Extract

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ABSTRACT

This experiment was carried out during two successive seasons 2019 and 2020 to study the beneficial effects of substituting marine algae extract concentration for mineral N, P, and K soil application on vegetative growth and its nutritional condition of 2-years old guava transplant, grown in a private orchard in Abu-Homos, El-Beheira government, Egypt. The obtained results showed that, using half of the recommended dose as a soil application for transplant with spraying algae extracts on the leaves led to an increase in vegetative growth as (length of guava transplants, No. of leaves/plant, leaf area, No. of new shoots, diameter of stem and leaf chlorophyll content). While, the control treatment recorded the highest value in leaf carotene content as compared with other treatments. Furthermore, the half of the recommended dose as a soil application for transplant with spraying algae extracts on the leaves led to an increase in leaf mineral contents (N, P, K, Ca, Mg, Fe, Zn, Mn and Cu) compared with other treatments.

Keywords: Guava transplants, Algae extract, chemical fertilizer

INTRODUCTION

One of the most significant and well-known fruits for all people is the guava (*Psidium guajava*, L.). This is due to it has a tasty flavour, a high amount of vitamin C (75-260 mg/100g), and is an excellent source of thiamine, riboflavin, phosphorus, calcium, iron, and pectin (0.5-1.8%), among other nutrients (Shukla et al., 2009). The cultivation of guava plants is common in the tropical and subtropical regions. Due to its high flexibility and capacity to grow in these soils, guava is one of the most popular fruit trees in the new reclamation desert (Ibrahim et al., 2010). Guava fruits contain acidic compounds that increase stomach acidity, and they also contain a number of vital nutrients. Furthermore, according to reports, malnutrition and environmental conditions are just two of the many variables that contribute to low yields.

NPK fertilization is typically a significant and limiting element for guava growth and production. Moreover, nitrogen is a crucial element in protoplasm since it is a part of proteins. It promotes cell division and is necessary for the manufacture of enzymes, amino acids, and plant colours(Kannyan, 2002; El-Salhy et al., 2010; Ahmed et al., 2013). All crops require phosphorus as a vital dietary ingredient. It is a crucial part of ATP and has a significant impact on plant energy changes as well as several roles in seed production (Sanker et al., 1984). Plants cannot develop without potassium since it is necessary for the production of amino acids (Edmond et al., 1975).

Green, brown, and red marine macro-algae are examples of seaweeds or algae extracts, and brown seaweed extracts are frequently utilized in horticultural crops. Polysaccharides, proteins, polyunsaturated fatty acids, pigments, polyphenols, minerals, plant growth hormones, and other physiologically active chemicals are transported from algal biomass to the liquid phase, depending on the source material, the location of the harvested algae and the species, as well as the extraction technique. They primarily defend our organisms from biotic and abiotic stress, which benefits people, animals, and plants. They also produce a variety of commercially valuable products, such as pharmaceutical and cosmeceutical substances (Al-Musawi, 2018). Therefore, the current study's objective was to shed light on the positive impacts of replacing mineral N, P, and K soil treatment with a concentration of marine algae extract on the vegetative growth and nutritional status of guava transplants.

MATERIALS AND METHODS

The current study was conducted on a 2-year-old guava transplant that was grown in a private orchard in Abu-Homos, El-Beheira government, Egypt, during two successive seasons of (2019 and 2020). In addition, 15 guava transplants planted with the cuttings system were selected for this experiment, and they were planted in 3×3 m, also irrigated with agricultural waste water using an immersion system. Tables (1) and (2) show the results of the chemical analysis of the soil and irrigation water, respectively.

Table (1): Soil chemical properties.

Sample depth(cm)	EC ds/m	pH	Soluble Salts (meq/l)								SAR
			Co_3^{--}	HCO_3^-	Ca^{++}	Mg^{++}	Na^+	K^+	Cl^-	SO_4^{--}	
0-90	2.12	8.31	0.8	2.2	5.2	2.2	16.5	0.5	11.1	10.3	8.6

Table (2): Irrigation water chemical properties.

Sample	EC dsm^{-1}	pH	Soluble Salts (ppm)									SAR
			$N\text{-}NO_3$	P^+	K^+	Ca^{++}	Mg^{++}	Na^+	Cl^-	CO_3^-	HCO_3^-	
WS	3.07	7.98	27	0	9	100	22	550	712	0	330	4.58

This experiment involved five treatments as follow:

- T1: Mineral NPK fertilization program (as control) was annually added at the rate of 40 g ammonium sulphate, 40g superphosphate and 20 g potassium sulphate per each plant. Whereas, the corresponding amount of each NPK fertilizer was fractionized into five equal doses to be soil applied monthly from mid-March until mid-June during every season as a soil application.
- T2: algae extracts application was added to the irrigation water at a rate 2litre\feddan as a soil application during March.
- T3: Adding algae extracts at a rate of 2L/F + half of the recommended mineral fertilization rate (20 g ammonium sulphate, 20 g superphosphate and 10g potassium sulphate per each plant) as a soil application in five equal doses to be soil applied monthly from mid-March until mid-June during every season as a soil application.
- T4: Adding algae extract at a rate of 3 cm/L as a foliar application in March and June.
- T5: Adding algae extract at a rate of 3 cm/L as a foliar application + half of the recommended mineral fertilization rate (20 g ammonium sulphate, 20 g superphosphate and 10 g potassium sulphate per each plant as a soil application in five equal doses applied monthly from mid-March until mid-June during every season.

The effect of previous treatments was studied by evaluating their influence on vegetative growth and leaf mineral contents as follow:

- Length of guava transplant (cm).
- Number of leaves per transplant.
- Leaf area (cm^2).
- Number of new shoots per transplant.
- Length of new shoots (cm).

- Diameter of stem (cm).
- Leaf chlorophyll (as a Total chlorophyll) using SPAD-502 MINOLTA chlorophyll meter which calculates a numerical SPAD value.
- Leaf carotene content (mg/100g) according to the outlined by (Wensttein, 1957).
- Leaf mineral content (N, P, K, Ca, Mg, Fe, Mn, Zn and Cu) were determined as described by (A.O. A. C., 1990).

Statistical analysis:

The Complete Randomized Block Design (RCBD) was followed in this study. The obtained data were subjected to analysis of variance (ANOVA) according to (Snedecor and Cochran, 1977) Differences between genotypes were compared using Duncans Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

A. Vegetative growth:-

Guava transplant vegetative growth, as length of guava transplants, number of new shoots/ transplant, length of new shoots, diameter of stem, number of leaves/transplant, leaf area and leaf chlorophyll content were investigated and presented in Tables (3 and 4).

A.1. Stem length of guava transplant:

Data in Table (3) showed that, T5 recorded significant differences compared with control and other treatments, except for T4 in the first season. In addition, the T5 and T4 treatments had the longest guava stem (187 and 178 cm in the first season and 218 and 202 cm in the second season) respectively. The control treatment (T1) had the shortest stem, which was 137 and 157 cm in the two seasons, respectively. In our opinion, this may due to the fact that, the use of half of the chemical soil fertilization rate reduces the osmotic pressure on the roots of the plant, which helps the better absorption of nitrogen fertilizers that, help increase vegetative growth. Also, foliar spraying with algae extracts help to increase vegetative growth as it contains gibberellins and cytokinins and many important nutrients that help elongate cells and increase their growth. Nitrogen is an important constituent of protoplasm, being a part of proteins. Enzymes, amino acids, plant colours, and cell division are all biosynthesized by it, and it also promotes cell division (Kannyan, 2002; El-Salhy et al., 2010 and Ahmed et al., 2013). According to (Kumar et al., 2010), T7 (800:600:600 g NPK + 25.00 kg FYM per tree per year) significantly outperformed T8 (800:600:600 g NPK + 5.00 kg Vermicompost per tree per year) in terms of growth parameters (plant height, spread, stem girth, and tree volume). Polysaccharides, proteins, polyunsaturated fatty acids, pigments, polyphenols, minerals, plant growth hormones, and other physiologically active substances are all transferred from algal biomass to liquid phase, and they all affect the composition of seaweed extracts. They primarily defend an organism from biotic and abiotic stress, which benefits people, animals, and plants. They also produce a variety of commercially valuable goods, including as pharmaceutical and cosmeceutical substances (Al-Musawi, 2018).

A.2. Number of new shoots:

Data concerning the effects of algae extract foliar application and soil mineral fertilization NPK on number of new shoots/transplant of guava transplants stem during two seasons 2019/2020 are shown in Table 3. The data indicated that, T5 resulted in the highest number of shoots from guava transplants (37.00 and 35.00) in both experimental seasons compared with all treatments. Furthermore, the fewest fresh guava shoot transplants were found in T1 (22.00 and 21.00) in 2019 and 2020, respectively. The results found significant differences between all treatments compared with control in the first season and significant differences between T5 and T1 (control) but, no significant differences between all other treatments. This is due to the increase in cell division as a result of auxins and many plant hormones that help in revealing vegetative buds according to Marhoon and Abbas (2015) who reported that, algae extract is a useful bio-stimulant for plant growth, it is rich with auxins and cytokinins which are plant growth regulators. Also, reducing the rate of chemical fertilization, especially with saline irrigation water, reduces the osmotic pressure of the soil solution, which increases the rate of absorption of NPK elements, which increases the vegetative growth of the guava transplants.According to Cooke (1972), the crop primarily needs the nutrients nitrogen (N), phosphorus (P), and potassium (K). Supplemental amounts of nutrients can be added to soil in the form of inorganic fertilizer to correct an inadequate supply of nutrients to the crop (Dirk and Hogarth, 1984). It is known that an inadequate supply of any of these nutrients during crop growth has a negative impact on the reproductive capability, growth, and yield of the plant (Vine, 1953 and Solubo, 1972).

A.3. Length of new shoots (cm):

Data shown in Table (3) indicate supremacy of T5, which it had significant differences between it and all other treatments except T3. In the first season, there were no appreciable differences between the two treatments. T5 recorded the highest length of new shoots (19 and 20) in both successive seasons compared with all other treatments. While in the control treatment (T1), it had the least value observed for the length of new shoots. According to Marhoon and Abbas (2015) who reported that algae extract is a useful biostimulant for plant growth, it is rich with auxins and cytokinins which are plant growth regulators, this is due to the fact that, auxins and plant hormones are present in algae extracts that help increase plant cell division with an appropriate dose of balanced fertilizer, which helps to increase the rate of absorption.

A.4. Diameter of guava transplants stem:

In both experimental seasons, the diameter of the transplanted guava stems was measured in centimeters. Compared to control treatment (T1) and all other treatments, T5 had the highest diameter values (4.87 and 5.13 cm, respectively) in both experimental seasons, while control treatment (T1) had the lowest measurements (3.43 and 3.37 cm, respectively) in this concern. Rashad et al., (2018) investigated plant cutting taking and growth performance of guava cutting under various growing media. They discovered that the rooting media had an impact on stem diameter. Guava cuttings' highest and lowest stem diameters were measured in silt and peat moss + sand + sawdust, respectively, with averages of 5.30 mm and 4.93 mm and 4.14 mm and 4.24 mm, respectively. When compared to the other treatments, the silt medium results in longer are sprouting length.

Table (3): Effects of algae extract foliar application and soil mineral fertilization NPK on length of guava transplants, number of new shoots/transplant, length of new shoots and diameter of guava transplants stem during two seasons 2019/2020.

Treatments	Length of guava transplants(cm)		No. of new shoots/ transplant		Length of new shoots (cm)		Stem diameter (cm)	
	2019	2020	2019	2020	2019	2020	2019	2020
T1	137.3	157.0	22.00	21.00	14.67	15.33	3.43	3.37
T2	157.7	176.3	24.00	25.00	16.00	17.00	4.07	4.10
T3	174.3	193.3	28.00	28.00	18.00	16.00	4.33	4.20
T4	178.3	202.0	33.00	28.00	15.67	16.00	4.40	4.43
T5	187.3	218.0	37.00	35.00	19.00	20.00	4.87	5.13
$LSD_{0.05}$	12.20	4.55	2.99	4.62	2.19	2.28	0.58	0.27

A.5. Number of leaves/transplant:

It was clear from obtained results that, greater vegetative growth and number of new shoots/transplant growths;this led to an increase the number of leaves/transplant as shown in Table (4). The highest number of leaves was recorded in T5 (75 and 105) in both successive seasons compared with all other treatments and control, whereas, control (T1) recorded the lowest number of leaves/ transplants (43 and 63) in both successive seasons. This is due to the increase of vegetative growth in seaweed treatments with the reduction of mineral fertilization to half the recommended dose, as this modifies the alkalinity of the soil and increases the rate of absorption. Where, algae extracts contain many plant hormones that help in its growth, it also contains many important nutrients that, the plant needs in its life cycle.The extract contains growth-promoting hormones (IAA and IBA), cytokinins, trace elements (Fe, Cu, Zn, Co, Mo, Mn and Ni), vitamins, and amino acids, according to Challen and Hemingway (1965). For citrus to develop and produce, N fertilization is a crucial and limiting component. Nitrogen serves a variety of purposes in plant life. N is a crucial component of protoplasm since it is a component of proteins. According to Kannayan (2002), El-Salhy et al., (2010), Ahmed et al., (2013), and others, it promotes cell division and the manufacture of enzymes, amino acids, and plant colours.

A.6. Leaf area (cm^2):

Data regarding the effects of algae extract foliar application and soil mineral fertilization NPK on leaf areaof guava transplants stem during two seasons 2019/2020 are shown in Table (4), indicated that, there are significant differences between all other treatments compared with control treatment, where, it represented the highest measured in leaf area parameter (43.20 and 46.60 cm^2) was recorded in T5 in both experimental seasons, respectively compared with all other treatments. T1 recorded the lowest measured of leaf area (43.87 and 43.50 cm) in both experimental seasons. In their 2017 study, Abo El-ez et al., (2017) evaluated a few particular guava genotypes. The outcome demonstrated that there were notable differences between guava genotypes during the pooled means of the 2014, 2015, and 2016 seasons of the experiment. The leaf area of the guava genotypes G.12 and G.11 was significantly higher than that of G.6 (32.27), which was significantly lower than that of G.12 (65.75), and the other guava genotypes were in between. These findings concur with those made public by El-Sharkawy and Othman (2009).

A.7. Leaf chlorophyll content (SPAD-unit):

Data presented in Table (4) revealed that, in both succeeding seasons, there were significant differences between T5 and T4 compared with T1, but non-significant differences between all other treatments were noticed that compared with the control treatment (T1). Additionally, it appears that T5 is the most effective treatment when compared to all other treatments during both experimental seasons. The lowest values of leaf chlorophyll content were observed for T1 in the second season (37.67), whereas T2 had the lowest values for the first season (37.67). This is owing to the fact that, seaweed extracts contain a variety of plant pigments that the plant uses in the formation of its pigments, also the formation of significant plant pigments in plant leaves is increased when chemical fertilizers are reduced and nitrogen is absorbed at the optimal rate, among other reasons, chlorophyll algae extract treatment increased plant pigment content in snap beans (Abu Seif et al., 2016). Antioxidants and growth-promoting properties in algal extract may be responsible for this effect (Lee et al., 2008; El-Sayed et al., 2018; El-Eslamboly et al., 2019). Sun et al., (2016) as well. By boosting the release of CO_2, it is said to be crucial for photosynthesis and the synthesis of protopeophyrin, the precursor to plant pigments (Kannaiyan, 2002 and Faraag, 2013).

A.8. Leaf carotene content (mg/g).

In both of the experimental seasons, the leaf carotene content was calculated using mg/g, as shown in Table (4). The results show that there are substantial differences between all treatments in the first and second seasons, with the exception of T1 and T2, where there was a non-significant difference.This is due to the fact that the increase in the percentage of chlorophyll in the leaves of the plant works to break down the carotene. The results of the content investigation were in agreement with Chandrika et al., (2009), who used high-performance liquid chromatography with diode array detection to examine the carotenoid content and in vitro bio-accessibility of lycopene from guava (*Psidium guajava*) and watermelon (*Citrullus lanatus*).

Table (4): Effects of algae extract foliar application and soil mineral fertilization NPK on number of leaves, leaf area and leaf chlorophyll content during two successive seasons 2019/2020.

Treatments	No. of leaves/transplant		Leaf area (cm^2)		Leaf chlorophyll content (SPAD unit)		Leaf carotene content (mg/g)	
	2019	2020	2019	2020	2019	2020	2019	2020
T1	43.00	63.00	41.63	42.07	38.33	37.67	2.90	3.07
T2	48.00	75.00	43.87	43.50	37.67	38.33	2.80	2.87
T3	57.00	85.00	45.87	48.83	40.43	39.27	2.17	2.43
T4	65.00	84.00	50.40	50.53	41.27	42.33	2.50	2.33
T5	75.00	105.00	53.07	53.50	43.20	44.60	2.03	2.03
$LSD_{0.05}$	5.99	13.86	2.96	2.77	2.71	1.37	0.36	0.25

B. Leafmineral contents:-

B.1. Leaf nitrogen content (%):

Data in Table (5) demonstrated significant differences between T5, which had the greatest leaf N contents (2.40 and 2.50%) in both experimental seasons, as compared to control and all other treatments. While T1 had the lowest leaf N content in two seasons (1.30 and 1.40%) respectively. This is due to the fact that algae extract contains a lot of important amino acids and nutrients that increase the nitrogen content in the leaves. The extracts include growth-promoting hormones (IAA and IBA), cytokinins, trace elements (Fe, Cu, Zn, Co, Mo, Mn and Ni), vitamins, and amino acids, according to Challen and Hemingway (1965). One crucial factor affecting how the adsorption process is controlled is the pH of the contact solution. As the contact solution's acidity rises, the adsorption capacity falls. The rivalry between metal ions and hydrogen ions as well as the differences in the hydrolysis products of metal ions with pH can both be used to explain these variations (Athanasiadis and Helmreich, 2005; Smiciklas et al., 2007; Wang et al., 2007; Sequeira et al., 2009). Ibrahim et al., (2015) in clay soil under El-Minia Governorate conditions found that leaf macronutrient (nitrogen percentage) was significantly enhanced as a result of mango trees cv. Keitte fertilization four times/year with organic manure with or without Royal jelly and seaweed extract.

B.2. Leaf phosphorus content (%):

The leaf P content was recorded in Table 5, and the results revealed that, when compared to all other treatments, T5 had the highest values of leaf P (0.46 and 0.48%) in both experimental seasons. However, in both experimental seasons, T1 had the lowest values of leaf P content (0.22 and 0.23%, respectively). In each of the two succeeding seasons, significant differences were detected between all treatments and the control group. This may be due to the fact that, the rate of available phosphorus in the soil increases whenever the alkalinity of the soil decreases, and this comes from reducing the rate of using mineral fertilizers with saline irrigation water.Similar findings were observed in the soils of Kheragarh tehsil in the Agra district by Mustafa et al. (2016). Organic carbon and available P had a strong positive correlation, while pH and $CaCO_3$ and available P had a negative correlation. Similar findings were published by Tomar et al., (2020). Guava leaves' phosphorus content ranged from 0.16 to 0.32%, with a mean value of 0.23 percent. Ibrahim et al., (2015) in clay soil under El-Minia Governorate conditions found that leaf macronutrient (phosphorus percentage) were significantly enhanced as a result of mango trees cv. Keitte fertilization four times/year with organic manure with or without Royal jelly and seaweed extract.

B.3. Leaf potassium content (%):

Algae extract combined with half the recommended amount of chemical fertilizer helped plants absorb potassium when it arrived at the leaves from the roots. According to the data shown in Table 5, there were significant differences between all treatments and the control group in both trial seasons. The greatest levels of leaf potassium content (3.23 and 3.23%) were seen in T5 in both seasons. Leaf potassium content was found to be at it's lowest (1.80 and 1.83%) in T1. In our opinion, Algae extracts when sprayed on the leaves, their content is high in nutrients for the soil, and thus the rate of potassium absorption in the leaves increases, so the potassium content of the leaves increases. Additionally, the rate at which phosphorus and potassium are absorbed rises when the soil's alkalinity decreases. Here, we discovered that decreasing fertilization rates lowers the soil's alkalinity, which improves the benefits and absorption of potassium supplied to the plant.Ibrahim et al., (2015) in clay soil under El-Minia Governorate conditions found that leaf macronutrients (potassium percentage) were significantly enhanced as a result of mango trees cv. Keitte fertilization four times/year with organic manure with or without Royal jelly and seaweed extract.

B.4. Leaf calcium content (%):

Data in Table (5) disclosed that, significant differences between T5 as a highest content of calcium compared with control and all other treatments except T4 in the first season, where the differences were not big enough to be significant between thus treatments. This is due to the fact that, the use of saline water in irrigation reduces the absorption of calcium as a result of the opposition between calcium and sodium, while when reducing the dose of fertilization to half the amount, this leads to a decrease in the osmosis of the solution and thus increases the rate of absorption, thus increasing the concentration of the element in the plant cell. The biochemical and mineral analyses of the underappreciated leaves of *Psidium guajava*, L. was examined by Thomas et al., (2017). They said that the mineral content of guava leaf dry weight (DW) was 1660 mg of Ca^{++}.

B.5. Leaf magnesium content (%):

Data presented in Table (5) clearly show that, significant differences between all treatments compared with control in both experimental seasons. T5 was recorded the highest content of leaf magnesium percentage (0.75 and 0.77 %) in both experimental seasons. On the other hand, T1 recorded the lowest content of leaf magnesium percentage (0.55 and 0.55%) in both experimental seasons, respectively. This is due to the fact that, reducing the rate of mineral fertilization reduces the osmotic pressure of the soil solution, which increases the rate of absorption of elements, including magnesium, at a greater rate. Also, foliar application with seaweed extracts that known by it's highly a content of many elements increases the content of the leaves of elements, including magnesium.Thomas et al., (2017) reported that, the concentration of magnesium was 440 mg per 100g of guava leaf dry weight (DW).

Table 5: Effects of algae extract foliar application and soil mineral fertilization NPK on leaf macro-elements content (%) during two successive seasons 2019/2020.

Treatments	N		P		K		Ca		Mg	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1	1.30	1.40	0.22	0.23	1.80	1.83	1.30	1.36	0.55	0.55
T2	1.53	1.50	0.30	0.31	2.03	2.07	1.52	1.47	0.61	0.66
T3	1.70	1.70	0.35	0.34	2.43	2.33	1.61	1.66	0.72	0.72
T4	2.13	2.03	0.39	0.39	2.90	2.77	1.84	1.82	0.75	0.77
T5	2.40	2.50	0.46	0.48	3.23	3.23	1.96	2.06	0.86	0.83
$LSD_{0.05}$	0.27	0.19	0.03	0.032	0.26	0.26	0.13	0.12	0.07	0.05

B.6. Leaf iron content (ppm)

As shown in Table (6), leaf iron content recorded the highest content in T5 compared with control and all other treatments (201.00 and 205.67 ppm) in both seasons respectively. Where, T1 recorded the lowest leaf iron content (157.33 and 157.00 ppm) in both experimental seasons, respectively. These results indicated significant differences between all treatments in both seasons compared with control. It is well known that semi-neutral or alkaline soil pH values make iron easy to absorb. As a result, using half as much chemical fertilizer in combination with foliar spraying of algae extracts lowers the soil's alkalinity and aids in the absorption of iron and other nutrients. Algal extracts are abundant in nutrients that are simple to absorb through stomata in leaves. Challen and Hemingway (1965) reported that, the extract contains growth promoting hormones (IAA and IBA), cytokinins, trace element (iron content), Vitamins and amino acids.

B.7. Leaf zinc content (ppm)

The data in Table (6) demonstrated that, over the two subsequent seasons, there were substantial differences between all treatments and the control. The first season's highest leaf zinc concentrations were T5 and T4. But when compared to all other treatments in the second season, T5 had the highest leaf zinc content (81.50 ppm). The control treatment (T1) had the lowest zinc concentration in both study seasons (45.00 and 55.53 ppm, respectively). According to Lal et al., (2000), spraying guava cv. leaves with $ZnSO_4$ at a rate of 4 g per plant per year considerably boosted the zinc content of the leaves in guava cv. Allahabad Safeda. Furthermore, Perveen and Hafeez-ur-Rehman (2000), found that, foliar zinc treatment markedly enhanced leaf zinc levels.

B.8. Leafmanganese content (ppm)

High manganese leaf content (104.90 and 106.92 ppm) was observed in both succeeding seasons when algal extract (T5) was used as a foliar treatment together with half of the required farm chemical fertilizers. In contrast, the control treatment had the lowest leaf manganese concentration in both trial seasons (79.97 and 82.03 ppm, respectively). The findings also demonstrate that there are notable differences between the treatments when compared to one another and when compared to the control group in the first season. While the treatments T1, T2, and T3 did not show any significant differences between them in the second season, the treatments T5 and T4 recorded significant differences between them and when compared to the other treatments and the control. This may be due to the fact that algae extracts are rich in many elements, and when sprayed on the leaves, the plant benefits from them by absorbing the largest amount of them. Challen and Hemingway (1965) reported that, the extract contains growth promoting hormones (IAA and IBA), cytokinins, trace element (manganese content), Vitamins and amino acids.

B.9. Leaf copper content (ppm)

Data presented in Table (6) revealed that, with the exception of treatments T5 and T4, there are no significant differences between them in the second season. There are also significant differences between several of the treatments and the control in both seasons. Additionally, according to the most recent data, T5 had the highest leaf copper content in both experimental seasons (72.80 and 73.67 ppm, respectively). While in both experimental seasons, T1 had the lowest copper content (56.67 and 51.47 ppm, respectively).This is due to the fact that spraying algae extracts rich in important elements in plant life increased the leaves' content of trace elements, including copper. The extract contains growth-promoting hormones (IAA and IBA), cytokinins, trace element (copper content), vitamins, and amino acids, according to Challen and Hemingway (1965).

Table 6: Effects of algae extract foliar application and soil mineral fertilization NPK on leaf micro-elements content (ppm) during two successive seasons 2019/2020.

Treatments	Fe		Zn		Mn		Cu	
	2019	2020	2019	2020	2019	2020	2019	2020
T1	156.33	157.00	45.00	55.53	79.97	82.03	50.67	51.47
T2	171.67	172.67	57.17	63.57	85.60	84.17	62.37	52.70
T3	181.00	179.00	63.47	71.50	91.80	89.30	64.87	63.60
T4	190.33	186.00	72.53	76.23	93.07	96.80	69.50	69.77
T5	201.00	205.67	72.97	81.50	104.90	106.92	72.80	73.67
$LSD_{0.05}$	7.70	7.60	4.53	6.58	5.09	6.50	2.56	4.06

CONCLUSION

Conclusionely, it could be mentioned on the basis of the obtained results that many farms must alter their fertilizer choices when using water with a high salinity by doing so could reduce the absorption process due to the high osmotic pressure of the soil solution in which the transplant are grown. Moreover, using half of the recommended mineral dose as a soil application with spraying algae extracts led to improvement in vegetative growth and nutritional condition of guava transplants.

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إستجابة شتلات الجوافة للتسميد الأرضي والرش الورقي بمستخلص الطحالب

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أجريت هذه التجربه خلال الموسمين المتتاليين ٢٠١٩/٢٠٢٠ لدراسة مدي تأثير إستخدام مستخلصات الطحالب البحريه علي معدلات التسميد المعدني NPK كإضافة أرضية ومدي تأثير ذلك علي النمو الخضري والمحتوي المعدني لشتلات الجوافة النامية في مزرعة خاصة بمركز أبو حمص – محافظة البحيرة – مصر. وقد أظهرت النتائج المتحصل عليها أن إستخدام نصف جرعة التسميد المعدني NPK الموصي بها كتسميد أرضي مع الرش الورقي بمستخلصات الطحالب البحريه أدي لزيادة الصفات الخضريه للشتلات (طول الساق/شتلة – عدد الأوراق/ شتلة – مساحة الورقة – عدد الأوراق/شتله – طول البراعم الخضريه الجديدة – عدد البراعم الخضرية الجديدة – قطر الساق/شتله– محتوي الأوراق من الكلورفيل) مقارنة بباقي المعاملات بينما سجلت معاملة الكنترول أعلي قيمة في محتوي الأوراق من الكاروتين مقارنة بباقي المعاملات. أيضاً سجلت معاملة نصف الجرعة الموصي بها من التسميد المعدني NPK كتسميد أرضي مع الرش الورقي بمستخلصات الطحالب إلي زيادة المحتوي المعدني للأوراق من العناصر (N, P, K, Ca, Mg, Fe, Zn, Mn, Cu) مقارنة بباقي المعاملات.