Impact of Organic and Chemical Compounds on Growth, Yield and Fruit Quality of Sweet Pepper under Saline Conditions
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ABSTRACT

Two field experiments were carried out in a private farm under drip irrigation with fertigation system at Kafr El-Sheik Governorate, during summer seasons of 2018 and 2019 in order to study the effect of organic compounds like algae extract freely (at a rate of 4,3, 2 L/Fed. for 3 times and control) and chemical treatments application like K, Ca compounds (at a rate of 4 L/Fed. for 3 times) and the interaction between them (at half amount of each one for 3 times) to minimize the harmful of salinity compared with control on vegetative growth characters, leaf pigments, yield and yield components, fruit quality and leaf chemical constituents of sweet pepper plants (Capsicum annum L.), cv. Spanish pepper.

Vegetative growth characters, i.e. plant height, number of branches, leaf number, dry weight/plant, leaf area/plant, fruit yield and its components parameters and TSS in fruit juice were significantly decreased by decreasing the amount of algae extract freely in the irrigation water from 4 L/Fed. (3 times) to control (without addition of algae extract freely), while treatments with 4L/Fed. gave the highest values of K percentage on fruit. On the other hand, control treatments resulted in the highest values of titratable acidity and proline contents in the leaves.

Sweet pepper plants were treated with the combination of K chemical compounds at 2L/Fed. and Ca chemical compounds at 2 L/Fed. for 3 times recorded the highest values of all studied growth characters, average fruit weight, early yield, total yield, TSS and nitrogen percentage followed by Ca chemical compound at 4L/Fed. with non-significant differences between both treatments. While, plants were treated with K chemical compound at 4 L/Fed. was recorded the highest values of phosphorus percentage.

Algae extract freely at a rate of 4 L/Fed. in combination with K chemical compound at a rate of 4 L/Fed. separately or with Ca chemical compound at 4 L/Fed. caused a stimulatory effect on most of the studied characters of sweet pepper plants. Meanwhile, the same treatments were recorded the lowest values of TSS in fruits of sweet pepper.

On the other hand, the control plants without either algae extract freely or K and Ca compounds recorded the lowest values of all studied growth characters, yield and its components and fruit quality as effects of salinity.

Economically, it is inferred that using of algae extract freely at a rate of 4L/Fed. plus potassium chemical compound at a rate of 4L/Fed. could be recommended for increasing unit productivity and also net profit, in addition of high quality of pepper fruits.

Key words: Sweet pepper, salinity, Calcium, Potassium, Algae extracts freely, Amino acid, Plant regulators, growth, yield, Quality.

INTRODUCTION

Pepper (Capsicum annum L.) is an important crop not only because of its economic importance but also for the nutritional value of its fruits which a major source of natural pigments and antioxidant compounds. The durable intake of these compounds in food is an important health protection from widespread human diseases, such as cancer and cardiovascular diseases (Howard et al., 1994).

Pepper (Capsicum annum L.) is moderately sensitive to salt stress. Under several conditions pepper plants may suffer from many faces of salinity which appear particularly under conditions of water deficit and over dose supply of mineral fertilizer, pepper will accumulate salt ions such as Na, K, P and Cl (Gunes et al. 1996). This turns to over-absorption and an imbalance of mineral elements. As a result, plants affected by salinity can suffer from membrane destabilization (Hasegawa et al., 2000), inhibition of the photosynthetic mechanism (Muñns and Termat 1985), also energy and lipid metabolism and protein synthesis. The lowest values of plant growth, total fruits yield, N, P, K uptake and K/Na, Ca/Na ratio. Also, N, P, K, protein and carbohydrate content in vegetable seeds tissues were observed at the highest salinity level (5500 ppm) (Muñns and Tester, 2008). Increasing NaCl levels in the nutrient solution from 0 to 100 mM significantly decreased vegetative growth, leaf area, dry matter plant, fruit yield parameters, calcium content of fruits as well as K, and Ca content in the leaves of tomato plants (Lee, 2006).

The low (50 mM NaCl) level of salinity treatment had no deleterious effects on vegetative growth parameters, at higher concentration of NaCl (100 and 200 mM), growth parameters were drastically reduced. Salinity treatments caused a reduction in chlorophyll content, accumulation of proline and enhancement of CAT activity in shoot and root of pepper plants (Chookhampany 2011).

DOI: 10.21608/ASEJAIQJSAE.2020.100682

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Received April 29, 2020, Accepted June 29, 2020
In Egypt, salinity of water and soil became a more pronounced problem in both newly and valley lands or in North Coast areas. It adversely affects vegetative growth and biomass yield of most horticultural crops. Most of the saline soils are located in the northern middle of Nile Delta as well as its eastern and western sides. This problem is usually counteracting the expansion in land reclamation (Gehad, 2003).

Salt stress in plants influence some basic plant metabolic process such as, photosynthesis, energy, lipid metabolism and protein synthesis (Parida and Das, 2005). Salt stress conditions are an osmotic that is apparently similar to that brought by water deficit (Almogaera et al., 1995). Injurious ions such as Na\(^+\) and Cl\(^-\) negatively affect nutrient uptake and balance (Sauram and Tyagi, 2004 and Hussein et al, 2007).

Potassium is an essential to record high yield, since it plays an important role in many processes in plant cells. These referred to its positive interaction with other nutrients (Usherwood, 1985). It makes a major contribution to lower the osmotic potential for solute transport in xylem and the water balance of plants (Marschner, 1995). In pepper plants subjected to saline stress, the contribution of extra K\(^+\) supply to fruit yield is not clear. It has been reported that the application of K to the nutrient solution mitigates the negative effects of salt on vegetative growth and fruit yield due to the restoration of the tissue K levels (Kaya and Higgs, 2003). Nevertheless, a high supply of K in the root medium may also contribute to the appearance of BER (blossom- end rot) in pepper plants (De Kreij, 1999).

Calcium is a major and essential plant nutrient, since fulfills a fundamental role in plant membrane stability, cell wall stabilization, and cell integrity (Hirschi, 2004). Probably the most recognizable Ca\(^{2+}\) deficiency that affects fruit production is BER (Saure, 2001). In pepper plants it has been proposed that plant growth under conditions which favour a high growth rate, a high Ca\(^{2+}\) concentration is required to prevent the induction of BER (Marcelis and Ho, 1999). Among the possible causes of BER induced by fruit Ca\(^{2+}\) deficiency, saline stress and imbalance of nutrient solution caused primarily by high K:Ca ratios stand out (Grattan and Grieve, 1999).

Compounds with poly hydro carboxylic acids have a vital role in reducing the adverse effect of salt stress in all growth and this as a result of its structure, especially for organic matter and organic acids which make a balance of charges formed during the extensive metabolism of anions such as nitrate (NO\(_3\)) and in modulating adaptation to the environment (Al-Fraihat et al., 2011).

Amino acids are involved directly or indirectly in the regulation of plant responses to environmental signals related to abiotic or biotic stress.

Glutathione is a strong antioxidant which prevents damage to important cellular components by reactive oxygen system (Sanaa et al, 2013).

Citric acid plays an important role in signal transduction system, membrane stability and functions activating transport enzymes, metabolism and translocation of carbohydrates. In addition, it considers as one of non-enzymatic antioxidants, which eliminate free radicals produced in cells under stress (Yan-Lin and Soon, 2001).

The main aims of this study to evaluate the effects of some organic compounds, chemical compounds and their combinations to relieve the harmful of salinity stress on sweet pepper plants under drip irrigation system, also to achieve the best revenue under these conditions.

**MATERIALS AND METHODS**

Two field experiments were carried out in a private farm under drip irrigation with fertigation system at Kafr El-Sheik Governorate, during summer seasons of 2018 and 2019. This investigation aimed to study the effect of salinity, some organic and chemical treatments application to minimize the harmful of salinity on growth, yield and fruit quality of sweet pepper plants (*Capsicum annum* L.) cv. Spanish. Analyses of soil and irrigation water were conducted according to (Black, 1983). Physical and chemical analysis of the experimental soil and water are shown in Table (1) and (2).
Table 1. Physical and chemical characteristics of the soil of experimental location

| Properties               | Season 2018 | Season 2019 |
|--------------------------|-------------|-------------|
| Physical properties      |             |             |
| Clay %                   | 45.2        | 39.5        |
| Silt %                   | 35.1        | 37.2        |
| Sand %                   | 21.8        | 23.4        |
| Soil texture             | Clay loam   | Clay loam   |
| Chemical properties      |             |             |
| *PH                      | 8.5         | 8.3         |
| **EC (dSm⁻¹)             | 4.35        | 3.32        |
| Soluble cations (meq lI):|             |             |
| Ca⁺⁺                     | 3.8         | 4.6         |
| Mg⁺⁺                     | 3.6         | 2.9         |
| K⁺⁺                      | 21          | 19          |
| Na⁺                      | 7.2         | 7.4         |
| Soluble anions:          |             |             |
| CO₃⁻⁻                    | 3.1         | 3.3         |
| HCO₃⁻⁻                   | 1.7         | 1.9         |
| Cl⁻                      | 5.5         | 5.6         |
| SO₄⁻⁻                    | 2.9         | 3.2         |
| Total N%                 | 0.19        | 0.18        |
| Available phosphorus     | 30.9        | 30.7        |

* measured in 1:25 soil water suspension.
** measured in the water extract of saturation soil paste.

Table 2. Irrigation water analysis (ppm)

|          | EC 1.9   |
|----------|----------|
| Carbonate| 0.0      |
| Bicarbonate| 281.95  |
| Chloride | 292.89   |
| Sulphate | 199.41   |
| Calcium  | 15.2     |
| Magnesium| 3.9      |
| Sodium   | 459.55   |
| Potassium| 4.3      |
| N        | 5.75 (ppm)|
| P        | 0.0850 (ppm)|
| K        | 7 (ppm)   |
| PH       | 8.9      |

Experimental design:

Split plot design with three replications was conducted; main plots included treatments with algae extract freely applications (organic compound). While sub plots including chemical compounds and its combinations.

Experimental treatments:

Organic commercial compound (Algae extract freely) contains of: 6% nitrogen -200ppm Molybdenum-16% amino acid (Threonine-Tryptophan-Arginine-Alanine-Asparagine- Aspartic acid- Cysteine- Serine- Glutamine-Glutamic acid-Glycine-Histidine-Tyrosine-Iso leucine- Leucine- Lysine- Valine- Methionine-Phenylalanine-Proline), used at (4,3 and 2 L/Fed.) with irrigation system.

Chemical commercial compound 1 (K) contains of: 36.5% potassium oxide-25% sulfur, used at (4L/Fed.).

Chemical commercial compound2 (Ca) contains of: 15% calcium mono carboxyle-1% poly ethylene glycol-6% nitrogen-5%proline acid-0.5% micro elements, used at (4L/Fed.).
The third chemical treatment contains half amount of both potassium (2L/ Fed.) and calcium (2L/ Fed.) together.

The treatments were applied 3 times, the first application after 15 days from transplanting and before flowering, and repeated with 15 days intervals according to irrigation schedule.

Chemical fertilizers (including N-P-K mineral) according to the recommended doses of Bulletin No. (902), 2004 Agriculture Research Center, Ministry of Agriculture, Egypt. NPK (19-19-19) commercial fertilizer, were added during the whole growth season under fertigation system.

Data recorded:

Vegetative growth

At 75 days after transplanting, random samples of five plants from each plot were taken to determine the following parameters:

a- Plant height (cm).
b- Number of leaves.
c - Number of main branches per plant.
d- Leaf area per plant (cm²) was measured after the first fruit harvest according to Yousri (1990).
e- Average dry weight of plant (g/plant) (including stem and leaves).

Fruit yield

Pepper fruits were picked weekly through the harvesting period for estimation of yield parameters, i.e., number of fruits/plant, average fruit weight (g), early yield (g/plant) including the first three pickings, total yield (g/plant), and also unmarketable yield (%) as a percent of fruit total yield which included fruits with blossom-end rot or button shape.

Quality and chemical properties of the fruits:

Chemical properties of fruits i.e., TSS (%), ascorbic acid (vitamin C in mg g⁻¹), acidity (mg g⁻¹), total nitrogen, phosphorus and potassium content and also dry matter (%) were recorded according to the method by A.O.A.C. (1984).

Chemical components of tomato leaf:

Mineral elements were determined in all leaves after 15 days from last addition of fertilizer doses while the total chlorophyll was determined according to Strain and Svec (1966), however; samples of leaves were dried at 70 °C to determine total nitrogen, phosphorus and potassium content according to the methods described by Watanabe and Olsen (1965) and Black (1983).

Respectively, proline was determined spectrophotometrically following the ninhydrin method described by Bates et al., (1973).

The economical evaluation

The economical evaluation was done to determine which treatment was affective and led to obtain the highest net revenue.

Statistical analysis:

The obtained data were subjected to the combined analysis of variance procedure and means compared using new L.S.D. methods at 5% level of significance according to Snedecor and Cochran (1980). Duncan’s multiple range test was used for means comparison (Duncan, 1955).

RESULTS AND DISCUSSION

Vegetative Growth

Effect of organic compound levels:

Data presented in Table 3 show the effect of salinity on vegetative growth characters of pepper plants as plant height, number of leaves and branches, leaf area and leaves dry weight. It is clear from the data that all growth characters were markedly reduced under soil saline condition without any addition of organic or chemical compounds treatments. Such results may be due to that biomass production of plants was inhibited by salinity as suggested by Bernstein (1963) and Cusido et al., (1987). Suppression of plant growth under saline conditions may be due to osmotic reduction in water availability or to excessive accumulation of Na and Cl in plant tissues. It is obvious from obtained results that all studied characters of vegetative growth were increased by increasing the level of algae extract freely (organic compound) from 1L/ Fed. to 3L/Fed., the highest values of all vegetative growth characters were recorded from plants which treated with 3L/Fed.

Nevertheless, similar findings coincided with the harmful effects of salinity on the plant growth performance that previously reported by Chookhampaney (2011) on pepper, El-Hefny 2010 on cowpea and El-Ghinibi and Fatma 2007 on pea.
Table 3. Effect of organic compound levels and some chemical treatments application on vegetative growth and dry weight of pepper plants during 2018 and 2019 seasons

| Treatments                        | Plant height (cm) | No. of leaves | No. of branches | Leaf area cm²/plant | Leaves d.w.(g) | Plant height (cm) | No. of leaves | No. of branches | Leaf area cm²/plant | Leaves d.w.(g) |
|----------------------------------|-------------------|---------------|-----------------|---------------------|---------------|-------------------|---------------|-----------------|---------------------|---------------|
| Organic treatments               |                   |               |                 |                     |               |                   |               |                 |                     |               |
| (Algae extract freely)           |                   |               |                 |                     |               |                   |               |                 |                     |               |
| 4(L/Fed.)                        | 86.1a             | 47.1a         | 5.83a           | 2518a               | 27.8a         | 82.6a             | 50.4a         | 5.33a           | 2564a               | 24.7a         |
| 3(L/Fed.)                        | 84.2a             | 41.8b         | 5.33ab          | 2199a               | 21.1b         | 81.3a             | 44.2b         | 5.00ab          | 2369a               | 20.2ab        |
| 2(L/Fed.)                        | 80.9b             | 33.9c         | 4.83bc          | 1966ab              | 18.42c        | 79.3a             | 38.8c         | 4.83ab          | 1749b               | 19.4b         |
| Control                          | 76.2c             | 29.2d         | 4.33c           | 1481b               | 17.4c         | 74.2b             | 28.2d         | 4.50b           | 1460c               | 17.1b         |
| Chemical treatments              |                   |               |                 |                     |               |                   |               |                 |                     |               |
| Control                          | 80.8b             | 33.3b         | 4.67a           | 1866ab              | 17.1c         | 78.7b             | 36.1b         | 4.33b           | 1824b               | 17.7b         |
| K (4L/Fed.)                      | 81.4b             | 39.3ab        | 5.17a           | 1982ab              | 19.7b         | 77.8b             | 39.2b         | 4.50b           | 2142a               | 19.4b         |
| Ca (4L/Fed.)                     | 79.0b             | 36.4b         | 5.33a           | 1722b               | 18.6b         | 76.6b             | 40.6b         | 5.33a           | 2018ab               | 18.8b         |
| K + Ca                           | 86.1a             | 43.1a         | 5.16a           | 2194a               | 29.4a         | 84.3a             | 45.6a         | 5.5a            | 2158a               | 25.5a         |

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.
Table 4. Effect of interaction between organic compound levels and some chemical treatments application on vegetative growth and dry weight of pepper plants during 2018 and 2019 seasons

| Treatments | Season 2018 | Season 2019 |
|------------|-------------|-------------|
|             | Plant height (cm) | No. of leaves | No. of branches | Leaf area cm²/plant | Leaves d.w. (g) | Plant height (cm) | No. of leaves | No. of branches | Leaf area cm²/plant | Leaves d.w. (g) |
| Organic treatments (Algae extract freely) |             |             |             |             |             |             |             |             |             |             |             |
| Control | 87.7ab | 40.5c-e | 5.33a-c | 2883a | 17.5b-e | 90.0b | 45.5bc | 6.00a | 2808a | 17.8e-g |
| K | 81.0de | 47.8b | 5.67ab | 2269b-d | 15.7de | 84.7c-e | 47.9b | 6.00a | 2382ab | 15.0h |
| Ca | 81.3de | 45.9bc | 6.00a | 2144cd | 16.7c-e | 81.0d-f | 46.9b | 6.00a | 2323ab | 16.6h |
| K+Ca | 87.3bc | 54.4a | 5.33a-c | 2867a | 19.1b-e | 88.7bc | 61.1a | 5.33ab | 2741a | 20.3b-e |
| Control | 79.2def | 39.3d-f | 4.67cd | 2277b-d | 22.3a | 79.3f | 41.3cd | 4.67ab | 2307ab | 23.3b |
| K | 82.7cd | 43.7b-d | 5.00bc | 2582ab | 18.7b-e | 84.7c-e | 43.9bc | 5.33ab | 2734a | 18.9d-g |
| Ca | 76.e | 37.2e-g | 5.67ab | 1716ef | 20.8ab | 77.3fg | 45.2bc | 6.00a | 1869bc | 21.9bc |
| K+Ca | 92.5a | 47.1b | 5.33a-c | 2562a-c | 20.8ab | 95.3a | 46.3b | 5.33ab | 2566a | 21.4b-d |
| Control | 80.8de | 26.8i | 4.00d | 1567ef | 15.6de | 81.3d-f | 32.1e | 4.00b | 1510cd | 26.4a |
| K | 83.8cd | 36.9e-g | 4.67cd | 1865de | 17.1c-e | 85.3b-d | 37.7d | 5.33ab | 1948bc | 14.9h |
| Ca | 7.7fg | 33.7f-h | 5.67ab | 2304bc | 18.9b-e | 77.7fc | 41.3cd | 5.33ab | 2691a | 17.7fg |
| K+Ca | 80.2def | 38.7d-g | 5.00bc | 1623ef | 18.4b-e | 79.3f | 44.0bc | 4.67ab | 1715cd | 18.6e-g |
| Control | 71.3g | 26.7i | 4.00d | 1553ef | 17.2c-e | 72.7gh | 25.7 | 4.00b | 1540cd | 17.3f-h |
| K | 71.0g | 28.7hi | 4.00d | 1531ef | 20.2b-d | 71.0h | 27.2fg | 4.00b | 1503cd | 19.5c-f |
| Ca | 77.7ef | 29.0hi | 4.00d | 1317f | 19.5b-e | 80.0ef | 28.8e-g | 4.00b | 1188de | 18.2e-g |
| K+Ca | 80.7ed | 32.3g-i | 5.67ab | 1651ef | 18.8e-b | 81.0d-f | 31.1ef | 5.33ab | 1611cd | 18.7e-g |

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.
Effect of chemical compounds treatments:
Data presented in Table 3 show the effect of application with K compound at 4L/Fed., Ca compound at 4L/Fed. and the combination between them as well as control on vegetative growth characters of pepper plants. It is clear from the data that, the combination between K and Ca compounds was the superior treatment which recorded the highest values of growth characters as compared with other treatments, followed by K chemical compound at 4L/Fed., while, the control treatment gave the lowest values of growth characters.

The increment in vegetative growth due to K chemical compound application might be due to the vital role of potassium oxide and sulfur present in the applied this compound. In addition, Manivvanna et al. (2016) stated that, potassium had a positive effect on growth of pepper plants and alleviated the deleterious effects of salt stress.

Effect of interaction between organic and chemical compounds:
Presented data in Table 4 indicate that, the interaction between salinity and application of K and / or Ca compounds had significant effect on all vegetative growth characters. Meantime, the interaction between organic compounds at 3L/Fed. and the combination between K and Ca compounds was the superior treatments regarding plant height, number of branches per plant and leaf area per plant, followed by the interaction between K and Ca each at 2 L/Fed. and the combination between K and Ca compounds. The obtained results were attributed to the structural and functional role of calcium in integrity of plant membranes, regulation of ion transport and control activities of cell wall enzymes (Rengel, 1992). In addition, algae extract (organic compound) contains of some amino acids which play important role in nutrient soluble and restricting the passage of toxic metals across the root and attracting beneficial microorganisms (Jasim et al., 2015), all of these conditions may stimulate the cell elongation and development and hence plant growth (Paleg, 1985). The obtained results are in harmony with those reported by Salwa Hammad and Sabah El-Gamal (2004) on pepper, El-Ghinihi and Fatma 2007 on pea and Al-Fraihat et al., 2011 on Marjoram.

Leaf chemical constituents:
Effect of organic compound levels:
Obtained results in Table 5 reveal that treated pepper plants under saline soil condition with 3L/Fed. algae extract freely (organic compound) significantly increased phosphorus and potassium percentage as well as total chlorophyll, while, treatments with 4L/Fed. significantly increased proline content in pepper leaves as compared with other treatments.

The negative effects of salinity on leaf chemical constituents are well-known and are often related to a low uptake of calcium, decreasing translocation of this element through xylem or an unfavorable partitioning of cations in plant tissues (Sonneveld 1988). The obtained results are in harmony with those reported by Chookhampaney (2011) on pepper and El-Hefny (2010) on cowpea.

Table 5. Effect of organic compound levels and some chemical treatments application on leaf chemical constituents of pepper plants during 2018 and 2019 seasons

| Treatments                        | Season 2018 | Season 2019 |
|-----------------------------------|-------------|-------------|
|                                   | Leaf chemical constituents |            |
|                                   | N%          | P%          | K%          | Proline mg/100 g D.W. | Total chlorophyll (mg/g D.W.) | N%          | P%          | K%          | Proline mg/100 g D.W. | Total chlorophyll (mg/g D.W.) |
| Organic treatments                |             |             |             |                  |                           |             |             |             |                  |                           |
| (Algae extract freely)            |             |             |             |                  |                           |             |             |             |                  |                           |
| 4(L/Fed.)                         | 3.08a 0.721b | 3.90b 159d | 43.9a 159d | 3.04a 0.685b 3.02c 148d | 44.5b 159d | 3.12a 0.721b | 47.7a 246b | 3.02a 0.697b 5.33b 270a | 46.9ab 159d |
| 3(L/Fed.)                         | 3.13a 0.781a | 6.14a 205c | 49.4a 205c | 2.86a 0.761a 5.70a 195c | 49.9a 205c | 3.21a 0.718b | 47.7a 246b | 2.92a 0.747a 6.35a 234b | 48.1ab 205c |
| 2(L/Fed.)                         | 3.16a 0.749ab | 5.90a 281a | 46.8a 281a | 2.98a 0.697b 5.33b 270a | 46.9ab 205c | 3.16a 0.749ab | 5.90a 281a | 2.98a 0.697b 5.33b 270a | 46.9ab 205c |
| Control                           | 2.99b 0.611c | 6.15a 257a | 44.0a 257a | 2.82b 0.583c 5.92a 234a | 43.1a 257a | 3.17a 0.837a | 5.71ab 218b | 47.2a 3.01ab 5.01b 218ab | 49.0a 218b |
| Chemical treatments               |             |             |             |                  |                           |             |             |             |                  |                           |
| Control                           | 2.99b 0.611c | 6.15a 257a | 44.0a 257a | 2.82b 0.583c 5.92a 234a | 43.1a 257a | 3.17a 0.837a | 5.71ab 218b | 47.2a 3.01ab 5.01b 218ab | 49.0a 218b |
| K (4L/Fed.)                       | 3.17a 0.837a | 5.71ab 218b | 47.2a 218b | 3.01ab 0.828a 5.01b 218ab | 49.0a 218b | 3.26a 0.763b | 5.51b 217b | 4.89a 3.12a 4.91b 206bc | 48.9a 217b |
| Ca (4L/Fed.)                      | 3.17a 0.837a | 5.71ab 218b | 47.2a 218b | 3.01ab 0.828a 5.01b 218ab | 49.0a 218b | 3.26a 0.763b | 5.51b 217b | 4.89a 3.12a 4.91b 206bc | 48.9a 217b |
| K + Ca                            | 3.17a 0.837a | 5.71ab 218b | 47.2a 218b | 3.01ab 0.828a 5.01b 218ab | 49.0a 218b | 3.26a 0.763b | 5.51b 217b | 4.89a 3.12a 4.91b 206bc | 48.9a 217b |

Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of significance according to Duncan’s multiple range test.
Table 6. Effect of interaction between organic compound levels and some chemical treatments application on leaf chemical constituents of pepper plants during 2018 and 2019 seasons

| Treatments          | Season 2018 | Season 2019 | leaf chemical constituents | Season 2018 | Season 2019 | leaf chemical constituents |
|---------------------|-------------|-------------|-----------------------------|-------------|-------------|-----------------------------|
|                     | N%          | P%          | K%  | Proline mg/100 g D.W. | Total chlorophyll (mg/g D.W.) | N%          | P%          | K%  | Proline mg/100 g D.W. | Total chlorophyll (mg/g D.W.) |
| Organic treatments  |             |             |     |                     |                             |             |             |     |                     |                             |
| (Algae extract freely) |             |             |     |                     |                             |             |             |     |                     |                             |
| 4(L/Fed.)           | Control     | 2.87c-f     | 0.643gh | 3.08g             | 171i | 41.9ef | 2.88bc  | 0.633de | 2.77fg  | 162f | 41.7b |
|                     | K           | 3.36ab      | 0.833b | 4.93de            | 160j | 42.9ef | 3.36ab  | 0.833ab | 5.01c-e | 156fg | 41.4b |
|                     | Ca          | 2.85d-f     | 0.660g | 4.02f             | 157ij| 41.5f  | 2.77bc  | 0.623de | 2.71fg  | 144fg | 41.5b |
|                     | K+Ca        | 3.15a-e     | 0.677fg | 3.83f          | 150j | 50.6a-d | 3.13a-c | 0.650de | 2.61fg  | 132g  | 50.8ab |
| 3(L/Fed.)           | Control     | 3.04b-f     | 0.592hi | 7.80a            | 224ef | 43.0c-f | 2.97a-c | 0.580ef | 7.52a   | 206e  | 43.2ab |
|                     | K           | 2.80ef      | 0.908a | 5.63cd            | 199gh | 55.2a  | 2.70c   | 0.893a  | 5.45c-e | 195e  | 55.0a  |
|                     | Ca          | 3.22a-d     | 0.805b-d | 6.00bc          | 204gh | 55.1a  | 3.17a-c | 0.813a  | 5.6b-e  | 192e  | 55.2a  |
|                     | K+Ca        | 3.01b-f     | 0.555i | 6.85b             | 296b | 42.9d-f | 2.88bc  | 0.523f  | 7.08ab  | 253c  | 43.3ab |
| 2(L/Fed.)           | Control     | 3.08a-f     | 0.733cd | 5.10de           | 225ef | 49.3a-e | 2.97a-c | 0.790b  | 4.93c-e | 241c  | 48.3ab |
|                     | K           | 3.25a-c     | 0.713ef | 6.86b            | 248cd | 48.3a-f | 3.07a-c | 0.700cd | 7.19a   | 236c  | 48.4ab |
|                     | Ca          | 2.92c-f     | 0.787bd | 6.22bc           | 216fg | 51.1ab  | 2.77bc  | 0.773bc | 6.21a-d | 209de | 50.8ab |
|                     | K+Ca        | 3.10a-e     | 0.817bc | 5.79cd           | 291b | 45.1b-f | 3.00a-c | 0.797b  | 4.67de  | 280b  | 44.0ab |
| Control             | Control     | 3.45a       | 0.813bd | 3.98f            | 260c | 50.6a-c | 2.50a   | 0.793b  | 4.12ef  | 253c  | 50.5ab |
|                     | K           | 3.02b-f     | 0.763de | 6.27bc           | 234de | 45.2b-f | 2.83bc  | 0.803b  | 6.22a-c | 232cd | 44.7ab |

Values having the same alphabetical letter (s) did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.
Table 7. Effect of organic compound levels and some chemical treatments application on yield and its components of pepper plants during 2018 and 2019 seasons

| Treatments                  | Season 2018               | Season 2019               |
|-----------------------------|---------------------------|---------------------------|
|                             | No. of fruits/ plant      | Average fruit wt. (g)     | Early yield (g/plant) | Total yield (g/plant) | % Unmarkeable fruits | No. of fruits/ plant | Average fruit wt. (g) | Early yield (g/plant) | Total yield (g/plant) | % Unmarkeable fruits |
| Organic treatments           |                           |                           |                       |                       |                      |                           |                           |                       |                       |                      |
| (Algae extract freely)       |                           |                           |                       |                       |                      |                           |                           |                       |                       |                      |
| 4(L/Fed.)                   | 16.1a                     | 28.9a                     | 155.2a                 | 466.2a                 | 3.2c                   | 16.8a                   | 30.9a                   | 174.3a                 | 519.9a                 | 1.7c                   |
| 3(L/Fed.)                   | 14.2b                     | 25.6a                     | 119.1b                 | 367.9b                 | 8.2b                   | 13.8b                   | 26.1b                   | 122.9b                 | 363.9b                 | 1.9c                   |
| 2(L/Fed.)                   | 11.6c                     | 20.6b                     | 80.9c                  | 241.9c                 | 10.2b                  | 10.4c                   | 20.6c                   | 75.3c                  | 220.1c                 | 6.7b                   |
| Control                     | 7.2d                      | 15.4c                     | 39.4d                  | 110.7d                 | 16.5a                  | 7.3d                    | 15.1d                   | 38.6d                  | 110.9d                 | 18.9a                  |
| Chemical treatments         |                           |                           |                       |                       |                      |                           |                           |                       |                       |                      |
| Control                     | 10.5b                     | 21.5b                     | 79.4c                  | 237.1b                 | 14.3a                  | 10.3c                   | 21.9b                   | 82.1c                  | 248.7c                 | 13.7a                  |
| K (4L/Fed.)                 | 12.1ab                    | 17.3c                     | 75.2c                  | 229.7b                 | 7.4b                   | 11.9b                   | 17.5c                   | 79.9c                  | 234.5c                 | 7.4b                   |
| Ca (4L/Fed.)                | 12.9a                     | 24.9a                     | 112.5b                 | 340.1a                 | 7.4b                   | 12.6ab                  | 25.9a                   | 119.1b                 | 345.1b                 | 7.4b                   |
| K + Ca                      | 13.6a                     | 26.6a                     | 127.6a                 | 379.8a                 | 7.5b                   | 13.4a                   | 27.3a                   | 130.2a                 | 386.6a                 | 7.5b                   |

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance according to Duncan’s multiple range test.
Table 8. Effect of interaction between organic compound levels and some chemical treatments application on yield and its components of pepper plants during 2018 and 2019 seasons

| Treatments | Organic treatments (Algae extract freely) | Chemical treatments | Season 2018 | Season 2019 | % Unmark etable fruits | % Unmark etable fruits |
|------------|------------------------------------------|---------------------|-------------|-------------|------------------------|------------------------|
|            | No. of fruits/plant | Average fruit wt. (g) | Early yield (g/plant) | Total yield (g/plant) | No. of fruits/plant | Average fruit wt. (g) | Early yield (g/plant) | Total yield (g/plant) |
| 4(L/Fed.)  | Control | 15.0cd | 24.8c | 123.3e | 390.6c | 6.7d | 16.0bc | 28.2cd | 144.3e | 471.9c | 2.7e |
|            | K      | 15.7a-c | 29.7ab | 155.5c | 488.3b | 1.8e | 16.7ab | 31.0b | 172.9c | 537.4b | 1.2e |
|            | Ca     | 16.7ab | 29.0b | 162.2bc | 500.1b | 1.8e | 16.1ab | 30.3bc | 181.7b | 538.9b | 1.2e |
|            | K+Ca   | 17.0a | 31.9a | 179.8a | 564.5a | 1.8e | 17.4a | 34.1a | 198.4a | 623.9a | 1.3e |
| 3(L/Fed.)  | Control | 12.3ef | 26.2c | 103.1fg | 343.3cd | 10.6cd | 12.0de | 26.8de | 107.5f | 344.9d | 8.9cd |
|            | K      | 13.4de | 15.9de | 63.9h | 234.1e | 7.2d | 13.3d | 15.9gh | 74.3h | 236.8f | 5.8e |
|            | Ca     | 15.3bc | 29.2b | 143.1d | 468.3b | 7.4d | 14.7c | 30.5b | 149.5e | 469.7c | 5.5e |
|            | K+Ca   | 15.7a-c | 31.2ab | 166.2b | 508.9ab | 7.2d | 15.3c | 31.0b | 160.6d | 493.7c | 5.6de |
| 2(L/Fed.)  | Control | 9.3g | 17.6d | 58.8hi | 184.4ef | 25.0a | 8.7gh | 16.9fg | 49.3ij | 168.7g | 29.2a |
|            | K      | 11.7f | 14.6e | 56.9h-j | 192.9ef | 13.6bc | 10.0f | 13.8h | 46.8j | 158.6g | 15.4bc |
|            | Ca     | 12.0ef | 24.7c | 95.7g | 317.1d | 13.7bc | 10.7ef | 25.8f | 96.7g | 298.6e | 15.4bc |
|            | K+Ca   | 13.3ef | 25.3c | 111.7f | 378.9ecd | 13.7bc | 12.3d | 25.9e | 108.6f | 338.7d | 15.4bc |
|            | Control | 5.3i | 17.4d | 32.4k | 95.4gh | 26.9a | 4.8i | 15.7gh | 27.1k | 96.5h | 26.8a |
|            | K      | 7.6h | 9.0f | 24.5k | 88.7h | 15.6b | 7.7h | 9.27i | 25.7k | 96.9h | 16.3b |
|            | Ca     | 7.8gh | 16.9de | 48.3j | 156.3fg | 15.8b | 8.0h | 17.2fg | 48.4ij | 147.3g | 16.4b |
|            | K+Ca   | 8.3gh | 18.1d | 52.6ij | 171.4f | 15.8b | 8.7gh | 18.2f | 53.2i | 175.4g | 16.4bs |

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.
Table 9. Effect of organic compound levels and some chemical treatments application on fruit quality characteristics of pepper plants during 2018 and 2019 seasons

| Treatments          | Season 2018 |          |          | Season 2019 |          |          |
|---------------------|-------------|----------|----------|-------------|----------|----------|
|                     | T.S.S  %    | Dry matter % | Vit.C m.g/100ml juice | Titratable acidity % | N % | P % | K % | T.S.S  % | Dry matter % | Vit.C m.g/100ml juice | Titratable acidity % | N % | P % | K % |
| Organic treatments  |             |          |          |             |          |          |          |          |             |          |          |          |          |          |          |          |          |          |
| (Algae extract freely) |             |          |          |             |          |          |          |          |             |          |          |          |          |          |          |          |          |          |
| 4(L/Fed.)           | 4.93bc      | 7.54a    | 65.5ab   | 0.348b      | 3.24a    | 0.600b   | 3.89b    | 4.89b      | 7.59a      | 65.4b   | 0.341b   | 3.14a    | 0.621b   | 4.05b    |          |          |          |          |
| 3(L/Fed.)           | 5.38a       | 5.70b    | 63.9c    | 0.334c      | 3.14a    | 0.690a   | 3.74bc   | 5.32a      | 6.03b      | 63.4c   | 0.332d   | 3.24a    | 0.680a   | 4.08b    |          |          |          |          |
| 2(L/Fed.)           | 5.10b       | 5.55b    | 66.7a    | 0.335c      | 3.30a    | 0.638ab  | 4.81a    | 4.97b      | 5.96b      | 66.9a  | 0.337c   | 3.16a    | 0.637ab  | 4.72a    |          |          |          |          |
| Control             | 4.67c       | 6.21ab   | 64.8bc   | 0.358a      | 3.19a    | 0.664a   | 3.39c    | 4.75b      | 6.74ab     | 65.3b  | 0.359a   | 3.21a    | 0.667ab  | 3.41c    |          |          |          |          |
| Chemical treatments |             |          |          |             |          |          |          |          |             |          |          |          |          |          |          |          |          |          |
| Control             | 5.08a       | 6.78a    | 65.7a    | 0.348b      | 3.16ab   | 0.643a   | 4.14a    | 4.89b      | 6.99ab     | 65.1a  | 0.341b   | 3.08ab   | 0.648a   | 4.15ab   |          |          |          |          |
| K (4L/Fed.)         | 5.16a       | 5.12b    | 65.5a    | 0.325d      | 3.12b    | 0.658a   | 3.90a    | 5.26a      | 5.79c      | 65.8a  | 0.325c   | 3.00b    | 0.642a   | 4.10ab   |          |          |          |          |
| Ca (4L/Fed.)        | 4.60b       | 6.73a    | 65.3a    | 0.367a      | 3.19ab   | 0.668a   | 3.79a    | 4.52c      | 7.27a      | 65.2a  | 0.367a   | 3.33a    | 0.680a   | 3.83b    |          |          |          |          |
| K + Ca              | 5.23a       | 6.35a    | 64.6a    | 0.335c      | 3.41a    | 0.623a   | 4.02a    | 5.25a      | 6.27bc     | 64.9a  | 0.338b   | 3.34a    | 0.635a   | 4.19a    |          |          |          |          |

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance according to Duncan’s multiple range test.
Table 10. Effect of interaction between organic compound levels and some chemical treatments application on fruit quality characteristics of pepper plants during 2018 and 2019 seasons

| Treatments                              | T.S.S % | Dry matter % | Vit.C m.g/100ml juice | Titratable acidity % | N% | P% | K% | T.S.S % | Dry matter % | Vit.C m.g/100ml juice | Titratable acidity % | N% | P% | K% |
|-----------------------------------------|---------|---------------|------------------------|----------------------|----|----|----|---------|---------------|------------------------|----------------------|----|----|----|
| 4(L/Fed.)                               | Control | 5.05c-f       | 7.31bc                 | 69.9a                | 0.348e | 3.05a-e | 0.520g | 4.27b | 5.27a-d       | 7.81a-c                | 70.1a               | 0.360cd | 3.09a-c | 0.530ef | 4.20bc |
| K                                       | 4.80f-h | 7.46b         | 60.3f                  | 0.300h               | 2.92e | 0.667cd | 3.78b-d | 4.73de | 6.91b-d       | 59.8f                  | 0.300g | 2.97b-e | 0.633b-e | 3.67c-e |
| Ca                                      | 4.60gh  | 9.64a         | 62.3e                  | 0.390b               | 3.42a | 0.690a-d | 3.84b-d | 4.47e | 9.57a         | 63.0cd                 | 0.390ab | 3.45a-c | 0.663b-d | 3.70c-e |
| K+Ca                                    | 5.20de  | 6.01c-f       | 69.4ab                 | 0.340ef              | 3.40ab | 0.565fg | 4.00b-d | 5.27a-d | 5.84c-f       | 69.2ab                 | 0.340ef | 3.48ab | 0.573d-f | 4.01cd |
| Control                                 | 4.80f-h | 6.01c-f       | 68.0bc                 | 0.328g               | 3.11a-e | 0.648c-e | 4.03bc | 4.87c-e | 6.00c-f       | 68.3ab                 | 0.333ef | 3.23a-e | 0.623c-e | 3.86c-e |
| 3(L/Fed.)                               | K       | 5.76a          | 5.50e-g                | 64.1d                | 0.300h | 2.93de | 0.650c-e | 3.75c-e | 5.80a         | 5.18d-f                | 64.5c | 0.300g | 2.86e | 0.667b-d | 3.63c-e |
| Ca                                      | 5.27b-d | 5.46e-g       | 62.6de                 | 0.377c               | 3.34a-c | 0.752ab | 3.84b-d | 5.33a-c | 5.28d-f       | 62.7c-e                | 0.377bc | 3.19a-e | 0.793a | 3.81c-e |
| K+Ca                                    | 5.57ab  | 6.50b-e       | 61.1f                  | 0.328g               | 3.38ab | 0.690a-d | 4.05bc | 5.53ab | 6.35c-e       | 60.4ef                 | 0.327f | 3.25a-e | 0.677a-d | 3.69c-e |
| Control                                 | 5.17c-e | 5.14fg        | 61.6ef                 | 0.335fg              | 2.97c-e | 0.705a-c | 4.99a | 5.27a-d | 4.72d-f       | 62.0d-f                | 0.333ef | 2.93-e-c | 0.707a-c | 5.06a |
| 2(L/Fed.)                               | K       | 5.40bc         | 4.43g                  | 69.4ab               | 0.300h | 3.32a-d | 0.667cd | 4.93a | 5.27a-d       | 4.36ef                 | 69.5a | 0.300g | 3.53a | 0.700a-c | 4.93ab |
| Ca                                      | 4.50h   | 6.53b-e       | 68.9a-c                | 0.360d               | 3.28a-e | 0.680b-d | 3.86b-d | 4.80c-e | 6.19c-e       | 68.3ab                 | 0.360cd | 3.26a-e | 0.653b-e | 3.97cd |
| K+Ca                                    | 5.07c-f | 6.91b-d       | 67.4c                  | 0.348e               | 3.36ab | 0.498g | 5.31a | 5.07b-d | 6.91b-d       | 67.0b                 | 0.347de | 3.48ab | 0.493f | 5.31a |
| Control                                 | 4.93d-g | 9.26a         | 62.0e                  | 0.365d               | 3.37ab | 0.708a-c | 3.29ef | 4.93c-e | 8.59ab        | 62.2c-f                | 0.363cd | 3.37a-e | 0.713a-c | 3.42c-e |
| K                                       | 4.90e-g | 4.45g         | 68.8a-c                | 0.400a               | 3.07a-e | 0.617d-f | 3.53d-f | 4.87c-e | 4.07f         | 68.0ab                | 0.400a | 3.10a-e | 0.633b-e | 3.37de |
| Ca                                      | 3.87f   | 6.37b-f       | 67.2c                  | 0.340ef              | 3.02b-e | 0.573e-g | 3.70c-e | 3.80f | 5.89f         | 67.1a                 | 0.340ef | 2.88de | 0.560f-d | 3.67c-e |
| K+Ca                                    | 5.13c-f | 5.84d-f       | 62.1e                  | 0.328g               | 3.36ab | 0.763a | 3.09f | 5.07b-d | 6.32c-e       | 61.9d-f                | 0.327f | 3.42a-d | 0.750ab | 3.11e |

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.
### Table 11. Influence of organic compound levels and some chemical treatments application on economics of pepper production during 2018 season

| Treatments          | Organic treatments (Algae extract freely) | Chemical treatments | Yield (T/fed.) | Gross returns (EP/fed.) | Cost of treatments (EP/fed.) | Total cost of Cultivation (EP/fed.) | Additional Returns (EP/fed.) |
|---------------------|------------------------------------------|---------------------|---------------|--------------------------|------------------------------|-----------------------------------|-------------------------------|
| 4(L/Fed.)           | Control                                  |                     | 4.3           | 6000                     | 1140                         | 7710                              | 1110                          |
|                     | K (4L/Fed.)                              |                     | 5.4           | 8100                     | 1860                         | 8430                              | 330                           |
|                     | Ca (4L/Fed.)                             |                     | 5.5           | 8250                     | 2100                         | 8670                              | 420                           |
| K+Ca (half amount)  | Control                                  |                     | 6.2           | 9300                     | 1980                         | 8550                              | 135                           |
| 3(L/Fed.)           | Control                                  |                     | 3.8           | 5700                     | 855                          | 7425                              | 1725                          |
|                     | K (4L/Fed.)                              |                     | 2.6           | 3900                     | 1575                         | 8145                              | 4245                          |
|                     | Ca (4L/Fed.)                             |                     | 5.2           | 7800                     | 1815                         | 8385                              | 585                           |
| K+Ca (half amount)  | Control                                  |                     | 5.6           | 8400                     | 1695                         | 8265                              | 135                           |
| 2(L/Fed.)           | Control                                  |                     | 2.02          | 3030                     | 570                          | 7140                              | 4110                          |
|                     | K (4L/Fed.)                              |                     | 2.12          | 3180                     | 1290                         | 7860                              | 4680                          |
|                     | Ca (4L/Fed.)                             |                     | 3.5           | 5250                     | 1530                         | 8100                              | 2850                          |
| K+Ca (half amount)  | Control                                  |                     | 4.2           | 6300                     | 1410                         | 7980                              | 1680                          |
| Control             | Control                                  |                     | 1.04          | 1560                     |                             | 6570                              | 5010                          |
|                     | K (4L/Fed.)                              |                     | 0.98          | 1470                     | 720                          | 7290                              | 5820                          |
|                     | Ca (4L/Fed.)                             |                     | 1.72          | 2580                     | 960                          | 7530                              | 4950                          |
|                     | K+Ca (half amount)                       |                     | 1.9           | 2850                     | 840                          | 7410                              | 4560                          |

Cost of cultivation:
- Basic cost of cultivation = 6570 EP/fed.
- Price of one Kg pepper fruits in summer season = 1.50 EP/Kg
- Cost of algae extract freely (organic compound) = 95 EP/L
- Cost of K compound = 60 EP/L
- Cost of Ca compound = 80 EP/L
- Cost of K+Ca (half amount) = 70 EP

### Table 12. Influence of organic compound levels and some chemical treatments application on economics of pepper production during 2019 season

| Treatments          | Organic treatments (Algae extract freely) | Chemical treatments | Yield (T/fed.) | Gross returns (EP/fed.) | Cost of treatments (EP/fed.) | Total cost of Cultivation (EP/fed.) | Additional Returns (EP/fed.) |
|---------------------|------------------------------------------|---------------------|---------------|--------------------------|------------------------------|-----------------------------------|-------------------------------|
| 4(L/Fed.)           | Control                                  |                     | 5.2           | 7800                     | 1140                         | 7710                              | 90                           |
|                     | K (4L/Fed.)                              |                     | 5.9           | 8850                     | 1860                         | 8430                              | 420                          |
|                     | Ca (4L/Fed.)                             |                     | 5.9           | 8850                     | 2100                         | 8670                              | 180                          |
| K+Ca (half amount)  | Control                                  |                     | 5.9           | 8850                     | 1980                         | 8550                              | 300                          |
| 3(L/Fed.)           | Control                                  |                     | 3.8           | 5700                     | 855                          | 7425                              | 1725                          |
|                     | K (4L/Fed.)                              |                     | 2.6           | 3900                     | 1575                         | 8145                              | 4245                          |
|                     | Ca (4L/Fed.)                             |                     | 5.2           | 7800                     | 1815                         | 8385                              | 585                          |
| K+Ca (half amount)  | Control                                  |                     | 5.4           | 8100                     | 1695                         | 8265                              | 165                          |
| 2(L/Fed.)           | Control                                  |                     | 1.9           | 2850                     | 570                          | 7140                              | 4290                          |
|                     | K (4L/Fed.)                              |                     | 1.7           | 2550                     | 1290                         | 7860                              | 5310                          |
|                     | Ca (4L/Fed.)                             |                     | 3.3           | 4950                     | 1530                         | 8100                              | 3150                          |
| K+Ca (half amount)  | Control                                  |                     | 3.7           | 5550                     | 1410                         | 7980                              | 2430                          |
| Control             | Control                                  |                     | 1.06          | 1590                     |                             | 6570                              | 4980                          |
|                     | K (4L/Fed.)                              |                     | 1.07          | 1605                     | 720                          | 7290                              | 5685                          |
|                     | Ca (4L/Fed.)                             |                     | 1.6           | 2400                     | 960                          | 7530                              | 5130                          |
| K+Ca (half amount)  |                                         |                     | 0.82          | 1230                     | 840                          | 7410                              | 6180                          |
Effect of chemical compounds treatments:

The effect of organic and chemical compounds on leaf chemical constituents are presented in Table 5. It can be seen from such data that application pepper plants with the combination between K compound and Ca compound was the best treatment which recorded the highest values of nitrogen and phosphorus percentage as well as total chlorophyll, followed by Ca compound while the lowest values were recorded by control treatment (without any addition for solving saline soil condition). On the other hand, application pepper plants with combination of (K + Ca) compounds gave the lowest values of proline content while, the control recorded the highest values.

The simulative effect of Ca compound which contains of poly ethylene glycol, nitrogen, proline and micro elements on chemical constituents may be due to that Ca is one of the most active element, it improves the absorption of nutrients by plants and soil microorganisms, have a positive effect on the dynamic of N and P in soil, stimulate plant respiration and the photosynthesis process, and favor the formation of soil aggregates, etc. (Brunetti et al., 2007). Similar findings were previously observed by Abd El-Rheem et al., 2012 on pepper and Afifi et al., 2010 on faba bean.

Effect of interaction between organic and chemical compounds:

Presented data in Table 6 indicate that, the interaction between algae extract freely (organic compound) and application with K and / or Ca compounds had significant effect on leaf chemical constituents, meantime, the interaction between 3L/Fed. and K at 4L/Fed. achieved the highest values of P% and total chlorophyll when using 4L/Fed. algae extract freely without any chemical compounds (control K and Ca) recorded the highest values of K%, regarding nitrogen percentage using Ca chemical compound at 4L/Fed. without algae extract freely (control) obtained the highest N%. On the other side, the interaction between organic compound at control treatment with control of chemical compounds recorded the highest values of proline content.

Yield and its components

Effect of organic compound levels:

It is obvious from the data in Table 7 that number of fruits per plant, average fruit weight, early yield per plant and total yield per plant were significantly decreased under saline soil condition, but increasing by increasing the level of algae extract freely (organic compound) from 2L/Fed. to 3L/Fed., the highest values of yield and yield components were recorded from the plants which treated with 3L/Fed., while, the lowest values were recorded from the plants treated with 2L/Fed.

Such results maybe due to that biomass production of plants was inhibited by salinity as shown in Table 2. These results compatible with those reported by Chookhampaney (2011) on pepper, El-Hefny 2010 on cowpea and El-Ghinbihi and Fatma 2007 on pea.

Effect of chemical compounds treatments:

Data presented in Table 7 show the effect of application with K compound at 4L/Fed., Ca compound at 4L/Fed. and the combination between them as well as control on yield and its components of pepper plants. It is clear from the data that, the combination between K compound and Ca compound was the superior treatment which recorded the highest values of fruits number per plant, average fruit weight, early yield per plant and total yield per plant as compared with other treatments, followed by Ca compound. While, the lowest values of yield and its components were recorded by control.

The increase in yield may be due to the essential effect of Ca that improve the nutrient status of plants. Chen and Aviad (1990) pointed out that Ca is important for plant growth hormones. Dorneanu et al., (2008) reported that Ca enhance the penetration of nutritive ions in leaves, stimulate the formation of some physiological active metabolite compounds, enlarge the capacity of plants for root absorption of elements from soil. These results compatible with those reported by Abd El-Rheem et al., 2012 on pepper and Afifi et al., 2010 on faba bean.

Effect of interaction between organic and chemical compounds:

Presented data in Table 8 indicate that, the interaction between organic compound and application with K and / or Ca compounds had significant effect on all yield and its components characters. Meantime, the interaction between 4L/Fed. algae extract freely (organic compound) and the combination between K and Ca compound was the superior treatment regarding number of fruits per plant, average fruit weight, early yield and total yield per plant, followed by the interaction between 3L/Fed. and the combination between K and Ca compound. As it has been mentioned above that the lowest levels of algae extract freely (control or 2L/Fed.) inhibited the yield and its components of pepper plants.

Fruit quality

Effect of organic compound levels:

Results listed in Table 9 demonstrate that, dry matter% and titratable acidity% were significantly increased under saline condition, the highest values of them were accomplished from the plants which
untreated with algae extract freely, the opposite was found in TSS and V.C. the highest values were obtained at using the organic compound. According to N %, P% and K % in fruits not in steady pace.

Injurious ions such as Na+ and Cl- which increase under saline condition, negatively affect nutrient uptake and balance (Sauram and Tyagi 2004 and Hussein et al., 2007). similar findings coincided with the harmful effects of salinity on the fruit quality performance that previously reported by Chookhampaney (2011) on pepper, El-Hefny (2010) on cowpea and El-Ghimbhi and Fatma (2007) on pea.

**Effect of chemical compounds treatments:**

The effect of organic and chemical compounds on fruit quality of pepper are presented in Table 9. It can be seen from the data that application pepper plants with the combination between K and Ca was the superior treatment which significantly increased TSS, dry matter and nitrogen percentage while, the highest values of titratable acidity were recorded from the plants which treated with Ca at 4L/Fed.

These results compatible with those reported by Abd El-Rheem et al., 2012 on pepper and Afifi et al., 2010 on faba bean.

**Effect of interaction between organic and chemical compounds:**

Presented data in Table 10 indicate that, the interaction between algae extract freely (organic compound) and application with K and / or Ca compound had significant effect on fruit quality of pepper plants, meantime. The interaction between 4 L/Fed.algae extract freely and Ca was the best treatment regarding dry matter, nitrogen and phosphorus percentage, while, the interaction between 3 L/Fed.algae extract freely and the combination between K and Ca was the superior treatment regarding vitamin C and TSS. On the other side, the interaction between 2L/Fed.algae extract freely and control (without K or Ca chemical compounds) gave the lowest values of fruit quality, beside treatments without any addition of neither organic nor chemical compounds, which expressed the effects of salinity on pepper fruits quality.

**The economical evaluation:**

The present study revealed that among the treatments showed in Table 11 and 12, the additional profit was higher in the treatments, i.e. 4L/Fed. algae extract (organic compound) with mixing of both calcium and potassium chemical compounds in half amount of them in the first season 2018, followed by 4L/Fed. algae extract (organic compound) combined with 4L /Fed. potassium chemical compound in the second season 2019. The lower additional returns were observed in using half amount of potassium and calcium chemical compounds without algae extract freely (organic compound), from the point of economics, it is inferred that the use of (4L/Fed. algae extract freely) plus potassium and calcium chemical compounds in half amount of them could be recommended for increasing unit productivity and also net profit, in addition of high quality of pepper fruits.

**RECOMMENDATION**

From the previous results of this investigation, it could be recommending that application of Ca compound at 4L/Fed. or with the combination between K compound at 2L/Fed. and Ca compound at 2 L/Fed. under using 4L/Fed. algae extract freely for sweet pepper plants grown under saline soil conditions were the superior treatments for enhancing growth, fruit yield and quality as compared with the other treatments.

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تأثير المركبات العضوية والكيميائية على النمو والمحصول وجودة ثمار الفلفل الحلو تحت ظروف الملوحة المعتدلة

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أجريت تجربتي حيال مieszاق بصرع في محافظة كفر الشيخ، خلال المواسم الصيفي لعامي 2018 و 2019 وذلك لدراسة تأثير الملوحة واستخدام كميات مختلفة من مستخلص الطحالب البحرية المضادة لمياه الري نظام الرمي التسويدي، حيث صدر الفولي 2، 3، 4 لتر/ فدان (3 مرات اضافة) و مركب كالميس 4 لتر/ فدان (مركب كيميائي) تحتوى على عصر البوتاسيوم بعدها 4 لتر/ فدان (3 مرات اضافة) والجمع بين مركب البوتاسيوم والكالميس بعدها نصف الكمية المستخدمة لكل منها (2 لتر/ فدان البوتاسيوم + 2 لتر/ فدان البوتاسيوم) بالإضافة إلى معاملة الكنترول والتفاعل بينهما على صفقات النمو الخضري، الصبغات النباتية، المحصول الكلي ومكوناته، جودة الثمار وكذلك المحتوى الكيميائي لأوراق نباتات الفلفل الحلو الصنف الأسباني.

أدت تغذية الفلي في كمية مستخلص الطحالب من معاملة الكنترول (دون اضافة) إلى 4 لتر/ فدان (بمعدل 3 مرات) إلى حدوث ارتفاع معنوي في صفقات النمو الخضري، الوزن الجاف/ نبات، المساحة الورقية/ نبات، المحصول المشرى ومكوناته، المواد الصلبة الكلية الخضرية في الثمار وكذلك محتوى النمو الخضري وصافي ريح بجانب إعادة جودة محصول ثمر الطماطم في الموسم الأول بينما استخدم مستخلص الطحالب البحرية بعدها 4 لتر/ فدان (3 مرات اضافة) بجانب اضافة مركب البوتاسيوم بعدها 4 لتر/ فدان (3 مرات اضافة) أعطى أعلى محصول و عائد اقتصادي في الموسم الثاني.