



# EFFECT OF ADDITION OF ORGANIC AND CHEMICAL FERTILIZATION AND SPRAYING OF ALPHA TOCOPHEROL ON THE GROWTH AND YIELD OF TOMATO (*SOLANUM LYCOPERSICUM* MILL.)

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## Abstract

A field experiment was carried out during the spring season of 2018 in the station (A) - Department of Horticulture and Gardening Landscape - College of Agriculture Engineering Sciences, University of Baghdad- Al-Jadriya. In order to study the effect of organic, chemical fertilizers and spraying of alpha-tocopherol on growth and yield of tomato (Hybrid Sreen). The experiment included two factors, the first factor was used different types of fertilizers which included the chemical fertilizers according to the recommendation N: 120, P<sub>2</sub>O<sub>5</sub>: 150 and K<sub>2</sub>O: 120 kg ha<sup>-1</sup> (T<sub>1</sub>) it was added in two batches, and the organic fertilizer of the cows manure at 30 ton ha<sup>-1</sup>(T<sub>2</sub>), It was added before planting. The Organic Fertilizer Manufacturer (Care Ball supermix) added in two levels, each level being as fertilizer treatment, 20 kg per 1000 m<sup>2</sup> (T<sub>3</sub>), the second level is 40 kg per 1000 m<sup>2</sup> (T<sub>4</sub>), as well as the control treatment (T<sub>0</sub>). The second factor was spraying the alpha tocopherol with two levels. The first level is the spraying alpha tocopherol at concentration of 100 mg L<sup>-1</sup> (E<sub>1</sub>), the second level was spraying alpha tocopherol at concentration of 200 mg L<sup>-1</sup> (E<sub>2</sub>), in addition to the control treatment, which sprayed with distilled water only (E<sub>0</sub>).

Results showed the treatment T<sub>2</sub> traits superior in all vegetative growth of plant: height plant, number of branches, number of leaves, leaf area and dry weight of vegetative growth, Also excelled (T<sub>2</sub>) of the number of fruits, highest yield per plant and total yield, while the treatment T<sub>1</sub> gave highest of weight of the fruit. In addition, the foliar spraying of alpha tocopherol showed significant superiority in treatment (E<sub>2</sub>) in all traits of vegetative growth and yield characteristics.

Treatment T<sub>2</sub>E<sub>2</sub> gave the highest plant length (145.3 cm), greatest number of plant branches (16.84 branch Plant<sup>-1</sup>), highest number of leaves (138.7 Leaf Plant<sup>-1</sup>), largest leaf area (264.7 dcm<sup>2</sup>Plant<sup>-1</sup>), highest dry weight of vegetative growth (233.6 g Plant<sup>-1</sup>), highest number of fruits and highest yield per plant and total yield (40.55 fruit Plants<sup>-1</sup>, 3.99 kg Plants<sup>-1</sup> and 66.33 ton ha<sup>-1</sup> respectively). While treatment T<sub>1</sub>E<sub>2</sub> was superior by giving the highest fruit weight (111.8 g fruit<sup>-1</sup>). The suggestion could be that using cow manure (organic fertilizer) 30 ton ha<sup>-1</sup> and foliar spraying of alpha tocopherol in concentration 200 mg L<sup>-1</sup>, resulted in highest of vegetative growth and yield.

**Key words :** Alpha Tocopherol, Solanum lycopersicum, chemical fertilization.

## Introduction

Tomato (*Solanum lycopersicum* Mill.) belongs to the *Solanaceae* family is native to South America, one of the most consumed vegetables and is the second most important vegetable after potatoes in many countries of the world, as one of the most prominent and most vegetable crops are popular in the world for being highly nutritious, This is due to the fact that the fruit contains nutrients such as potassium and a number of acids such as ascorbic (vitamin C), citric, malic and vitamins such as vitamin E,

A and C and some phenolic compounds and contain some pigments such as carotene and lycopene (Gerszberg *et al.*, 2015). Plant production is largely dependent on soil fertility, which is the most important factor in increasing production, and the aim of the various agricultural operations is to maintain and try to improve and increase soil fertility, which is an important identification in many countries of the world (Souri, 2016). The addition of mineral fertilizer is one of the main and important methods to provide soils with important nutrients of the plant are

usually provided through mineral fertilizers, which are chemical combination that contain more than one nutrients and normally produced by chemical reactions (Ali, 2012). However, the addition of chemical fertilizer at high rates to the soil led to the emergence of some negative effects on health and the environment resulting from the remaining effects of nitrates, oxalates, sulfates, chlorides and phosphates. Efforts therefore have been focused on adopting the organic farming methods that has adopted soil conservation, treating the environmental degradation and producing healthy and safe food depending on organic manure instead of chemical fertilizers (AL-hassan, 2010). Organic fertilizer is very important in increasing plant production through its role in maintaining soil fertility and soil processing by suppling the major and minor nutrients necessary for plant growth. It also provides suitable environmental conditions for plant growth, such as improving soil structure, reducing its apparent density, increasing water retention and improving porosity, which helps plant roots grow properly, also providing the suitable environmental conditions for the microorganisms activity and supply them carbon and energy it needs during the process of metallization and reduce the pollution of heavy elements (Abu Rayan, 2010).

Due to the simultaneous flowering and production of tomato plants cultivated in open field with high temperatures, it has become necessary to work on the use of some techniques that increase the resistance of plants to environmental stresses, especially heat stress, and these techniques is the use of alpha tocopherol. Alpha tocopherol (vitamin E) is found in membranes rich in polyunsaturated lipids acids which is in form of a dissolved lipid, it can be found in different parts of plant and the chloroplast membranes is the most contained part of alpha tocopherol (Shao *et al.*, 2008). Alpha tocopherol have an important function in protect the system of photosynthesis. alpha tocopherol is one of the most important antioxidants lipid that play a protective role to cell membrane system, making it an important part of the plant defense mechanisms that maintain the normal function of the photosynthesis system (Rady *et al.*, 2011).

## Materials and Methods

A field experiment was carried out in the station (A) -Department of Horticulture and Gardening Landscape College of Agricultural Engineering Sciences, University of Baghdad- Al-Jadriya. In order to study the effect of organic, chemical fertilizers and spraying of alpha tocopherol on the growth and yield of tomato, The experiment included two factors, the first factor was used different types of fertilizers which included the cows

manure, Organic Fertilizer Manufacturer (Care Ball supermix), and chemical fertilizers As follows:

1. Control treatment (without fertilizer) T<sub>0</sub>.
2. The chemical fertilizers treatment was according to the recommendation N: 120, P<sub>2</sub>O<sub>5</sub>: 160 and K<sub>2</sub>O: 120 kg ha<sup>-1</sup> (Ali, 2012) it was added in two batches The first batch was after 14 days of planting and the second batch after 35 days of planting (T<sub>1</sub>).
3. The organic fertilizer treatment of the cows manure at 30 ton ha<sup>-1</sup>, added before planting (AL-kadhimi, 2017) (T<sub>2</sub>).
4. The Organic Fertilizer treatment (Care Ball supermix), 20 kg per 1000 m<sup>2</sup> (T<sub>3</sub>).
5. The Organic Fertilizer treatment (Care Ball supermix), 40 kg per 1000 m<sup>2</sup> (T<sub>3</sub>).

The Organic Fertilizer (Care Ball supermix) is granulated fertilizer, which was added for one time before planting on 30 cm depth from soil surfaces relying on the company recommendation 20-40 kg per 1000 m<sup>2</sup>.

The second factor was spraying the alpha tocopherol with two levels on two batches the first batch was after 21 days of planting and the second batch after 42 days of planting, as well as the control treatment, As follows:

1. First treatment was Control treatment sprayed with distilled water only (E<sub>0</sub>).
2. Second treatment was spraying alpha-tocopherol at concentration of 100 mg L<sup>-1</sup> (E<sub>1</sub>).
3. Third treatment was spraying alpha-tocopherol at concentration of 200 mg L<sup>-1</sup> (E<sub>2</sub>).

Factorial experiment was adopted according to a Randomized Complete Block Design RCBD with three replicates, each replicates include 15 treatments, to be 45 experimental units.

The Seeds were planted in cork dishes in 5/2/2018. The seedlings were then transferred to the field and planted in 23/3/2018 on rows which is length of 25 m and 1.5 m width with 45 experimental units. The drip irrigation system was used and seedlings were planted on one side of the drip lines.

## Parameters measured

**1. Characteristics of vegetative growth:** Five plants were selected randomly from each experimental unit. The measurements were taken and the average of each recipe was taken as follows:-

**Plant length (cm):** The lengths of plants were measured at the end of the season from soil surface to the end of longest plant branch by the metric measuring

**Table 1:** Chemical Properties of Organic Fertilizer Used (Cows manure).

Qualities	Unit	Value
EC	ds m <sup>-1</sup>	2.96
pH	.....	6.8
Total nitrogen	g kg <sup>-1</sup>	29.5
Total phosphor	g kg <sup>-1</sup>	13.2
Total potassium	g kg <sup>-1</sup>	21.7
Organic carbon	g kg <sup>-1</sup>	359
C/N	.....	12.17

The Analysis was in the laboratories of the Ministry of Science and Technology- Department of Environment and Water Treatment.

**Table 2:** The Components of the Organic Fertilizer Manufacturer (Care Ball supermix).

Component	The percentage
Total Organic Material	40%
Total free amino acid	5%
Total seaweed	3%
Humic acid	30%
Fulvic acid	10%

tape.

**Number of branches (branch plant<sup>-1</sup>):** The total number of branches of plants were calculated at the end of the season.

**Number of leaves (leaf plant<sup>-1</sup>):** The number of leaves were calculated at the end of the season.

**The leaf area (dcm<sup>2</sup> plant<sup>-1</sup>):** 30 discs were taken from the area of plant leaves and dried in an electric oven at 70°C until the stability of weight, the total dry weight of plant leaves was calculated for the purpose of calculating the leaves area according to the following equation;-

$$\text{Leaf area (dcm}^2\text{)} = \frac{\text{cross sectional area of discs} \times \text{total dry weight of leaves}}{\text{total dry weight of discs}}$$

**The dry weight of the plant (g plant<sup>-1</sup>):** The vegetative total was cut from its contact area with soil for five plants at the end of the season. It was dried in an electric oven at 70 °C until the weight was stable.

### Yield components

Number of fruits (fruit plant<sup>-1</sup>) was calculated by calculate the number of cumulative fruits of plants of the experimental unit for each harvesting and divided on the number of experimental unit plants.

**The weight of the fruit (g plant<sup>-1</sup>):** was calculated by calculate the cumulative harvesting and divided on the number of cumulative fruits.

**Plant yield (g plant<sup>-1</sup>):** calculated by taking the cumulative yield of experimental unit and dividing on the

number of plants.

**Total yield (ton ha<sup>-1</sup>):** The yield of experimental unit was calculated On the basis of the total yield of all experimental unit plants and ratios to hectare.

## Results and Discussion

Results of table 3 revealed the treatment of cows manure superior In all traits of vegetative growth on plant height (140.2 cm plant<sup>-1</sup>), number of branches (15.84 branches plant<sup>-1</sup>), number of leaves (127.6 leaf plant<sup>-1</sup>), leaf area (253.9 dcm<sup>2</sup>plant<sup>-1</sup>), dry weight of plant (216.6 g plant<sup>-1</sup>), Compared with control treatment which gave lower values for plant height (97.9 cm), number of branches (11.02 branch plant<sup>-1</sup>), number of leaves (85.5 and leaf plant<sup>-1</sup>), leaf area (148.9 dcm<sup>2</sup>plant<sup>-1</sup>) and dry weight of vegetative growth (129.8 g plant<sup>-1</sup>), In addition the results showed a significantly increase with foliar spraying of alpha tocopherol treatment (E<sub>2</sub>) in all traits of vegetative growth, plant length (124.2 cm, plant<sup>-1</sup>), number of branches (14.14 branch plant<sup>-1</sup>), number of leaves (114.7 leaf plants<sup>-1</sup>), leaf area (216.9 dcm<sup>2</sup> plant<sup>-1</sup>) and dry weight of vegetative growth (182.7 g plant<sup>-1</sup>), Comparison with the treatment E<sub>0</sub> (control treatment), which gave the lowest for the values for the plant length (111.2 cm plant<sup>-1</sup>), number of branches (11.78 branches), number of leaves (94.7 leaf plants<sup>-1</sup>), leaf area (190.3 dcm<sup>2</sup>plant<sup>-1</sup>) and the dry weight of the plant (157.8 g.plant<sup>-1</sup>).

The interaction between the experiment factors was significantly effect, the treatment T<sub>2</sub>E<sub>2</sub> gave the highest values in all traits of vegetative growth: plant length (145.3 cm plant<sup>-1</sup>) which was insignificantly differences with treatment T<sub>2</sub>E<sub>1</sub>, number of branches (16.84 branch plant<sup>-1</sup>), number of leaves (138.7 leaf plant<sup>-1</sup>), leaf area (264.7 dcm<sup>2</sup>plant<sup>-1</sup>) and the dry weight of vegetative growth (233.6 g plant<sup>-1</sup>) which was insignificantly different with treatment T<sub>2</sub>E<sub>1</sub>, compared with control treatment which gave lower values in all traits vegetative growth as the length of plant height (91.4 cm), number of branch (9.62 branch plant<sup>-1</sup>), number of leaves (76.4 leaf plant<sup>-1</sup>), leaf area (136.3 dcm<sup>2</sup>plant<sup>-1</sup>) and the dry weight of vegetative growth (112.7 g plant<sup>-1</sup>).

Results of table 4 revealed significantly differences in the treatment cow manure T<sub>2</sub> which superior in the number of fruits, which gave the highest values (37.44 fruits plant<sup>-1</sup>), compared with control treatment which recorded the lowest number (21.04 fruit plant<sup>-1</sup>) and yield plant (3.634 kg plant<sup>-1</sup>) compared with control treatment (1.882 g plant<sup>-1</sup>) and the total yield (60.517 ton ha<sup>-1</sup>) compared with control treatment (31.372 ton ha<sup>-1</sup>), while the chemical fertilizers treatment T<sub>1</sub> was characterized

**Table 3:** Effect of addition of organic and chemical fertilization and spraying of alpha tocopherol on the growth of tomato for the spring season 2018.

dry weight of vegetative growth (g plant <sup>-1</sup> )	leaf area (dcm <sup>2</sup> plant <sup>-1</sup> )	Number of leaves (leaf plant <sup>-1</sup> )	Number of branches (branches plant <sup>-1</sup> )	Plant height (cm plant <sup>-1</sup> )	Treatment
129.8	148.9	85.5	11.02	97.9	T <sub>0</sub>
186.2	244.4	120.8	14.79	130.0	T <sub>1</sub>
216.6	253.9	127.6	15.84	140.2	T <sub>2</sub>
157.6	171.1	93.2	11.55	105.8	T <sub>3</sub>
169.8	210.8	104.7	12.37	116.4	T <sub>4</sub>
4.58	1.75	1.39	0.32	2.92	LSD %5
157.8	190.3	94.6	11.78	111.2	E <sub>0</sub>
175.4	210.2	109.6	13.41	118.7	E <sub>1</sub>
182.7	216.9	114.7	14.14	124.2	E <sub>2</sub>
3.55	1.35	1.08	0.25	2.26	LSD %5
112.7	136.3	76.4	9.62	91.4	T <sub>0</sub> E <sub>0</sub>
135.2	152.8	87.2	11.28	95.5	T <sub>0</sub> E <sub>1</sub>
141.4	157.6	92.8	12.17	106.7	T <sub>0</sub> E <sub>2</sub>
174.8	233.2	106.7	13.40	122.7	T <sub>1</sub> E <sub>0</sub>
182.6	247.6	126.1	15.12	131.2	T <sub>1</sub> E <sub>1</sub>
201.3	252.3	129.5	15.86	136.1	T <sub>1</sub> E <sub>2</sub>
189.4	239.4	112.3	14.75	133.6	T <sub>2</sub> E <sub>0</sub>
226.9	257.8	131.9	15.92	141.8	T <sub>2</sub> E <sub>1</sub>
233.6	264.7	138.7	16.84	145.3	T <sub>2</sub> E <sub>2</sub>
145.7	158.6	82.3	9.94	97.8	T <sub>3</sub> E <sub>0</sub>
162.3	174.1	94.6	12.10	108.2	T <sub>3</sub> E <sub>1</sub>
164.8	180.7	102.7	12.61	111.5	T <sub>3</sub> E <sub>2</sub>
166.7	184.2	95.3	11.23	110.7	T <sub>4</sub> E <sub>0</sub>
170.1	218.7	108.5	12.67	117.2	T <sub>4</sub> E <sub>1</sub>
172.6	229.5	110.2	13.22	121.4	T <sub>4</sub> E <sub>2</sub>
7.94	3.02	2.41	0.56	5.05	LSD %5

by giving the highest average of the fruit weight (107.07 g plant<sup>-1</sup>) compared with the control treatment T<sub>0</sub> (89.60 g plant<sup>-1</sup>)

The spraying of alpha tocopherol was superior significantly on the number of fruits (30.32 fruit plant<sup>-1</sup>), fruit weight (100.52 g plant<sup>-1</sup>) plant yield (3.051 kg plant<sup>-1</sup>) and the total yield ( 50.822 ton ha<sup>-1</sup>) compared with control treatment E<sub>0</sub> which gave the lowest values (24.20 fruits plant<sup>-1</sup>, 93.54 g fruits<sup>-1</sup>, 2.274 kg plant<sup>-1</sup>, 37.911 ton ha<sup>-1</sup>, respectively).

The interaction showed superiority the cows manure with the spraying of the second level T<sub>2</sub>E<sub>2</sub> was giving highest number of fruits (40.55 fruit - plant<sup>-1</sup>), which was insignificantly with treatment of T<sub>2</sub>E<sub>1</sub> (39.34 fruit plant<sup>-1</sup>) and superiority of T<sub>2</sub>E<sub>2</sub> treatment in both plant yield and total yield (3.990 kg plant<sup>-1</sup>, 66.330 tons ha<sup>-1</sup>,

respectively) Compared with T<sub>0</sub>E<sub>0</sub>, which gave the lowest values of the varieties (18.66 fruit plant<sup>-1</sup>, 1.577 kg plant<sup>-1</sup> and 26.280 ton ha<sup>-1</sup>), while the T<sub>1</sub>E<sub>2</sub> treatment was significantly in the highest fruit weight (111.8 g plant<sup>-1</sup>) compared with treatment T<sub>0</sub>E<sub>0</sub> which gave the lowest rate (84.7 g. Fruit plant<sup>-1</sup>).

The results of the (Tables 3, 4) indicate the superiority of organic manure (cow manure) in vegetative and yield characteristics. This may be due to the role of organic fertilizers in improving the physical, chemical and biological properties of the soil as a result of the addition of the fertilizers of the cows' It has an important role as it is involved in many of the physiological processes and events which stimulate carbon metabolism, stimulate cell division and increase the plant height, number of leaves and their area (Abu Dahi and AL-younis, 1988). The reason is that organic matter contains carbon, which is a source of microorganism in the soil. When carbon is digested by it, CO<sub>2</sub>, which is soluble in water, is released as carbonic acid (as well as other acids resulting from organic matter decomposition) this reduces the soil pH (pH) of the soil so that the elements become more readily available (Adediram *et al.*, 2004). The high content of nitrogen for organic fertilizer has an important role in which nitrogen stimulates the plant to produce Auxins as well as the manufacture of proteins, which helps to stimulate the process of cell division and prolongation and thus increase in Plant height, also increases the manufacture of chlorophyll and increase photosynthesis and release the necessary energy for cell division and elongation (Taiz and Zeiger, 2006). The C/N in the cows manure was

more appropriate to decomposed the organic matter for a longer period during the growing season of the tomato, thus providing nutrients ready for absorption by roots plant and thus moves the plant to vegetative growth (Uzun *et al.*, 2007). The superiority of the treatment of the addition of the cow manure may be attributed to its role in providing the necessary elements and give the plant the ability to grow and production with good specifications and its role in increasing metabolism and transfer the carbohydrates manufactured in the leaves to storage places in the fruits (AL-Mharib *et al.*, 2015). The Organic fertilizer increases availability of essential nutrients (nitrogen, phosphorus and potassium) and increases its uptake by the plant, which has increased vegetative growth and increased the number of flower buds in the plant (Jahan, 2007). Organic fertilizer also process the plant continuously until the later stages of its growth with

**Table 4:** Effect of addition of organic and chemical fertilizers and spraying of alpha-tocopherol and their overlap in the indicators on yield of tomato for the spring season 2018.

Total yield (ton ha <sup>-1</sup> )	Plant yield (kg plant <sup>-1</sup> )	Wight fruit (g plant <sup>-1</sup> )	number of Fruit (Fruit plant <sup>-1</sup> )	Treatment
31.372	1.882	89.60	21.04	T <sub>0</sub>
52.962	3.178	107.07	29.73	T <sub>1</sub>
60.517	3.634	97.03	37.44	T <sub>2</sub>
38.648	2.319	96.37	24.07	T <sub>3</sub>
43.277	2.597	96.97	26.76	T <sub>4</sub>
2.44	0.15	6.47	1.59	LSD %5
37.911	2.274	93.54	24.20	E <sub>0</sub>
47.332	2.840	98.16	28.90	E <sub>1</sub>
50.822	3.051	100.52	30.32	E <sub>2</sub>
1.89	0.11	5.01	1.23	LSD %5
26.280	1.577	84.7	18.66	T <sub>0</sub> E <sub>0</sub>
32.667	1.960	90.3	21.88	T <sub>0</sub> E <sub>1</sub>
35.170	2.110	93.8	22.58	T <sub>0</sub> E <sub>2</sub>
45.220	2.713	101.6	26.82	T <sub>1</sub> E <sub>0</sub>
54.887	3.293	107.8	30.75	T <sub>1</sub> E <sub>1</sub>
58.780	3.527	111.8	31.63	T <sub>1</sub> E <sub>2</sub>
50.833	3.050	94.1	32.42	T <sub>2</sub> E <sub>0</sub>
64.387	3.863	98.4	39.34	T <sub>2</sub> E <sub>1</sub>
66.330	3.990	98.6	40.55	T <sub>2</sub> E <sub>2</sub>
31.503	1.890	93.6	20.25	T <sub>3</sub> E <sub>0</sub>
39.887	2.393	96.9	24.80	T <sub>3</sub> E <sub>1</sub>
44.553	2.673	98.6	27.17	T <sub>3</sub> E <sub>2</sub>
35.720	2.143	93.7	22.85	T <sub>4</sub> E <sub>0</sub>
44.833	2.690	97.4	27.77	T <sub>4</sub> E <sub>1</sub>
49.277	2957	99.8	29.67	T <sub>4</sub> E <sub>2</sub>
4.23	0.25	11.21	2.75	LSD %5

the necessary nutrients, which increases the strength of the Vegetative growth total and thus increase the efficiency of photosynthesis process, causing an increase in yield (Thuy *et al.*, 2017). The results It is noted that of spray alpha tocopherol have improved the vegetative growth rate and components of the tomato for his important role to protecting the membranes of plastids from light oxidation, which providing the appropriate environment for photosynthesis and increasing the accumulation of metabolic products. This helps to increase cell size, elongation ( Munne-Bosch and Algere, 2002). the alpha -tocopherol has a stimulating role in physiology processes, cell elongation and division, and increased vegetative growth compared with growth plants in non-treated with (AL-Tohamy and El-Greadly, 2007) alpha -tocopherol works to prevent increased free radicals

(ROS) in the plant by wiping the roots of the proxy Thyloquide membranes in the cell that maintain the integrity and conduct of Vital activities in the plant (Orabi *et al.*, 2015). It also works to protect plant tissues from toxic oxygen derivatives, which affect the effectiveness of many enzymes and reduce the damage caused by oxidative processes as it acts as an antioxidant and protection of cellular membranes and thus conduct metabolic processes correctly and increase the growth of vegetative and stimulate the process of carbon representation and increase the accumulation of metabolism and carbohydrates and storage In fruits, and increase plant yield, number of fruits and fruit weight (Pourcel *et al.*, 2007; Shao *et al.*, 2008)

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