

Effect of some irrigation and fertilization treatments on growth and productivity of winter tomato grown under low tunnels

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Abstract

Two field experiments were carried out during the two successive seasons of 2015/2016 and 2016/2017 at the Private Farm on Wade El-Moulak region, Ash sharqiyah Governorate, Egypt, to assess the effect of drip irrigation rates and organic and mineral nitrogen fertilizers as well as different interaction among them on growth, yield and chemical constituents of tomato plants hybrid GS12 F1. The drip irrigation treatments began of transplanting and were added in the morning at two times/week up to end of May month, thus number of irrigation to season was 52 ones. The amounts of water were added using water counter and pressure counter at 1 bar. The amounts of calculate water were added to different treatments, express through drippers (4 L/h) to give such amounts of water. Obtained results showed that the effect of fertilization treatments on vegetative growth character is ties of tomato plants.

Key words: irrigation, fertilization, growth, tomato, low tunnels.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetables worldwide. As it is a relatively short duration crop and gives a high yield, it is economically attractive and the area under cultivation is increasing daily. Moreover, tomatoes contribute to a healthy, wellbalanced diet and having rich in minerals, vitamins, essential amino acids, sugars and dietary fibres. Tomato (*Lycopersicon esculentum*, (Mill.) L.) is one of the most important vegetable crops grown in Egypt for fresh consumption and processing. The total cultivated area of tomato in Egypt was about 459,283 fed. during 2003 season* which produced 7,140,198 tons with average of 15.55 tons/feddan.

As a good sources of plant nutrient supply and as good soil conditioners. Contains much vitamin B and C, iron and phosphorus. Tomato fruits are consumed fresh in salads or cooked in sauces, soup and meat or fish dishes. They can be processed into purées, juices and ketchup. Canned and dried tomatoes are economically important processed products.

Water is one of the major resources that limit agricultural developments especially in the arid lands. The Egyptian water resources are not sufficient related to the agricultural development in Egypt.

As the Egyptian water share from the River Nile is limited by $55.5 \times 10^9 \text{ m}^3$ / year, the necessity to rationalize the irrigation water needs no emphasis. About 85 % of the Egyptian water balance is used for agricultural purpose. Drip irrigation system has already been established as recommended method for vegetable production especially under sandy soil conditions. Drip irrigation besides giving a saving of 32% as compared with surface irrigation system. During the last decades, considerable research efforts have gone into the study of plant water relations,

microclimatology and evapotranspiration. Using chemical fertilizers (NP) in agriculture specially in vegetable crops causing hazardous effect for human, plant and animals, and led to depression in the activities of nitrogen fixing bacteria and also in activities of phosphorus bacteria (Waksman, 1952). Similar to frequent application of water, optimum split applications of fertilizer improves quality and quantity of crop yield than the conventional practice. The capital investments in the construction of irrigation systems of new type decrease by 20-60 % in comparison with the systems of regular operation. This reduction happens due to water flow distribution and minimization of diameters of the water conveyance network and also due to elimination of thorough water treatment necessary for drip irrigation systems. The empirical studies and optimization calculations have shown that the minimum discharge capacity and, hence, the minimum coefficient for the water conveyance network and equipment are provided by the system of continuous operation, when the degree of equipment use in time is equal to one. Energy consumption by the systems of pulse localized irrigation is much lower than by drip irrigation systems, because the required pressure for a design module is less than 3-5 mm of water column. A great attention has been directed towards the use of organic fertilizers to reduce plant and soil contaminations with mineral fertilizers, improve the fertility of soil and reduce nutrient losses. In addition, the organic fertilizers were considered as good sources of plant nutrient supply and good soil conditioners. Addition of organic matter, can improve all soil properties; such as water holding capacity, soil aggregation, stability, soil fertility, and increase cation exchange capacity. Also, organic fertilizers were used to decrease soil pH and increase the availability of major and minor nutrients

(Tahoun et al, 2000). Some stated that application of organic manure increased dry weight/plant; N, P and K contents; number of fruits/plant; average fruit weight as well as yield/plant and feddan (Mohsen, 2006; Olaniyi and Ajibola, 2008; Agyeman et al., 2014; Ilupeju et al., 2015; and Yousafzai et al., 2016 on tomato). Therefore, this study was carried out to study the responses of growth, yield, fruit quality and chemical constituents of tomato plants to various sources of organic and mineral nitrogen with biofertilizers treatments.

Materials and Methods

Two field experiments were carried out during the two successive seasons of 2015/2016 and

2016/2017 at the Private Farm on Wade El-Moulak region, Ash sharqiyah Governorate, Egypt, to assess the effect of drip irrigation rates and organic and mineral nitrogen fertilizers as well as different interaction among them on growth, yield and chemical constituents of tomato plants hybrid GS₁₂ F₁. The drip irrigation treatments began of transplanting and were added in the morning at two times/week up to end of May month, thus number of irrigation to season was 52 ones. The amounts of water were added using water counter and pressure counter at 1 bar. The amounts of calculate water were added to different treatments, express through drippers (4 L/h) to give such amounts of water which presented in Schedule 2.

Schedule 2. The amount of water, the time needed to give such amounts and amounts of water supply at every irrigation.

Treatments (m ³ /fed)	Time needs (h)	Water supply every irrigation (m ³ /fed)
1456	1	28
2184	1.5	42
2912	2	56
3640	2.5	70

Seeds of hybrid GS₁₂ F₁ were sown in nursery on 15th Oct. in foam trays and seedlings were transplanted (with 3-4 true leaves i.e. after 45 days) from sowing on 2nd Dec. for 1st and 2nd seasons.

The experimental unit area was 36 m² (7.2 x 5 m) and each unit contained six rows with 5 m length for each and 120 cm width of them, four inner rows were possessed for yield determination, whereas the two outer rows were devoted to plant growth parameter. The distance between seedling was 50 cm.

This experiment included 16 treatments as follow:

A- Drip irrigation rates

- 1- 1456 m³/fed
- 2- 2184 m³/fed
- 3- 2912 m³/fed
- 4- 3640 m³/fed

B- Organic and mineral nitrogen

- 1- 135 kg (45 N unit) nitrate ammonium (25% mineral N) + 50.4 m³ chicken manure/fed (75% organic N).
- 2- 269 kg (90N unit) nitrate ammonium (50% mineral N) + 33.6 m³ chicken manure/fed (50% organic N).
- 3- 403 kg (135 N unit) nitrate ammonium (75% mineral N) + 16.8 m³ chicken manure/fed (25% organic N).
- 4- 538 kg (180 N unit) nitrate ammonium (100% mineral N).

Chicken manure (as organic N) was added at the time of soil preparation. The source of mineral nitrogen fertilizer was nitrate ammonium (33.5%N). Amount of the mineral nitrogen, for every treatment,

was divided into eight equal portions (8 frequencies) and weekly applied starting from 15 days after transplanting.

All experimental units received equal amounts of P and K fertilizers at the rates of 450 and 200 kg/fed as a calcium superphosphate (15.5% P₂O₅) and potassium sulphate (48% K₂O), respectively. At the times, one third of P and K fertilizers were added at the time of soil preparation. The other two thirds were divided into three equal portions and added every 15 days. The first portion was added after 30 days from transplanting. The other normal agricultural treatments of growing tomato plants were practiced.

These treatments were arranged in split plot design with three replicates in both seasons. Drip irrigation rates were assigned at random in the main plots, while sub plots were devoted to organic and mineral nitrogen.

Data recorded

A. Plant Growth

a. Morphological characters

A random sample of six plants from each plot was taken at age 80 days and the following data were recorded: Plant height (cm), Number of leaves/plant And Number of branches/plant, **Fresh weight**, Fresh weight of leaves/plant (g), Fresh weight of branches/plant (g) and Fresh weight of whole plant (g)

b. Dry weight, Dry weight of leaves/plant (g), Dry weight of branches/plant (g) and Dry weight of whole plant (g)

B. Fruit Yield

Mature fruits were continuously harvested when reached suitable maturity stages, and the following data were recorded: **Number of fruits/plant, Average fruit weight (g), Fruit yield/plant (kg), Fruit yield/fed (ton):**

Total fruit yield was calculated on the basis of total yield along harvesting at full-ripe maturity stages by summing (the sum of all harvests).

5- Fruit quality:

5.1 Total soluble solids percentage (TSS %): It was determined in fruit juice by Carle zeis Refractometer.

5.2 Ascorbic acid (Vit. C mg/100 ml juice): It was determined in fruit juice using 2,6-Dichlorophenol indophenol dye (A.O.A.C., 1990).

5.3 Tetratable acidity (%): Tetratable acidity was determined by the titration against (NaOH) using phenolphthalin (Phth) as indicator according to the method described in (A.O.A.C., 1990).

C. Minerals Content and Total protein

Total nitrogen, phosphorus and potassium were determined in dry plant according to A.O.A.C. (2005)

Total protein (%): It was determined as nitrogen content and converted to its equivalent protein content by multiplying X 6.25.

C. NPK Uptake

NPK uptake were calculated as NPK contents on dry weight basis, according to (Klute 1986 and Page *et al.* 1982).

Statistical Analysis

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split plot design by using means of "MSTAT-C" computer software package. Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described by Snedecor and Cochran (1980).

Result and Discussion

4- Effect of irrigation quantity and fertilization treatments on:

4-1-Vegetative growth characters.

Data illustrated in Tables (1, 2 and 3) show the effect of irrigation quantity, fertilization treatments and their interaction on vegetative growth traits of tomato plants during 2015 and 2016 seasons.

4-1-1- Effect of irrigation quantity.

Data showed in Tables (1, 2, and 3) indicate that all the studied growth characters expressed as plant height, number of leaves per plant, number of branches per plant, leaves fresh (g/plant), branches fresh weight (g/plant), total plant fresh weight (g/plant), leaves dry weight (g/plant), branches dry weight (g/plant) and total plant dry weight (g/plant) were significantly increased with increasing

irrigation water amount up to 2912 m³/fed. During the growing season. In this concern the highest values in all a fore mentioned growth parameters were attained as a result of applying 2912m³/fed. compared with the other used irrigation water quantity, i.e., 1456, 2184 and 3640m³/fed. obtained results are true during 2015 and 2016 seasons of study. Such increases in plant growth traits due to increasing the amount of water irrigation may be due to the role of water in enhancing the physiological processes and increasing the solubility and uptake of macro-nutrients (Tables 5 and 6) which incorporated in the formation of cells and consequently increasing the plant growth. Obtained results are in agreement with those reported by EL-Tantawy and EL-Beik (2007), Ghassemi-Golezani and Mardfar (2008), El-Noemani *et al.* (2010), Abd El-Aal *et al.* (2011), and Marzouk *et al.* (2016) who showed that increase water quantity led to a significant increase of plant growth (plant height, number of branches and leaves /plant). Also, Amer *et al.* (2002a&b) recorded that increasing irrigation levels (80, 100 and 120% Ep.) increased mineral contents (NPK) in leaves, branches and whole plant. Ismail (2004) explained that drip irrigation at rates of 800, 1200 and 1600 m³ water / fed. Significantly increased NPK and protein contents.

4-1-2- Effect of fertilization treatments.

Concerning the effect of fertilization treatments on vegetative growth character is tics of tomato plants, the same data shown in Tables (1, 2 and 3) clear that all the studied vegetative growth parameters, i.e. plant height, number of leaves per plant, number of branches per plant, leaves fresh weight, branches fresh weight, total plant fresh weight weight, leaves dry weight, branches dry weight and total plant dry weight were positively affected due to the application of both mineral. NPK fertilization and organic manure. In this regard, application NPK mineral fertilization in a single form at the recommended dose or in combination with organic manure at different rates led to a significant differences between all the measured growth aspects of tomato plants. In this connection, the highest values for all recorded vegetative growth characters of plant were obtained as a result of using 75 % NPK mineral fertilizers. From the recommended doses plus organic manure, meanwhile the lowest values were obtained as a result of using 25%NPK mineral fertilizer plus organic manure. obtained results are true during both seasons of study. Application of NPK mineral fertilizers and organic manure increased the macro-elements content (N,P and K) in different plant parts (Tables 5 and 6) which play the major role in increasing cell division and cell elongation and consistently increased plant growth. Obtained results are coincided with those reported by El-Shobaky (2002), Abd El-Rahman (2001), El-Robae (2003), ElNaggar (2004), El-Mansi *et al.*

(2004), Baddour (2010) and Muhammad et al. (2011) in case of mineral nitrogen fertilizer and Fattahallah (1992a), Abd-Allah et al., (2001), Abd El-Hakeem (2003), El-Mansi et al., (2004), Mohsen (2006), Olaniyi and Ajibola (2008), Ayeni et al (2010), Agyeman et al. (2014), Mojeremane et al. (2016) and Yousafzai et al. (2016) in case of organic manure.

4-1-3-Effect of the interaction.

As for the effect of the interaction treatments the same data in Tables (1, 2 and 3) indicate that there were significant differences in all measured vegetative growth parameters during both seasons of growth due to the interaction between the different studied treatments. In this respect, irrigating tomato plants with 2912m³/fed. of water irrigation and fertilizing the plants with 75% NPK mineral fertilizers from the highest values in the different

vegetative growth traits (plant height, number of leaves per plant, number of branches per plant, leaves fresh weight, branches fresh weight, total plant fresh weight, leaves dry weight, branches dry weight and total plant dry weight) during the two seasons of growth. Whereas, the lowest values were recorded in the case of irrigation with 1456m³/fed water irrigation and fertilizer the plants with 25 % NPK mineral fertilizers + organic manure. Obtained results are true during both seasons of study. In this respect, El-Mansi et al. (2004), Mohsen (2006), Mahila et al. (2010) and Dawa et al. (2013a) all working on tomato recorded similar results and Dawa et al. (2013b) on sweet pepper. Also, El-Noemani et al. (2010), Abd El-Aal et al. (2011), and Marzouk et al. (2016) who showed that increase water quantity led to a significant increase of plant growth (plant height, number of branches and leaves /plant).

Table 1. Effect of irrigation quantity and fertilization treatments on Plant height, No. of. Leaves and No. of. Branches of tomato plants during the two seasons of study (2015-2016).

Treatment	Plant height(cm)		No. of. Leaves		No. of. Branches			
	1 st	2 nd	1 st	2 nd	1 st	2 nd		
Irrigation ratios	1456 m ³ /fed	68.9	65.7	36.5	44.5	3.0	2.5	
	2184 m ³ /fed	91.1	77.1	53.9	61.4	3.4	4.0	
	2912 m ³ /fed	108.5	87.5	69.5	69.5	4.4	5.0	
	3640 m ³ /fed	93.2	76.1	55.2	69.5	3.5	3.3	
	LSD	2.7	5.4	1.8	2.8	0.5	0.9	
Fertilization	Fert.1	77.8	66.8	37.6	59.0	2.8	2.6	
	Fert.2	84.1	70.4	44.0	51.5	3.0	3.2	
	Fert.3	103.1	88.5	70.1	62.4	4.6	4.7	
	Fert.4	96.6	80.9	63.3	72.1	3.9	4.2	
	LSD	2.1	2.2	1.9	2.3	0.4	0.4	
Interaction between Irrigation and Fertilization	1456	Fert1	62.6	60.6	30.3	30.6	2.6	1.3
		Fert2	68.0	59.6	33.6	31.0	2.3	2.3
		Fert3	73.3	76.6	42.0	60.3	3.6	3.6
		Fert4	71.6	66.0	40.3	56.0	3.3	3.0
	2184	Fert1	71.0	63.0	28.0	56.0	2.3	3.3
		Fert2	87.6	71.6	47.3	59.6	3.0	3.6
		Fert3	106.0	88.3	70.3	58.0	4.6	4.6
		Fert4	100.0	85.6	70.0	72.0	3.6	4.3
	2912	Fert1	101.0	76.0	56.0	69.0	3.6	3.6
		Fert2	102.3	77.0	54.6	57.6	3.6	4.3
		Fert3	118.3	103.0	90.3	66.3	5.6	6.3
		Fert4	112.3	94.3	77.0	85.3	4.6	5.6
	3640	Fert1	76.6	67.6	36.3	80.6	2.6	2.3
		Fert2	78.6	73.3	40.6	57.6	3.0	2.6
		Fert3	115.0	86.0	78.0	65.0	4.6	4.3
		Fert4	102.6	77.6	66.0	75.0	4.0	4.0
	LSD	4.3	4.5	3.8	4.6	0.9	0.9	

Fert1=25%(NPK) + Organic
Fert2=50%(NPK) + Organic

Fert3=75%(NPK) + Organic
Fert4=100% (NPK)

Table 2. Effect of irrigation quantity and fertilization treatments on F w. leaves (g), F w. branches (g) and F w. plant (g) of tomato plants during the two seasons of study (2015-2016).

Treatment	F w. leaves (g)		F w. branches (g)		F w. plant (g)		
	1 st	2 nd	1 st	2 nd	1 st	2 nd	
Irrigation Ratios	1456 m ³ /fed	160.13	204.00	105.29	124.00	265.42	328.00
	2184 m ³ /fed	226.11	238.33	174.90	187.83	401.01	426.16
	2912 m ³ /fed	293.017	383.75	198.25	228.83	491.27	612.58
	3640 m ³ /fed	297.76	283.00	184.20	171.25	481.96	454.25
	LSD	6.64	4.06	10.34	7.42	12.29	8.93
and Fertilization	Fert.1	179.60	190.33	117.07	152.66	296.68	343.00
	Fert.2	216.03	232.50	140.97	168.25	357.01	400.75
	Fert.3	317.66	374.08	215.25	208.50	532.92	582.58
	Fert.4	263.72	312.16	189.34	182.50	453.06	494.66
	LSD	9.33	3.18	7.10	8.11	12.54	8.85
Interaction between Irrigation and Fertilization	Fert1	151.80	109.66	79.66	108.33	231.46	218.00
	Fert2	156.30	144.66	91.76	120.00	248.06	264.66
	Fert3	167.06	298.00	132.23	159.33	299.30	457.33
	Fert4	165.36	263.66	117.50	108.33	282.86	372.00
	LSD	168.06	187.00	86.03	170.00	254.10	357.00
Interaction between Irrigation and Fertilization	Fert1	174.80	236.33	140.93	158.33	315.73	394.66
	Fert2	263.26	281.00	155.23	193.33	418.50	474.33
	Fert3	395.33	581.00	281.76	328.00	677.10	909.00
	Fert4	338.66	436.66	215.10	235.66	553.76	672.33
	LSD	223.76	228.33	161.66	174.00	385.43	402.33
Interaction between Irrigation and Fertilization	Fert1	252.47	267.33	159.33	180.00	411.80	447.33
	Fert2	414.76	332.66	216.36	132.33	631.13	465.00
	Fert3	300.06	303.66	199.43	198.66	499.50	502.33
	Fert4	300.06	303.66	199.43	198.66	499.50	502.33
	LSD	18.74	6.37	14.21	16.23	25.09	17.70

Fert1=25%(NPK) + Organic
Fert2=50%(NPK) + Organic

Fert3=75%(NPK) + Organic
Fert4=100% (NPK)

4-2- Chemical composition of plant foliage.

Data recorded in Table (4) clear the effect of irrigation quantity and fertilization treatments as well as their interaction on chemical composition of tomato plant foliage expressed as N,P and K percentage during 2015 and 2016 season of growth.

4-2-1- Effect of irrigation quantity.

Data at Table (4) show the effect of irrigation water amount (1456,2184, 2912 and 3640 m³/fed.) on chemical composition of tomato there were a significant differences in all measured mineral constituents of plant foliage among the amounts used of irrigation water during both season of growth. Such data clear that increasing the quantity of irrigation water applied from 1456 up to 2912 m³/fed. Led to increase in all measured mineral constituents of plant foliage. In this respect, the highest values in all determined macro elements were obtained in case of using 2912 m³/fed. of irrigation water, followed by using 3640m³/fed. obtained results are true during both seasons of growth. Such

enhancing effect of irrigation water amounts on mineral constituents with increasing the rate of irrigation water may be due to the increase in water and mineral constituents up take by plant roots and trans location to plant foliage. Which, causes the increasing of the concentration of such constituents in plant foliage tissues. Also, the higher mineral contents in case of using 2912m³/fed. Of irrigation water was connected with the higher vegetative growth compared with the other uses amounts of irrigation water (Tables 1,2 and 3). Obtained results are in agreement with those reported by Amer *et al.* (2002b), Sawan *et al.* (2002), Ismail (2004), EL-Tantawy and EL-Beik (2007), Ghassemi-Golezani and Mardfar (2008), El-Noemani *et al.* (2010), El-Aal *et al.* (2011), Byan (2014), Silva *et al.* (2016), Marzouk *et al.* (2016), Farahmand, A. R *et al.* (2006) and Morais *et al.* (2017) who revealed that increasing the amount of irrigation water led to an increase in total yield and its attributes i.e., weight and numbers of pods / plant as well as early yield.

Table 3. Effect of irrigation quantity and fertilization treatments on D w. leaves (g), D w. branches (g) and D w. plant (g) of tomato plants during the two seasons of study (2015-2016).

Treatment	D w. leaves (g)		D w. branches (g)		D w. plant (g)			
	1 st	2 nd	1 st	2 nd	1 st	2 nd		
Irrigation Ratios	1456 m ³ /fed	40.45	45.55	28.41	32.32	68.86	77.87	
	2184 m ³ /fed	63.07	62.59	40.90	53.02	103.97	115.61	
	2912 m ³ /fed	78.25	87.13	61.39	65.98	139.65	153.11	
	3640 m ³ /fed	70.38	70.15	51.50	55.28	121.89	125.35	
	LSD	2.83	2.48	3.80	1.98	4.81	3.73	
Fertilization	Fert.1	37.76	44.38	28.57	36.21	66.34	80.52	
	Fert.2	53.35	58.43	38.87	43.18	92.23	101.66	
	Fert.3	101.45	97.17	65.75	73.84	167.20	171.00	
	Fert.4	59.59	65.47	49.00	53.30	108.60	118.76	
	LSD	2.23	2.25	2.03	2.56	2.87	3.47	
Interaction between Irrigation and Fertilization	1456	Fert1	25.80	17.40	17.33	17.20	43.13	34.60
		Fert2	31.33	44.50	18.66	24.43	50.00	68.93
		Fert3	61.66	64.03	50.00	55.23	111.66	119.27
		Fert4	43.00	56.26	27.66	32.43	70.66	88.70
	2184	Fert1	50.26	50.30	9.33	36.53	59.60	86.83
		Fert2	61.20	58.96	30.46	44.63	91.66	103.60
		Fert3	78.33	78.73	70.93	75.53	149.27	154.26
		Fert4	62.50	62.36	52.86	55.40	115.36	117.76
	2912	Fert1	38.00	48.93	42.76	48.80	80.76	97.73
		Fert2	65.00	65.40	56.00	57.30	121.00	122.70
		Fert3	140.43	159.87	82.00	90.06	222.43	249.93
		Fert4	69.60	74.33	64.80	67.76	134.40	142.10
	3640	Fert1	37.00	60.60	44.86	42.33	81.86	102.93
		Fert2	55.90	65.06	50.36	46.36	106.26	111.43
		Fert3	125.36	86.03	60.10	74.53	185.46	160.57
		Fert4	63.26	68.90	50.70	57.60	113.96	126.50
	LSD	4.46	4.50	4.07	5.12	5.75	6.95	

Fert1=25%(NPK) + Organic
 Fert2=50%(NPK) + Organic

Fert3=75%(NPK) + Organic
 Fert4=100% (NPK)

4-2-2- Effect of fertilization treatments.

Data illustrated in Table (4) show that there were significant differences among the tested fertilizer treatments in all assayed mineral composition of plant foliage expressed as N%, P% and K% during both seasons of study. In this concern, application of 100% of recommended doses of NPK mineral fertilizers reflected the highest plant foliage content of N,P and K content compared with the other used fertilizers treatments, followed by using 75% from the recommended doses of NPK mineral fertilizers+ organic manure gave the lowest values of the all the formations chemical composition traits of plant foliage obtained results may be due to the synergistic effect of mineral NPK fertilizers and organic manure in increasing the absorption of NPK elements by plant roots. Such enhancing effect of mineral nitrogen and chicken manure on produced yield was noticed by Abd El- Rahman (2003), El-Robae (2003), Patial et al. (2004), El-Mansi et al. (2004), Shuayb (2004), El- Beheidi et al. (2006), Thimma (2006), Ewulo et al. (2008), Law-Ogbomo and Egharevba (2008), Olaniyi and Ajibola (2008), Baddour (2010) Hamden and Fadni (2010),

Muhammed et al. (2011) and Agyeman et al. (2014) all working on tomato.

4-2-3- Effect of the interaction.

As for the interaction effect, data at Table (4) showed that there were significant differences between the interaction treatments between irrigation water quantity and fertilization treatments in all measures mineral composition of plant foliage during both seasons of growth. In this respect application of 2912m³/fed. Of irrigation water combined with 100% of the recodes doses of NPK mineral fertilizers only gave the highest plant foliage content of NPK compared with the other used interaction treatments, followed by using 3640m³/fed. Irrigation water with the same level of fertilization .on the opisite side, the interaction treatments between 1456m³/fed. Irrigation water the lowest quantity and 25 % from the recommended doses of NPK mineral fertilizers +organic manure reflected the lowest values from the formations chemical composition of plant foliage traits, followed by the interaction treatment between applied 2184m³/fed. irrigation water the same fertilizer treatment.

Table 4. Effect of irrigation quantity and fertilization treatments on Number fruits, Average fruit weight (g), Fruit /plant (kg)and yield /fed (ton)of tomato plants during the two seasons of study (2015-2016).

Treatment	Number fruits		Average fruit weight (g)		Fruit /plant (kg)		yield /fed (ton)			
	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd		
Irrigation Ratios	1456 m ³ /fed	47.5	39.8	64.75	70.97	3.1	2.8	21.7	19.9	
	2184 m ³ /fed	50.2	45.9	70.74	77.36	3.6	3.5	25.2	25.0	
	2912 m ³ /fed	54.4	50.5	83.59	82.59	4.5	4.1	31.8	29.1	
	3640 m ³ /fed	45.5	44.9	76.30	77.86	3.4	3.5	24.4	24.5	
	LSD	2.1	1.4	2.12	2.78	0.2	0.1	1.7	0.9	
Fertilization	Fert.1	44.5	42.3	60.85	69.30	2.7	2.9	19.0	20.6	
	Fert.2	47.6	44.6	68.83	70.43	3.3	3.1	23.1	22.1	
	Fert.3	52.3	46.9	84.73	88.19	4.4	4.1	30.9	29.0	
	Fert.4	53.2	47.2	80.96	80.85	4.3	3.8	30.1	26.8	
	LSD	1.2	1.0	1.72	2.17	0.1	0.1	0.9	0.9	
Interaction between Irrigation and Fertilization	1456	Fert1	35.6	35.3	59.00	64.53	2.1	2.2	14.7	15.9
		Fert2	43.3	38.3	62.01	67.41	2.6	2.5	18.8	18.0
		Fert3	54.6	44.3	69.66	78.93	3.8	3.4	26.6	24.4
		Fert4	56.3	41.3	68.33	73.00	3.8	3.0	26.9	21.1
	2184	Fert1	44.0	41.0	57.40	64.90	2.5	2.6	17.6	18.6
		Fert2	48.0	43.3	61.60	70.90	2.9	3.0	20.7	21.5
		Fert3	54.3	47.3	84.90	94.00	4.6	4.4	32.2	31.1
		Fert4	54.6	52.0	79.06	79.63	4.3	4.1	30.2	28.9
	2912	Fert1	54.3	50.0	66.46	74.26	3.6	3.7	25.2	25.9
		Fert2	53.3	52.0	79.00	79.73	4.2	4.1	29.5	29.0
		Fert3	55.0	50.0	96.70	89.06	5.3	4.4	37.2	31.1
		Fert4	55.0	50.0	92.20	87.30	5.0	4.3	35.4	30.5
	3640	Fert1	44.0	43.0	60.53	73.50	2.6	3.1	18.6	22.1
		Fert2	46.0	45.0	72.73	63.70	3.3	2.8	23.4	20.0
		Fert3	45.3	46.0	87.66	90.76	3.9	4.1	27.8	29.2
		Fert4	47.0	45.6	84.26	83.50	3.9	3.8	27.7	26.6
	LSD	2.4	2.0	3.44	4.34	0.2	0.2	1.9	1.8	

Fert1=25%(NPK) + Organic
Fert2=50%(NPK) + Organic

Fert3=75%(NPK) + Organic
Fert4=100% (NPK)

4-3-Fruit yield and its components.

Obtained data in (Table 5) show the effect of water irrigation quantity and fertilizers treatments as well as their interaction on fruit yield and its components at pressed as number of fruits per plants average fruit weight, fruit yield per plant and total fruit yield per fed.

4-3-1- Effect of irrigation quantity.

Data on the effect of irrigation water quantity on total fruit yield and its components are presented in table (4), such data show that there were significant differences in total produced fruit yield and its components, i.e., number of fruits per plant, average fruit weight, plant fruit yield and total fruit yield per fed. among the used irrigation water quantity during both seasons of study. such data reveal that there were progressive and consistent increments in total fruit yield and its components with increasing the amount of irrigation water from 1456m³/fed. Upto 2912m³/fed. And decreased with increasing the amount of irrigation water up to 3640m³/fed. during both seasons of this study. In this couarn, irrigated

tomato plants with 2912m³/fed produced the highest total fruit yield and its components compared with other used irrigation water quantity treatments on the other hand, the lowest values in total fruit yield and its components were recorded by application of 1456m³/fed of water irrigation in both seasons of growth. Such increases in total fruit yield are related with increasing in number of fruits per plant and plant fruit yield as well as increasing in average fruit weight. Also, such increments in total fruit yield and its components due to increasing the quantity of irrigation water applied are connected with the enhancing effect of quantity of irrigation water on vegetative growth traits of plants (Tables,1,2 and 3) which in turn effect on the yielding ability of plants. The increase in minerals content might be attributed to increase in dry matter accumulation with increasing water levels was reported

by Merghany (1999) on snap been, Nour (1999) on pea and Sawan *et al.* (2001) on sugar pea.

4-3-2- Effect of fertilization treatments.

Data presented in Table (5) show clearly that there were significant differences in all measured fruit yield its components parameters among the studied fertilizer treatments. In this concern, the highest values in average fruit weight, plant fruit yield and total fruit yield per fed. Were obtained as a result of fertilization with to 75% from the recommended doses of NPK mineral fertilizers plus 25% organic manure followed by the treatment treated with 100% from the recommended doses of NPK mineral fertilizers. Obtained results are true during 2015 and 2016 seasons of study. Meanwhile, the highest number of fruit per plant were obtained from fertilizing tomato plants with 100% from the recommended doses of NPK mineral fertilizers. this is true during both seasons of growth (Table,5). The positive effect of using 75% from the recommended

doses NPK mineral fertilizers combined with 25% organic manure on fruit yield and its components may be due to the promotive effect of such treatment on vegetative growth traits (Tables,1,2 and 3) which affect consequently on fruit yield production. Obtained results are similar to those reported by Abo-El- Defan (1990), Fattahallah (1992a), Moursey, et al. (2001), Darwish (2002), El-Naggar (2004), Ewulo et al. (2008) and Ayeni et al (2010) all working on tomato reported that fertilizing tomato plants with organic manure at different rates enhanced N,P and K contents of plant foliage. Also, El-Beheidi et al. (1991), Merghany (1997), Barakat and Gabr (1998), Mohsen (2006) and Dawa et al. (2013) reported similar results in case of using mineral nitrogen fertilizer.

Table 5. Effect of irrigation quantity and fertilization treatments on N (%), P (%), K (%) and Protein (%) of tomato plants during the two seasons of study (2015-2016).

Treatment	N (%)		P (%)		K (%)		Protein (%)			
	1 st	2 nd	1 st	2 nd	1 st	2 nd	1 st	2 nd		
Irrigation Ratios	1456 m ³ /fed	1.23	1.25	0.27	0.27	0.62	0.63	7.72	7.85	
	2184 m ³ /fed	1.25	1.32	0.32	0.31	0.70	0.69	7.83	8.25	
	2912 m ³ /fed	1.46	1.46	0.33	0.32	0.79	0.74	9.15	9.13	
	3640 m ³ /fed	1.44	1.43	0.32	0.32	0.78	0.72	9.00	8.99	
	LSD	0.03	0.01	0.01	0.01	0.01	0.03	0.21	0.12	
Fertilization	Fert.1	1.21	1.22	0.30	0.29	0.58	0.58	7.58	7.63	
	Fert.2	1.26	1.30	0.31	0.30	0.70	0.67	7.91	8.13	
	Fert.3	1.42	1.44	0.32	0.32	0.77	0.72	8.92	9.04	
	Fert.4	1.48	1.50	0.32	0.32	0.84	0.81	9.28	9.43	
	LSD	0.02	0.02	0.01	0.01	0.02	0.01	0.15	0.14	
Interaction between Irrigation and Fertilization	1456	Fert1	1.18	1.21	0.26	0.25	0.52	0.53	7.39	7.56
		Fert2	1.21	1.23	0.26	0.26	0.63	0.63	7.60	7.77
		Fert3	1.26	1.27	0.28	0.28	0.66	0.66	7.89	7.97
		Fert4	1.28	1.30	0.29	0.28	0.68	0.73	8.00	8.12
	2184	Fert1	1.19	1.22	0.31	0.29	0.55	0.57	7.47	7.64
		Fert2	1.21	1.28	0.32	0.31	0.67	0.63	7.56	8.00
		Fert3	1.27	1.34	0.33	0.33	0.75	0.73	7.97	8.41
		Fert4	1.33	1.43	0.33	0.33	0.83	0.82	8.31	8.95
	2912	Fert1	1.24	1.23	0.31	0.31	0.64	0.63	7.77	7.72
		Fert2	1.33	1.35	0.32	0.32	0.75	0.72	8.33	8.43
		Fert3	1.59	1.59	0.34	0.33	0.86	0.76	9.97	9.95
		Fert4	1.68	1.66	0.34	0.34	0.94	0.85	10.52	10.41
	3640	Fert1	1.23	1.21	0.31	0.31	0.62	0.61	7.70	7.58
		Fert2	1.30	1.33	0.32	0.32	0.74	0.71	8.16	8.33
		Fert3	1.57	1.57	0.34	0.33	0.83	0.74	9.85	9.83
		Fert4	1.64	1.63	0.34	0.34	0.92	0.82	10.27	10.22
	LSD	0.05	0.05	0.01	0.01	0.05	0.01	0.31	0.28	

Fert1=25%(NPK) + Organic
Fert2=50%(NPK) + Organic

Fert3=75%(NPK) + Organic
Fert4=100% (NPK)

4-3-3- Effect of the interaction.

With regard to the effect of the interaction between the amount of irrigation water and fertilization treatments, data illustrated in Table,5 clear that the total fruit yield per plant and feddan as well as number of fruits per plant and average fruit weight

were significantly affected. In this concern, the highest fruit yield per plant and feddan were obtained from the interaction treatment between irrigation tomato plants with 2912m³/fed. irrigation water and fertilized with 75% from the recommended doses of NPK mineral fertilizers plus 25% organic manure.

These results were true during both seasons growth. Moreover the highest average fruit weight were obtained from the same previously mentioned interaction treatment during the first season (2015), meanwhile during second one were obtained from the interaction treatment between irrigation with 2184m³/feddan and fertilization the plants with 75% from the recommended doses of NPK mineral fertilizers plus 25% organic manure. where as the highest number of fruits per plant in the first season of growth were obtained from irrigated tomato plants with 1456m³ of irrigation water and fertilized with 100% from the recommended doses of NPK mineral fertilizer, while in the second season it was obtained from irrigated tomato plants with 100% from the recommended doses of NPK mineral fertilizers.

4-4- N, P and K uptake.

Data illustrated in Table (6) clear the effect of irrigation quantity and fertilization treatments as well as their interaction on nitrogen, phosphorus and potassium uptake in tomato plant foliage during the two seasons of study.

4-4-1- Effect of irrigation quantity.

With regard to the effect of irrigation rates on N,P,K uptake of plant foliage, it is clear from the recorded data in Table (6) that increasing quantity of irrigation water from 1456 m³/fed up to 2912 m³/fed significant increased the uptake of nitrogen , phosphorus and potassium in plant foliage. These results were true during 2015 and 2016 seasons of study. The highest values of NPK uptake by plant roots were obtained from tomato plants irrigated with 2912 m³/fed. followed by 3640m³. on the other hand the lowest values of NPK uptake were obtained when irrigated plants with the lowest value of irrigation water (1456 m³/fed).the increases of NPK uptake in plant foliage as a result of increasing the irrigation water amount may be due to the increasing of absorbed and trans located water and macro elements to the various plant foliage parts, which in turn increased such amounts of macro-elements in different cells of plant partes. Also, such increment in all estimates macro-elements uptake was connected with the increase in vegetative growth parameters (Tables, 1, 2 and 3) as a result of increasing the quantity irrigation water application.

Table 6. Effect of irrigation quantity and fertilization treatments on n uptake, p uptake and k uptake of tomato plants during the two seasons of study (2015-2016).

Treatment	n uptake		p uptake		k uptake			
	1 st	2 nd	1 st	2 nd	1 st	2 nd		
irrigation ratios	1456 m ³ /fed	858.6	987.9	192.9	215.8	442.8	514.4	
	2184 m ³ /fed	1315.6	1538.7	344.4	373.1	759.2	813.1	
	2912 m ³ /fed	2109.1	2303.5	467.1	508.0	1151.7	1156.2	
	3640 m ³ /fed	1798.3	1832.5	404.3	412.7	972.7	915.5	
	LSD	107.5	52.3	16.9	12.3	64.0	29.8	
Fertilization	Fert.1	809.7	984.5	202.0	243.0	397.0	482.5	
	Fert.2	1179.7	1330.9	292.2	316.2	658.9	693.5	
	Fert.3	2447.5	2527.5	552.8	558.4	1331.0	1252.5	
	Fert.4	1644.6	1819.5	361.6	392.0	939.5	970.7	
	LSD	43.2	53.1	9.7	10.91	37.0	35.6	
Interaction between Irrigation and Fertilization	1456	Fert1	510.4	418.5	114.7	89.5	227.1	185.0
		Fert2	608.4	856.9	133.5	183.0	318.2	433.5
		Fert3	1410.9	1522.7	316.7	335.9	740.6	791.4
		Fert4	904.5	1153.4	206.8	254.8	485.2	647.6
	2184	Fert1	713.2	1062.1	185.7	254.3	328.1	494.9
		Fert2	1109.1	1325.9	297.3	322.8	617.1	653.2
		Fert3	1905.9	2078.6	503.5	517.8	1129.5	1130.7
		Fert4	1534.2	1688.1	391.0	397.2	962.0	973.4
	2912	Fert1	1005.4	1208.6	253.3	306.8	522.6	615.8
		Fert2	1613.3	1655.6	393.6	398.4	907.5	892.0
		Fert3	3550.9	3982.2	760.0	841.3	1914.2	1899.4
		Fert4	2266.8	2367.6	461.4	485.4	1262.6	1217.8
	3640	Fert1	1009.6	1249.1	254.3	321.5	510.3	634.3
		Fert2	1388.1	1485.4	344.5	360.6	792.9	795.2
		Fert3	2922.3	2526.4	631.2	538.4	1539.7	1188.4
		Fert4	1873.0	2069.0	387.1	430.4	1048.1	1044.0
	LSD	86.5	106.2	19.5	21.8	74.0	71.2	

Fert1=25%(NPK) + Organic

Fert2=50%(NPK) + Organic

Fert3=75%(NPK) + Organic

Fert4=100% (NPK)

4-4-2- Effect of fertilization treatments.

Referring to the effect of fertilization treatments on the uptake of N,P and K by plant roots , the some data in Table (5) show clearly that the uptake of such NPK elements was significantly differed as a result of the application of fertilization treatments as mineral form or organic manure. In this respect .the highest nitrogen , phosphorus and potassium uptake was connected with using 75% form the recommended doses of NPK mineral fertilizers + organic manure, followed by application of 100% from the recommended doses of NPK mineral fertilizers only. On the other hand the lowest values of NPK uptake by plant roots were obtained when fertilizing tomato plants with 25% from the recommended doses of NPK mineral fertilizers+ organic manure. Such increments in uptake of all estimated macro-elements were connected with the increase in vegetative growth traits (Tables,1,2 and 3) as a result of application fertilization treatments.

4-4-3- Effect of the interaction.

Data mentioned in Table (6) show that there were a significant effects on NPK uptake by plant roots due to the interaction between the irrigation water quantity and the used fertilization treatments. In the regard, application 2912 m³/fed. of irrigation water with fertilizing plants with 75% from the recommended doses of NPK mineral fertilizers+ organic manure reflected the highest values of N, P and K uptake by plant roots during both season of study than the other tested interaction treatments , followed by the interaction treatment between 3640 m³/fed. of irrigation water plus the same mentioned fertilizers treatment. On the other hand, the lowest values of NPK uptake by plant roots were obtained from the interaction treatment between 1456 m³/fed. of water irrigation with 25% from the recommended doses of NPK mineral fertilizer + organic manure, followed the same irrigation level (1456m³/fed. irrigation water) + 50%from the recommended doses of NPK mineral fertilizers + organic manure.

4-4-Tss, Ascorbic acid and Vit.c.

Data illustrated in Table (7) clear the effect of irrigation quantity and fertilization treatments as well as their interaction on nitrogen, phosphorus and potassium uptake in tomato plant foliage during the two seasons of study.

4-4-1- Effect of irrigation quantity.

With regard to the effect of irrigation rates on Tss, Ascorbic acid and Vit.c of fruits, it is clear from the recorded data in Table (7) that increasing quantity of irrigation water from 1456 m³/fed up to 2912 m³/fed significant increased the uptake of nitrogen , phosphorus and potassium in plant foliage. These results were true during 2015 and 2016 seasons of study.

The highest values of Tss, Ascorbic acid and Vit.c by plant roots were obtained from tomato plants

irrigated with 2912 m³/fed. followed by 3640m .on the other hand the lowest values of Tss, Ascorbic acid and Vit.c were obtained when irrigated plants with the lowest value of irrigation water (1456 m³/fed).the increases of Tss, Ascorbic acid and Vit.c in plant foliage as a result of increasing the irrigation water amount may be due to the increasing of absorbed and trans located water and macro elements to the various plant foliage parts, which in turn increased such amounts of macro-elements in different cells of plant partes.

4-4-2- Effect of fertilization treatments.

Referring to the effect of fertilization treatments on the Tss, Ascorbic acid and Vit.c by plant roots , the some data in Table (7) show clearly that the uptake of such NPK elements was significantly differed as a result of the application of fertilization treatments as mineral form or organic manure. In this respect .the highest nitrogen , phosphorus and potassium uptake was connected with using 75% form the recommended doses of NPK mineral fertilizers + organic manure, followed by application of 100% from the recommended doses of NPK mineral fertilizers only. On the other hand the lowest values of Tss, Ascorbic acid and Vit.c by plant roots were obtained when fertilizing tomato plants with 25% from the recommended doses of NPK mineral fertilizers+ organic manure.

4-4-3- Effect of the interaction.

Data mentioned in Table (7) show that there were a significant effects on Tss, Ascorbic acid and Vit.c by plant roots due to the interaction between the irrigation water quantity and the used fertilization treatments. In the regard, application 2912 m³/fed. of irrigation water with fertilizing plants with 75% from the recommended doses of NPK mineral fertilizers+ organic manure reflected the highest values of N, P and K uptake by plant roots during both season of study than the other tested interaction treatments , followed by the interaction treatment between 3640 m³/fed. of irrigation water plus the same mentioned fertilizers treatment. On the other hand, the lowest values of Tss, Ascorbic acid and Vit.c by plant roots were obtained from the interaction treatment between 1456 m³/fed. of water irrigation with 25% from the recommended doses of NPK mineral fertilizer + organic manure, followed the same irrigation level (1456m³/fed. irrigation water) + 50%from the recommended doses of NPK mineral fertilizers + organic manure. Such increase in TSS, ascorbic acid and total acidity may be due to the decreasing in moisture content of fruit and the presences of other nutrient elements affecting on the assimilation of ascorbic acid and total acidity contents. In this connection Khalil (1982), Soares et al.(1985), Midan et al. (1986), Hasegawa (1989), Fattahallah (1992b), El-Gizawy et al. (1993), Elkner and

Rumpel (1995), Merghany (1997), Abd-Allah et al. (2001), Moursey et al. (2001), Abd El- Rahman (2003), Akande and Adediran (2004), El-Mansi et al. (2004), El-Naggar (2004), Shuayb (2004), Heeb et al. (2006), Mohsen (2006), Shukla et al. (2006), Ewulo et al. (2008), Baddour (2010) and Kandil

and Gad (2010) all working on tomato and Shehata (1992) and Ademoyegun et al. (2011) working on pepper reported that using organic fertilizer combined with mineral nitrogen has positive effect on fruit TSS, ascorbic acid and fruit titrable acidity content.

Table 7. Effect of irrigation quantity and fertilization treatments on TSS (%), Acidity (%) and Vit.C (mg/100 ml Juice) of tomato plants during the two seasons of study (2015-2016).

Treatment	TSS (%)		Acidity (%)		Vit.C(mg/100 ml Juice)			
	1 st	2 nd	1 st	2 nd	1 st	2 nd		
Irrigation ratios	1456 m ³ /fed	4.85	4.89	0.88	0.87	18.33	18.65	
	2184 m ³ /fed	4.50	4.59	0.77	0.74	19.96	20.76	
	2912 m ³ /fed	4.25	4.38	0.70	0.69	20.92	21.89	
	3640 m ³ /fed	3.93	3.99	0.65	0.65	18.62	19.49	
	LSD	0.18	0.13	0.03	0.04	00.61	00.68	
Fertilization	25% + org	3.99	4.04	0.63	0.60	17.18	17.97	
	50%+ org	4.21	4.22	0.73	0.69	19.37	20.20	
	75%+ org	4.75	4.99	0.87	0.82	21.64	22.85	
	100%	4.59	4.61	0.78	0.83	19.64	19.77	
	LSD	0.28	0.11	0.03	0.03	00.36	00.34	
Interaction between Irrigation and Fertilization	1456	Fert1	4.24	4.30	0.76	0.74	16.76	17.06
		Fert2	4.57	4.64	0.82	0.80	17.95	18.90
		Fert3	5.66	5.65	1.00	0.95	19.73	19.78
		Fert4	4.94	4.99	0.95	0.99	18.88	18.86
	2184	Fert1	4.01	4.15	0.68	0.60	17.38	18.47
		Fert2	4.39	4.26	0.78	0.70	19.99	20.76
		Fert3	4.78	5.29	0.89	0.85	22.50	23.49
		Fert4	4.83	4.64	0.74	0.81	19.98	20.33
	2912	Fert1	3.91	3.81	0.58	0.55	17.70	18.66
		Fert2	3.92	3.99	0.68	0.65	21.52	22.46
		Fert3	4.52	4.91	0.82	0.81	24.28	26.42
		Fert4	4.65	4.82	0.71	0.74	20.17	20.01
	3640	Fert1	3.78	3.88	0.52	0.52	16.88	17.68
		Fert2	3.98	4.00	0.63	0.61	18.00	18.67
		Fert3	4.04	4.12	0.76	0.67	20.06	21.70
		Fert4	3.94	3.97	0.70	0.79	19.53	19.88
	LSD	0.56	0.21	0.05	0.05	00.73	00.67	

Fert1=25%(NPK) + Organic
Fert2=50%(NPK) + Organic

Fert3=75%(NPK) + Organic
Fert4=100% (NPK)

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تأثير بعض معاملات الري والتسميد على نمو وإنتاجية الطماطم الشتوى تحت الاتفاق البلاستيك

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الملخص

أجريت تجربتان حقليتان بمزرعة خاصة بقرية الحوة مركز بيلا محافظة كفر الشيخ خلال الموسم الصيفي لعامى 2013 - 2014 على الطماطم هجين مورس 44 وذلك لدراسة تأثير الإضافة الأرضية والرش ببعض منشطات النمو على نمو وإنتاجية الطماطم المنزرعة تحت ظروف الأراضى الملحية (تشمل الدراسة 16 معاملة ناتجة من التفاعل بين 4معاملات للإضافة الأرضية وهى الهمر كمصدر لحمض الهيوميك بتركيز 5جم/لتر والدبل ون كمصدر لمستخلص الطحالب البحرية بتركيز 5جم/لتر والفرى سال كمصدر للكالسيوم وحمض الجلوتاريك بتركيز 5جم/لتر بالإضافة للكنترول وكذلك 4 معاملات للرش وهى كالأئى الأمينو باور كمصدر للأحماض الأمينية 1مل/لتر والسورد كمصدر لحمض السلسيك بتركيز 1جم/لتر واحادى فوسفات البوتاسيوم بتركيز 1جم/لتر بالإضافة إلى معاملة الكنترول0

وقد أوضحت النتائج إن معاملات الإضافة الأرضية ثلاث مرات وذلك بعد الشتل ب10ايام ثم مرة كل 10ايام بعد ذلك قللت التأثير السلبى لملوحة التربة وادى ذلك الى زيادة النمو الخضرى لنباتات الطماطم (طول النبات - عدد الأفرع والأوراق - الوزن الطازج والجاف وكذلك المساحة الورقية للنبات) وكذلك أدى استخدام هذه المعاملات الى زيادة محتوى النباتات من الكلوروفيل الكلى والنيتروجين - الفسفور - الكالسيوم - البوتاسيوم والبرولين وقلل من تركيز الصوديوم فى المجموع الخضرى للنبات وكذلك ادت الى زيادة المحصول الكلى للنبات - الفدان - المحصول القابل للتسويق وقللت من المحصول الغير قابل للتسويق

وأدت هذه المعاملات أيضا إلى تحسن صفات الجودة الطبيعية (متوسط وزن الثمرة طول وقطر الثمرة وصلابة الثمار) و كذلك تحسين صفات الجودة الكيميائية(نسبة المواد الصلبة الذائبة- فيتامين ج - الحموضة الكلية) بالإضافة الى ذلك فان استخدام مستخلص الطحالب البحرية أعطى أفضل النتائج فى هذا الاتجاه

أما بالنسبة لمعاملات الرش فقد ادى الرش بالأحماض الامينية و حمض السلسيك واحادى فوسفات البوتاسيوم إلى زيادة معنوية فى كلا من النمو الخضرى - التركيب الكيماوى -المحصول ومكوناته وصفات الجودة الطبيعية والكيميائية للنباتات0

وعلاوة على ذلك فان رش النباتات بحمض السلسيك بتركيز 1جم/لتر أدى الى الحصول على أعلى القيم وبالإضافة الى ذلك ادت جميع معاملات التفاعلات المختلفة الى حدوث زيادة معنوية فى النمو الخضرى والمحصول ومكوناته والصفات الطبيعية والكيميائية للثمار وبالإضافة الى ذلك فان معاملة التفاعل بين الإضافة الأرضية بمستخلص الطحالب البحرية والرش بحمض السلسيك كان لهما التأثير الأعلى فى هذا الاتجاه .