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 annuum* L.). cv. Spanish pepper.

Vegetative growth characters, *i.e.* plant hight, 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 decaling 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 treats 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 received 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 (Munns 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 by the highest salinity level (5500 ppm) (Munns 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).

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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 fulfils 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 (NO3) 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 ll):		
Ca^{++}	3.8	4.6
Mg^{++}	3.6	2.9
K^{++}	21	19
Na^{+}	7.2	7.4
Soluble anions:		
CO_3^{--}	3.1	3.3
HCO_3^{--}	1.7	1.9
Cl^{-}	5.5	5.6
SO_4^{--}	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 15days 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 75days 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 (cm^2) 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 leave:

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 0Cto 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-Ghinbihi 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 2018and 2019 seasons

Treatments	Growth characters / plant									
	Season 2018					Season 2019				
	Plant height (cm)	No. of leaves	No. of branches	Leaf area cm^2/plant	Leaves d.w.(g)	Plant height (cm)	No. of leaves	No. of branches	Leaf area cm^2/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 2018and 2019 seasons

Treatments		Growth characters / plant									
		Season 2018					Season 2019				
Organic treatments (Algae extract freely)	Chemical treatments	Plant height (cm)	No. of leaves	No. of branches	Leaf area cm^2/plant	Leaves d.w.(g)	Plant height (cm)	No. of leaves	No. of branches	Leaf area cm^2/plant	Leaves d.w.(g)
4(L/Fed.)	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
3(L/Fed.)	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.ef	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
2(L/Fed.)	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	Control	71.3g	26.7i	4.00d	1553ef	17.2c-e	72.7gh	25.7g	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	18.8b-e	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 3show 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-Ghinbihi 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, treats 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 2018and 2019 seasons

Treatments	leaf chemical constituents									
	Season 2018					Season 2019				
	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	3.04a	0.685b	3.02c	148d	44.5b
3(L/Fed.)	3.13a	0.781a	6.14a	205c	49.4a	2.86a	0.761a	5.70ab	195c	49.9a
2(L/Fed.)	3.21a	0.718b	6.16a	246b	47.7a	2.92a	0.747a	6.35a	234b	48.1ab
Control	3.16a	0.749ab	5.90a	281a	46.8a	2.98a	0.697b	5.33b	270a	46.9ab
Chemical treatments										
Control	2.99b	0.611c	6.15a	257a	44.0a	2.82b	0.583c	5.92a	234a	43.1a
K (4L/Fed.)	3.17ab	0.837a	5.71ab	218b	47.2a	3.01ab	0.828a	5.01b	218ab	49.0a
Ca (4L/Fed.)	3.26a	0.763b	5.51b	217b	48.9a	3.12a	0.732b	4.91b	206bc	48.9a
K + Ca	3.17ab	0.757b	5.14b	198c	47.6a	2.83ab	0.747b	4.81b	190c	48.5a

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 6. Effect of interaction between organic compound levels and some chemical treatments application on leaf checonstituents of pepper plants during 2018and 2019 seasons

Treatments		leaf chemical constituents									
		Season 2018					Season 2019				
Organic treatments (Algae extract freely)	Chemical treatments	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.)
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	160ij	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	2.92c-f	0.780cd	4.25ef	195h	45.3b-f	2.60c	0.760bc	4.21ef	189e	44.1ab
2(L/Fed.)	Control	3.01b-f	0.555i	6.85b	296b	42.9d-f	2.88bc	0.523f	7.08ab	253c	43.3ab
	K	3.08a-f	0.733cd	5.10de	225ef	49.3a-e	2.97a-c	0.790b	4.93c-e	241c	48.3ab
	Ca	3.25a-c	0.713ef	6.86b	248cd	48.3a-f	3.07a-c	0.700cd	7.19a	236c	48.4ab
	K+Ca	2.92c-f	0.787b-d	6.22bc	216fg	51.1ab	2.77bc	0.773bc	6.21a-d	209de	50.8ab
Control	Control	2.71f	0.598hi	6.43bc	340a	46.6b-f	2.58c	0.593ef	6.32a-c	315a	47.8ab
	K	3.10a-e	0.817bc	5.79cd	291b	45.1b-f	3.00a-c	0.797b	4.67de	280b	44.0ab
	Ca	3.45a	0.813b-d	3.98f	260c	50.6a-c	2.50a	0.793b	4.12ef	253c	50.5ab
	K+Ca	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.

Table7.Effect of organic compound levels and some chemical treatments application on yield and its components of pepper plants during 2018and 2019 seasons

Treatments	Yield and its components									
	Season 2018					Season 2019				
Organic treatments (Algae extract freely)	**No. of fruits/ plant**	**Average fruit wt. (g)**	**Early yield (g/plant)**	**Total yield (g/plant)**	**% Unmarke table fruits**	**No. of fruits/ plant**	**Average fruit wt. (g)**	**Early yield (g/plant)**	**Total yield (g/plant)**	**% Unmarke table fruits**
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.

Table8. Effect of interaction between organic compound levels and some chemical treatments application on yield and its components of pepper plants during 2018and 2019 seasons

Treatments		Yield and its components									
		Season 2018					Season 2019				
Organic treatments (Algae extract freely)	Chemical treatments	No. of fruits/ plant	Average fruit wt. (g)	Early yield (g/plant)	Total yield (g/plant)	% Unmarketable fruits	No. of fruits/ plant	Average fruit wt. (g)	Early yield (g/plant)	Total yield (g/plant)	% Unmarketable fruits
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	10.0fg	13.8h	46.8j	158.6g	15.4bc
	Ca	12.0ef	24.7c	95.7g	317.1d	13.7bc	10.7ef	25.8e	96.7g	298.6e	15.4bc
	K+Ca	13.3ef	25.3c	111.7f	378.9cd	13.7bc	12.3d	25.9e	108.6f	338.7d	15.4bc
Control	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.

Table9. Effect of organic compound levels and some chemical treatments application on fruit quality characteristics of pepper plants during2018 and 2019 seasons

Treatments	Fruit quality													
	Season 2018							Season 2019						
	T.S.S %	Dry matter%	Vit.C m.g/ 100ml juice	Titrat-able acidity %	N%	P%	K%	T.S.S %	Dry matter%	Vit.C m.g/ 100ml juice	Titrat-able 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

Table10.Effect of interaction between organic compound levels and some chemical treatments application on fruit quality characteristics of pepper plants during 2018and 2019 seasons

Treatments		Fruit quality													
		Season 2018							Season 2019						
Organic treatments (Algae extract freely)	Chemical treatments	T.S.S %	Dry matter %	Vit.C m.g/ 100ml juice	Titrat-able acidity %	N%	P%	K%	T.S.S %	Dry matter %	Vit.C m.g/ 100ml juice	Titrat-able 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
3(L/Fed.)	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
	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
2(L/Fed.)	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	2.93c-e	0.707a-c	5.06a
	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	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	3.87i	6.37b-f	67.2c	0.340ef	3.02b-e	0.573e-g	3.70c-e	3.80f	5.89c-f	67.1a	0.340ef	2.88de	0.560d-f	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)	Treatments: 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)	6.2	9300	1980	8550	750
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)		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)		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) = 95EP/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)	Treatments: 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)	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)	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)	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 Table7 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-Ghinbihi 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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الملخص العربي

تأثير المركبات العضوية و الكيميائية على النمو والمحصول وجودة ثمار الفلفل الحلو تحت ظروف الملوحة

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أجريت تجربتن حقليتين بمزرعة خاصة بمحافظة كفر الشيخ ، خلال الموسم الصيفى لعامى 2018 و 2019 وذلك لدراسة تأثيرالملوحة واستخدام كميات مختلفة من مستخلص الطحالب البحرية المضاف لمياه الرى بنظام الرى التسميدى وهى صفر ، 2، 3 ، 4 لتر/ فدان بمعدل 3 مرات والمعاملة بمركب كيميائى يحتوى على عنصر البوتاسيوم بمعدل 4 لتر/ فدان(3مرات اضافة) و مركب كيميائى يحتوى على الكالسيوم بمعدل 4 لتر/ فدان(3 مرات اضافة) والجمع بين مركب البوتاسيوم والكالسيوم بمعدل نصف الكمية المستخدمة لكل منهما (2لتر /فدان بوتاسيوم + 2 لتر / فدان كالسيوم) بالاضافة إلى معاملة الكنترول والتفاعل بينهم على صفات النمو الخضرى ، الصبغات النباتية ، المحصول الكلى ومكوناته، جودة الثمار وكذلك المحتوى الكيماوى لأوراق نباتات الفلفل الحلو الصنف الأسبانى.

أدت الزيادة فى كمية مستخلص الطحالب من معاملة الكنترول (بدون اضافة) إلى 4لتر/ فدان (بمعدل 3 مرات) إلى حدوث ارتفاعا معنويا فى صفات النمو الخضرى ،الوزن الجاف / نبات ، المساحة الورقية/نبات ،المحصول الثمرى ومكوناته ، المواد الصلبة الكلية الذائبة فى الثمار وكذلك محتوى الثمار من البوتاسيوم ، وعلى الجانب الآخراظهرت معاملة الكنترول إلى زيادة الحموضة الكلية فى الثمار وكذلك محتوى الأوراق من البرولين.

سجلت معاملة إضافة مركب الكالسيوم بتركيز 4لتر / فدان (3مرات اضافة) ومعاملة الجمع بين مركب البوتاسيوم بتركيز 2 لتر/ فدان ومركب الكالسيوم بتركيز 2لتر/فدان (3 مرات اضافة) زيادة معنوية بالنسبة لكل القياسات الخضرية ، محتوى الأوراق من النيتروجين ، الكلوروفيل الكلى ، المحصول ومكوناته ، المواد الصلبة الذائبة الكلية فى الثمار وكذلك المادة الجافة فى الثمار.

أوضحت النتائج أن معاملة التفاعل بين كمية مستخلص الطحالب البحرية بمعدل 4لتر /فدان (3 مرات اضافة) وإضافة مركب الكالسيوم بمعدل 4لتر/ فدان (3مرات اضافة) ومعاملة الجمع بين مركب البوتاسيوم 2لتر / فدان ومركب الكالسيوم 2 لتر / فدان (3مرات اضافة) سجلت تأثيرا معنويا منشطا على معظم الصفات التى تمت دراستها ، فى حين أنها سجلت أقل القيم بالنسبة لمحتوى الثمار من المواد الصلبة الذائبة الكلية. ومن ناحية أخرى سجلت معاملة التفاعل بين الكنترول و بدون اضافة مستخلص الطحالب البحرية فى ماء الرى اقل القيم بالنسبة لصفات النمو الخضرى والمحصول ومكوناته وكذلك جودة الثمار.

وقد اظهرت الجدوى الاقتصادية ان استخدام مستخلص الطحالب البحرية بمعدل 4 لتر/ فدان(3 مرات اضافة) بجانب اضافة مركب البوتاسيوم و الكالسيوم بمعدل2 لتر/ فدان لكل منهما (3مرات اضافة) قد حقق اعلى معدل لانتاجية وحدة المساحة وصافى ربح بجانب اعلى جودة لمحصول ثمار الطماطم فى الموسم الاول،بينما استخدام مستخلص الطحالب البحرية بمعدل 4 لتر/ فدان(3 مرات اضافة) بجانب اضافة مركب البوتاسيوم بمعدل4 لتر/ فدان (3مرات اضافة) اعطى اعلى محصول و عائد اقتصادى فى الموسم الثانى.