



## Effect of Some Organic Fertilizer on Producing Tomato Crops under Protected Cultivation in the New Lands



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**T**HIS investigation was conducted under greenhouse conditions in the Abu Ghaleb area, Giza Governorate, Egypt, during two successful seasons of 2019 and 2020. The Rosalina F<sub>1</sub> tomato hybrid was used in this study to produce organic tomatoes. There were five treatments, chicken manure, plant compost, animal compost, chemical fertilizer and humic acid. The highest values of fruit weight were found with treatment of chicken manure, 83.6 and 78.3g, in seasons 2019 and 2020, respectively. While the plant compost treatment recorded the highest values of plant height, 120 and 118 cm, in seasons 2019 and 2020, respectively. The lowest values of unmarketable crop in 2019 was 83.30g/plant with plant compost treatment and 88.33g/plant in 2020 was with chicken manure treatment, while the highest values of unmarketable crop were found when treated with animal compost, 136 and 125g/plant, in seasons 2019 and 2020, respectively. With respect to N and Ca percentage, the highest concentrations were recorded with plant compost treatment, 0.52, 2.98% and 2.95 2.89% in 2019 and 2020, respectively. Regarding K%, the highest concentration was recorded with animal compost treatment, 4.2 and 4.66% in 2019 and 2020, respectively. The trait of firmness recorded highly significant values were recorded with chicken manure treatment, 0.36 lb/inch<sup>2</sup> in both seasons. It was found that total plant yield and marketable crop weight per plant recorded the highest values with chicken manure, 1736 and 1646g/plant (unmarketable crop weight per plant 90g) in season 2019, and 1628 and 1540g/plant (unmarketable crop weight per plant 88.3g) in season 2020, respectively. In most cases, no significant differences were realized between chicken manure and plant compost treatments. The lowest significant values of all measured parameters were achieved when tomato plants received chemical fertilizer or humic acid treatments.

**Keywords:** Tomatoes, Organic fertilizer, Protected cultivation and New Reclaimed Lands.

### Introduction

Tomato plant, a member of the family Solanaceae, it is considered as a dominant vegetable crop grown and widely consumed throughout the world. In addition, tomato fruits are particularly appreciated for their nutritional properties, resulting from their content of vitamins A, C, lycopene, flavonoids and other minerals that are

good for human health (Bhowmik et al., 2012, Akhtar and Hazra, 2013). Moreover, it has a special taste with diverse edible methods besides its significant importance in processed products across the globe. Tomatoes originated in Central and South America (including tropical, sub-tropical and temperate regions). It is the largest vegetable crop in the world next to potatoes.

In Egypt, tomatoes are cultivated in open fields and/or under greenhouse conditions. The cultivated area of tomatoes reaches 428,175 feddans, producing 6,751,856 tons with average productivity of 15.7 tons per feddan (FAOSTAT, 2019). The spread of soil pollution from traditional agriculture as a result of the residues of pesticides, fertilizers and industrial hormones has led to the reluctance of many consumers to purchase traditional agricultural products, especially with increasing environmental and health awareness among the public. Therefore, many countries in the world tend to switch to organic agriculture and reduce traditional agriculture. As explained by Rembiacowask (2004). Intensive and excessive use of traditional agrochemicals has the ability to have negative and harmful effects on the three elements of the environment (water, soil, and air). Besides, the excessive application of chemical fertilizer leads to food safety and quality decline problems, such as nitrate accumulation in vegetal products. Indeed, several studies have demonstrated that organic farming, which strictly prohibits synthetic fertilizers, provides an alternative that has the potential to minimize the negative influence from by using chemical fertilization, and the products from the organic farming systems are generally endowed with improved nutritional properties (Ye et al., 2020). Chemical fertilizers, when constantly added to the soil, work on various accumulations of desirable and undesirable elements in the soil and cause many side reactions that have negative effects on the environment. Also, the extensive use of these chemical fertilizers makes them precipitate with irrigation water and quickly see into the groundwater. Shuyan et al. (2017) studied the effect of organic fertilizers on the growth of tomatoes and found that organic fertilizers increase vegetable growth and quality. More recently, Shenglan et al. (2022) found that the application of organic fertilizers play an important role in improving soil properties, fruit quality, net photosynthesis, water used efficiency and nutritional quality of pear- jujube. In fact, The application of organic fertilizer can not only improve soil fertility (Nig, et al., 2016 and Li, et al., 2020) improve soil and chemical properties (Li, et al., 2021 and Zhou, et al., 2020) and enhance soil water storage capacity (Mi, et al., 2016 and Sebastiana, et al., 2006) but also effectively promote the vegetative growth and reproductive growth of the plant, thereby improving the quality of plants (Xu et al., 2021, Hou et al., 2018 and Yu et al., 2021).

With the importance of tomatoes as an important vegetable crop, and with the attempt to organically produce this crop. The idea of this research, was to focus on the cultivation of the tomato crop under greenhouse conditions with different sources of organic fertilizers, compared to traditional chemical fertilizers.

### **Materials and Methods**

The experiment was conducted under greenhouse conditions in the newly reclaimed sandy soil in the Abu Ghaleb area, Giza Governorate, Egypt, during both seasons of 2019 and 2020. The plastic houses used were

40m in length, 6 m in width, and 3.2m height. Each plastic house was divided into 5 planting lines each of 50 cm wide, 20 cm height where seedlings were planted 50cm apart. The plastic cover was a local-UV-treated polyethylene sheet of 7m in width and 180-200 microns in thickness. The house was equipped with two systems for irrigation, namely spaghetti drippers and overhead sprinklers. The drip irrigation system can deliver a given amount of water only, or water plus fertilizers throughout the day. The irrigation system was provided with valves.

#### *Plant material and planting in the nursery*

The Rosalina F<sub>1</sub> tomato commercial hybrid was selected for this study. This tomato hybrid is characterized by high fruit productivity and quality as fruit color and firmness when grown under greenhouses in terms of disease resistance. The hybrid seeds were planted in the nursery on 5/9/2019 for the first season and on 5/9/2020 for the second season. Then, after 35 days, on 10/10/2019 and 10/10/2020 the tomato seedlings were transplanted into the greenhouse.

#### *Soil preparation and treatments*

The soil is prepared as follows: part of the organic fertilizers under study were placed on the tranches and thoroughly mixed with the soil before transplanting. The remaining part of the organic fertilizers were added in batches every 25 days. The amount of nitrogen units in all fertilization treatments was constant. Chemical fertilizers were applied with water irrigation as a plant fertigation application through drip irrigation system.

#### *Treatments*

Five fertilizer treatments were applied:

1- Chicken manure (CK), 2- Plant compost (PL), 3- Animal compost (AN), 4 - Chemical fertilizer (CE), 5 - Humic acid (HU).

Chemical fertilizer (recommended doses of chemical fertilizers for tomato production under greenhouse conditions) was considered as a control treatment and consisted of fertilizer 20-20-20, urea and calcium nitrate. Also, humic acid treatment was supplied with urea and calcium nitrate as a source of nitrogen. Fertilizer 20-20-20 was used as a source of nitrogen for treatment with chemical fertilizers, in addition to calcium nitrate, and also with humic acid.

Using a soaked Chicken manure in the first age of the plant in the first addition, provided that a quantity of 2 kg of poultry manure is placed in a piece of sponge to facilitate its filtering and soak it in a barrel of 200 liters of water for 36 hours with stirring.

The infusion was taken after that and the plants were irrigated at a rate of 1 liter of the infusion twice a week at a rate of 1 liter per plant and this was done to the first addition of fertilizers after 25 days of transplanting part of Chicken manure was applied as compost tea. It was applied 2 times every week as 1 liter per plant, starting after 25 days from transplanting. Where, two kg of poultry manure were soaked in 200 liters of water for 36 hours with regular stirring.

### Measurements

#### Vegetative growth measurements

Five plant for each replicate were used for measuring

- 1- Plant height: The length of the stem (cm) is measured from the surface of the soil to the top of the plant at the age of 100 days after transplanting.
- 2- Number of leaves per plant: The number of leaves on a plant is measured at the age of 100 days after transplanting.
- 3- Leaves length: The blade length of the leaves (cm) is measured at the age of 100 days after transplanting. The blade length of the leaves is measured on leaf No. 6 from the bottom.
- 4- Stem thickness: The thickness of the stem (mm or cm) was measured at 120 days after transplanting using a clipper.
- 5- Leaf chlorophyll: The chlorophyll percentage is measured using a portable chlorophyll meter device (SPAD-502, Konica Minolta Sensing, Inc., Japan) in a unit of measurement SPAD at the age of 100 days after transplanting in the fifth leaf from the top of the plant.

**TABLE 1. The percentage of nitrogen in each fertilizer source was as follows:**

| Fertilizer source                  | N%          |
|------------------------------------|-------------|
| Chicken manure (CK)                | 2.29        |
| Plant compost (PL)                 | 1.01        |
| Animal compost (AN)                | 0.90        |
| Chemical fertilizer (control) (CE) | 20- 46 - 15 |
| Humic acid (HU).                   | 1.17        |

**TABLE 2. The Amount of fertilizers used during the season:**

| Type of fertilizer  | Amount of fertilizer  |
|---------------------|---|
| Chicken manure      | 1,08 kg   |
| Plant Compost       | 1,6 kg  |
| Animal Compost      | 2,7 k   |
| Chemical Fertilizer | 50 g of the chemical fertilizer 20:20:20 +Urea 8.6 g + Calcium Nitrate 33.3 g.                  |
| Humic Acid .        | 1g Humic Acid + 50 g of the chemical fertilizer 20:20:20 + Urea 8.6 g + Calcium Nitrate 33.3 g. |

6- Determining the percentage of nitrogen, phosphorous, potassium and calcium in the leaves. By taking the sixth leaf from top of the plant at the age of 80 days after transplanting.

#### *B-Fruit measurements*

1. The number of fruits per plant: The number of fruits on the plant were counted from the beginning of the harvest to the end of the season.
2. The average weight of the fruit: the weight of all harvested fruits was calculated (crop yield per plant), was divided by the number of fruits per plant to obtain the average weight of the fruit.
3. The total crop yield per plant: the total harvested fruits per plant (marketable and unmarketable) were weighed to obtain the plant yield (kg).
4. Marketable yield: The quantity of the total marketable yield was calculated in kg.
5. Unmarketable yield: The quantity of the total unmarketable yield was calculated in kg.
6. Hardness by lb/inch. The used device for firmness with fruit texture analyzer model GS-serial NO.FTA2.

7. Measure the percentage of vitamin C in fruits ml/100 g fresh. Measure the percentage of vitamin C in fruits ml/100 g fresh. By Nerdy (2018).

8. Measure of acidity in fruits %. By Stevens (2008).

9. Fruit color estimation by 1 sheet. col. ill., 22 x 28 cm. folded to 22 x 10 cm. (John Henry Co. 1975).

#### *C- Tomato leaves mineral content*

The percentage of N, P, K and Ca contents were determined in acid digested solution of dried tomato leaves samples on a dry weight basis Total nitrogen was determined using micro-kjeldahl method and Phosphorus was determined by Thermoscientific UV/VIS Spectrophotometer Model Evolution 300.. Whereas, K and Ca were determined by Atomic Absorption Spectrometer Thermoscientific – Model iCE 3000 Series. Chapman and Pratt (1962).

#### *Experimental design*

The data was analyzed and tabulated in a completely randomized sector system in three replications.

**TABLE 3. Completely randomized sectors in three replicates, each replicate has 5 plants.**

|            | Treatment |    |    |    |    |
|------------|-----------|----|----|----|----|
|            | CK        | PL | AN | CE | HU |
| Replicates | Border    |    |    |    |    |
|            | R1        | R3 | R2 | R3 | R1 |
|            | R2        | R2 | R1 | R1 | R2 |
|            | R3        | R1 | R3 | R2 | R3 |
|            | Border    |    |    |    |    |
|            |           |    |    |    |    |

**CK** = Chicken manure, **PL** = Plant Compost, **AN** = Animal Compost, **CE** = Chemical Fertilizer **HU** = Humic Acid .

**TABLE 4. Soil physical and chemical analysis of the experimental site.**

| Physical analysis     |          |          |         | Chemical analysis    |                               |                        |                    |
|-----------------------|----------|----------|---------|----------------------|-------------------------------|------------------------|--------------------|
| Sand (%)              | Silt (%) | Clay (%) | Texture | pH at 1: 2.5         | EC <sub>e</sub> (dS/m)        | CaCO <sub>3</sub>      | Organic matter (%) |
| 95.55                 | 3.73     | 0.72     | Sand    | 7.47                 | 3.70                          | *                      | *                  |
| Soluble Cations meq/l |          |          |         | Soluble Anions meq/l |                               | Available elements ppm |                    |
| Na+                   | Ca++     | Mg++     | K+      | Cl                   | HCO <sub>3</sub> <sup>-</sup> | N                      | K                  |
| 33.00                 | 2.15     | 2.95     | 0.34    | 34.80                | 2.65                          | 11.76                  | 24.29              |

Undetected

TABLE 5. Chemical analysis for irrigation water.

| TDS<br>(ppm) | EC <sub>w</sub><br>(dS/m) | CO <sub>3</sub> <sup>-</sup> | HCO <sub>3</sub> <sup>-</sup> | Cl   | SO <sub>4</sub> <sup>-</sup> | Ca <sup>++</sup> | Mg <sup>++</sup> | Na <sup>+</sup> | K <sup>+</sup> |
|--------------|---------------------------|------------------------------|-------------------------------|------|------------------------------|------------------|------------------|-----------------|----------------|
| 600          | 0.94                      | -                            | 3.30                          | 3.23 | 0.23                         | 4.40             | 3.00             | 3.20            | 0.46           |

*Statistical analysis*

All data were subjected to the statistical analysis of variance according to Snedecor and Cochran (1968). The least significant difference (L.S.D) Express the numbers using the Duncan test. It was employed to compare the significant differences among the means of treatments at ( $P \leq 0.05$ ) level of significance according to the procedures mentioned by Gomez and Gomez (1984).

**Results**

Data presented in Tables 6 and 7 showed the effect of using different organic fertilizers on the plant height, No. of leaves per plant, leaf blade length, stem thickness, number of fruits per plant and the average fruit weight of tomato plants during the seasons of 2019 and 2020.

The highest values of tomato leaf blade length, stem thickness and average fruit weight re-obtained with the treatment of chicken manure, 34.6 cm, 0.53 mm and 83.6g, respectively. Plant compost treatment recorded the highest values of plant height, No. of leaves per plant, and number of fruits per plant, 120 cm, 23, and 23, respectively. The lowest values of the plant height, No. of leaves per plant, leaf blade length, stem thickness, number of fruits per plant and average of fruit weight were recorded with both treatments of humic acid and chemical fertilizer. These findings were true in the first season. In the second season of 2020, chicken manure recorded the highest values of leaf blade length, stem thickness, number of fruits per plant and average of fruit weight. However, the lowest values were found with chemical and humic treatments. Tao et al. (2022) found that the use of chicken manure significantly increased fruit yield and fruit quality (represented by the organic function index) by 43 and 23%, respectively, as compared to the non-use of manure. Also, Chinyere and Chukwuma (2015) found that the application of 10 tons per hectare of poultry manure was better in both growth factor and yield, while the plants in the control plots gave the lowest performance.

In the same regard, the highest values of plant height and No. of leaves per plant were found with plant compost treatment. On the other hand, the lower values of plant height, No. of leaves per plant, leaf blade length, stem thickness, number of fruits per plant and average fruit weight were recorded with humic acid treatment. In fact, no significant difference was detected between chicken manure and plant compost treatments. In addition, no significant differences effect was realized between humic and chemical fertilizer treatments.

Data presented in Tables 8 and 9 showed the results of the total plant yield, marketable yield, unmarketable yield, fruit firmness, total acidity and vitamin C content of tomato fruits in the 2019 and 2020 seasons. It was found that total plant yield and marketable yield, fruit firmness, total acidity and vitamin C were in favor of the chicken manure treatment. The effect of chicken manure was significant in both seasons of the study. On the other hand, the lowest values of unmarketable yield in 2019 were 83.3 g with plant compost treatment and 88.3 g in 2020 with chicken manure treatment, while the highest values of unmarketable yield were found when tomato plant treated with animal compost, and this trait is undesirable in tomato crop production.

The total plant yield, marketable yield and vitamin C content showed the lowest values when using the Humic acid treatment in both seasons. The trait of fruit firmness recorded highly significant values with chicken manure treatment 0.36 lb/inch<sup>2</sup> in both seasons. Total acidity was almost not significant among all treatments. This results were coincided with Tao et al. (2022), Chinyere and Chukwuma (2015) and Al-Dairi et al. (2021).

Finally, the results shown in Tables 10 and 11 showed the nutrient contents in tomato leaves such as nitrogen, phosphorous, potassium and calcium as well as leaf chlorophyll SPAD reading and fruit color parameters. The highest values



**TABLE 6.** The effect of different organic fertilizer treatments on plant height, No. of leaves per plant, leaf blade length, stem thickness, number of fruits per plant and average fruit weight of tomato plants in the first season of 2019.

| Treatments | Plant height<br>cm | No. of leaves<br>per plant | Leaf blade<br>length cm | Stem thickness<br>mm | Number of<br>fruits per plant | Average<br>fruit weight g |
|------------|--------------------|----------------------------|-------------------------|----------------------|-------------------------------|---------------------------|
| CK         | 114.00 a           | 21.67 ab                   | 34.67 a                 | 0.53 a               | 19.33 ab                      | 83.67 a                   |
| PL         | 120.67 a           | 23.00 a                    | 25.00 b                 | 0.47 ab              | 23.33 a                       | 67.33 b                   |
| AN         | 103.33 b           | 20.00b c                   | 29.00 ab                | 0.43 ab              | 18.00 ab                      | 68.00 b                   |
| CE         | 103.33 b           | 19.00 c                    | 25.67 b                 | 0.37 ab              | 18.00 ab                      | 67.00 b                   |
| HU         | 99.33 b            | 18.33 c                    | 25.00 b                 | 0.33 b               | 13.67 b                       | 70.00 b                   |

CK = Chicken manure, PL = Plant Compost, AN = Animal Compost, CE = Chemical Fertilizer  
 HU = Humic Acid .

**TABLE 7.** The effect of different organic fertilizer treatments on plant height, No. of leaves per plant, leaf blade length, stem thickness, number of fruits per plant and average fruit weight of tomato plants in the second season of 2020.

| Treatments | Plant height<br>cm | No. of leaves<br>per plant | Leaf blade<br>length cm | Stem thickness<br>mm | Number of<br>fruits per plant | Average fruit<br>weight g |
|------------|--------------------|----------------------------|-------------------------|----------------------|-------------------------------|---------------------------|
| CK         | 112.33 ab          | 22.67 ab                   | 35.67 a                 | 0.57 a               | 19.33 a                       | 78.33 a                   |
| PL         | 118.33 a           | 21.33 ab                   | 30.33 ab                | 0.53 ab              | 17.67 b                       | 74.33 ab                  |
| AN         | 115.33 a           | 23.67 a                    | 31.00 ab                | 0.47 ab              | 18.00 ab                      | 67.67 bc                  |
| CE         | 103.00 b           | 20.33 b                    | 25.00 b                 | 0.43 b               | 17.00 b                       | 64.00 bc                  |
| HU         | 98.00 ab           | 20.33 b                    | 25.67 b                 | 0.43 b               | 15.33 c                       | 67.33 c                   |

CK = Chicken manure, PL = Plant Compost, AN = Animal Compost, CE = Chemical Fertilizer,  
 HU = Humic Acid .

**TABLE 8.** The effect of different organic fertilizer treatments on plant total yield, marketable yield, unmarketable yield, fruit firmness, total acidity and vitamin C content in the first season of 2019.

| Treatments | Plant total<br>yield g | Marketable<br>yield<br>g | Unmarketable<br>yield<br>g | Fruit firmness<br>lb/inch <sup>2</sup> | Total<br>acidity | Vitamin C<br>ml/100 fresh<br>wt |
|------------|------------------------|--------------------------|----------------------------|--|------------------|---------------------------------|
| CK         | 1736.67 a              | 1646.67 a                | 90.00 d                    | 0.36 a                                 | 0.64 a           | 29.00 a                         |
| PL         | 1673.33 a              | 1586.67 ab               | 83.3 d                     | 0.27 b                                 | 0.63 a           | 28.00 ab                        |
| AN         | 1393.33 ab             | 1256.67 bc               | 136.67 a                   | 0.29 b                                 | 0.62 a           | 28.00 ab                        |
| CE         | 1346.67 ab             | 1248.33 bc               | 98.33 c                    | 0.30 b                                 | 0.62 a           | 26.00 b                         |
| HU         | 1090.00 b              | 983.33 c                 | 106.67 b                   | 0.31 b                                 | 0.63 a           | 26.00 b                         |

CK = Chicken manure, PL = Plant Compost, AN = Animal Compost, CE = Chemical Fertilizer,  
 HU = Humic Acid.

of P and leaf chlorophyll reading were recorded with chicken manure treatment, 0.32 % and 54.6 SPAD and 0.45 % and 53.6 SPAD in 2019 and 2020, respectively. Plant compost treatment gave the highest N and Ca% of 0.52, 2.98%, and 2.95, 2.89% in 2019 and 2020, respectively. Regarding, K %, the highest concentrations were recorded with animal compost treatment, 4.2 and 4.66% in 2019 and 2020, respectively. Also, the obtained results showed that chicken manure treatment recorded significant differences for P and leaf chlorophyll reading, while nitrogen and calcium percentage were significant with plant compost treatment. However, potassium percentage was significant with animal compost treatment. In contrast, the fruit color parameter showed no significant among all fertilizer treatments in both seasons of cultivation. Except in the first season significant differences were detected only between chicken manure treatment and the rest treatments.

### Discussion

This study was conducted on sandy soil, which is capable of quickly draining excess water but cannot hold significant amounts of water or nutrients for the grown plants. The increase in growth and yield of tomato crop in the present study due to the application of organic and inorganic fertilizers was a result of the increase in nutrient status of the substrate because of the applied nutrients leading to absorption, hence significant improvement in growth, yield leaf nutrient concentration and fruit mineral levels of tomato crop. Chicken manure fertilizer is higher in nitrogen and also contains a good amount of potassium and phosphorus. Several workers have reported that organic manure can be potentially beneficial for soil physical, chemical and biological properties which positively enhance plant growth and productivity as well as maintain soil fertility (Hou et al., 2018 and Zhou et al., 2020).

**TABLE 9.** The effect of different organic fertilizer treatments on plant total yield, marketable yield, unmarketable yield, fruit firmness, total acidity and vitamin C content in the second season of 2020.

| Treatments | Plant total yield g | Marketable yield g | Unmarketable yield g | Fruit firmness lb/inch <sup>2</sup> | Total acidity | Vitamin C ml/100 fresh wt |
|------------|---------------------|--------------------|----------------------|-------------------------------------|---------------|---------------------------|
| CK         | 1628.33 a           | 1540.00 a          | 88.33 d              | 0.36 a                              | 0.65 a        | 30.00 a                   |
| PL         | 1435.00 ab          | 1330.00 ab         | 105.00 c             | 0.31 c                              | 0.62 a        | 30.00 a                   |
| AN         | 1330.00 ab          | 1205.00 ab         | 125.00 a             | 0.33 b                              | 0.61 a        | 29.00 b                   |
| CE         | 1205.00 ab          | 1096.67 ab         | 108.33 bc            | 0.31 c                              | 0.60 a        | 28.00 c                   |
| HU         | 1126.67 b           | 1013.33 b          | 113.33 b             | 0.33 b                              | 0.63 a        | 28.00 c                   |

CK = Chicken manure, PL = Plant Compost, AN = Animal Compost, CE = Chemical Fertilizer, HU = Humic Acid.

**TABLE 10.** The effect of different organic fertilizer treatments on the percentage of N, P, K, Ca, leaf chlorophyll reading and fruit color in the first season of 2019.

| Treatments | Leaves N % | Leaves P % | Leaves K % | Leaves Ca % | Leaf chlorophyll SPAD reading | Fruit color |
|------------|------------|------------|------------|-------------|-------------------------------|-------------|
| CK         | 0.32 ab    | 0.40 a     | 4.11 a     | 2.85 ab     | 54.67 a                       | 5.67 a      |
| PL         | 0.52 a     | 0.31 ab    | 3.35 b     | 2.98 a      | 52.33 b                       | 5.00 b      |
| AN         | 0.42 ab    | 0.35 ab    | 4.20 a     | 2.54 c      | 51.00 bc                      | 5.00 b      |
| CE         | 0.22 b     | 0.20 c     | 2.30 d     | 2.62 c      | 50.00 c                       | 5.00 b      |
| HU         | 0.32 ab    | 0.25 bc    | 2.98 c     | 2.75 bc     | 51.33 bc                      | 5.00 b      |

CK = Chicken manure, PL = Plant Compost, AN = Animal Compost, CE = Chemical Fertilizer, HU = Humic Acid.

**TABLE 11. The effect of different organic fertilizer treatments on the percentage of N, P, K, Ca, leaf chlorophyll reading and fruit color in the second season of 2020.**

| Treatments | Leaves N % | Leaves P % | Leaves K % | Leaves Ca % | Leaf chlorophyll SPAD reading | Fruit color |
|------------|------------|------------|------------|-------------|-------------------------------|-------------|
| CK         | 2.73bc     | 0.45 a     | 4.21b      | 2.13b       | 53.67 a                       | 5.67a       |
| PL         | 2.95a      | 0.21 c     | 2.98c      | 2.89a       | 52.67 a                       | 5.33a       |
| AN         | 2.95a      | 0.36 b     | 4.66a      | 2.31b       | 53.33 a                       | 5.33a       |
| CE         | 2.87ab     | 0.24 d     | 1.65e      | 3.02a       | 50.67 b                       | 5.00a       |
| HU         | 2.58c      | 0.26 d     | 2.06d      | 2.95a       | 53.00 a                       | 5.00a       |

CK = Chicken manure, PL = Plant Compost, AN = Animal Compost, CE = Chemical Fertilizer, HU = Humic Acid.

Chicken manure has been used for decades as an organic fertilizer for growing a wide range of vegetables (Abo-Sedera *et al.*, 2016, Alhroust *et al.*, 2016, Shaheen *et al.*, 2016 and Pokhrel *et al.*, 2017) and for reducing plant disease incidence and severity or suppressing soil borne diseases (Koné *et al.*, 2010 and Santos *et al.*, 2011). Moreover, part of the chicken manure fertilizer was applied as compost tea. It is well known that compost tea is a rich source of available nutrients. Various liquid manures or their extracts are also known to serve primarily as a source of soluble plant nutrients, growth stimulants and disease suppressors. Shaban and Fazeli-Nasab (2015) reported that compost tea is a highly concentrated microbial solution produced by extracting beneficial microbes from compost that is intended to increase microbial population densities during production.

The concluded data also indicated that plant compost recorded the highest values of most growth parameters as chicken manure. It is known that the application of organic compost improves soil physical and chemical characteristics. In addition, improvements in yield and quality following application of these organic-based substances have been attributed to an enhancement of the beneficial microbial communities in soil, an improvement of mineral absorption conditions for plants, and stimulation of defense compounds, growth regulators or phytohormones in plants (Pujiastuti, *et al.*, 2020 and Zhang, *et al.* 2021).

In contrast, data exhibited that the lower values of vegetative growth parameters were found with chemical fertilizer and humic acid treatments and these may be attributed to the soil

texture under study (soil sandy). Sandy soils are often considered as soils with physical properties easy to define: weak structure or no structure, poor water retention properties, high permeability and poor cation exchange capacity as reported by (Bockhem *et al.*, 2020). In case, chemical fertilizer, most of the nutrients were leached in sand soil with drainage water. Therefore, the growth parameters were low with chemical fertilizer. Umoh *et al.* (2018) reported that coastal Plain Sand, Sandstone and Basaltic Soil with high sand content exhibits highest amount of K leaching compared to shale, alluvium and basement complex with high clay content. In addition, Eslami *et al.* (2018) found that approximately 84% and 88% of the  $\text{NH}_4^+$  and  $\text{K}^+$  of soils fertilized with chemical fertilizers were lost during the experiment, respectively. Regarding humic acid, it is very poor in nutrients and so the growth parameters are also low under sandy soil. Nyoman Rupiasih and Vidyasagar (2005) reported that humic substances contain carbon, hydrogen, oxygen and nitrogen with small amounts of sulfur and phosphorus. Ghabbour and Davis (2004) added that analysis of a wide variety of humic substances (HS) shows that the percentage composition of C, O, H and N varies in the range as follows: C (45-60), O (25-45), H (4-7), N (2-5) and inorganic elements (ash) 0.5-5.

### Conclusion

Under sandy soil conditions, the overall suggestion is that using chicken manure and chicken manure tea or plant compost as an organic fertilizer led to a significant increase in the vegetative growth and fruit yield as well as fruit quality attributes of tomato plants grown under protected cultivation.



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### Conflicts of Interest

The author declares that there are no conflicts of interest related to the publication of this study.

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## تأثير بعض الاسماد العضوية في إنتاج محاصيل الطماطم تحت الزراعة المحمية في الأراضي الجديدة

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تم إجراء هذه التجربة تحت ظروف الصوب البلاستيكية في منطقة أبو غالب ، محافظة الجيزة ، مصر ، في خلال موسمين ناجحين لعامي ٢٠١٩ و ٢٠٢٠ . تم استخدام هجين الطماطم Rosalina F1 في هذه الدراسة لإنتاج الطماطم العضوية. كان هناك خمس معاملات هي :سماد الدواجن والسماد الكمبوست النباتي والسماد الكمبوست الحيواني والأسمدة الكيماوية والهوميك اسد . تم الحصول على أعلى قيم لطول الورقة وسمك الساق ووزن الثمار مع معاملة سماد الدجاج ٣٤,٦ سم و ٠,٥٣ سم و ٨٣,٦ جم على التوالي. بينما سجلت معاملة سماد الكمبوست النباتي أعلى قيم لارتفاع النبات وعدد الأوراق وعدد الثمار ١٢٠ سم و ٢٣ و ٢٣ على التوالي. وكانت أقل قيم للمحصول غير القابل للتسويق في عام ٢٠١٩ هي ٨٣,٣٠ جرامًا بمعاملة سماد الكمبوست النباتي وهي ٨٨,٣٣ جرامًا في موسم ٢٠٢٠ . كانت معاملة سماد الدواجن ، بينما تم العثور على أعلى قيم للمحصول غير القابل للتسويق عند معاملة سماد الكمبوست الحيواني ، وهذه الصفة غير مرغوب فيها في محصول الطماطم. أدى تطبيق سماد الدواجن إلى أعلى قيم لقراءات الفوسفور 0.32 SPAD % و ٥٤,٦ في ٢٠١٩ و ٠,٤٥ % و ٥٣,٦ في موسم ٢٠٢٠. وفيما يتعلق بنسبة النيتروجين والكالسيوم ، سجلت أعلى التركيزات مع معاملة سماد الكمبوست النباتي ٠,٥٢ و ٢,٩٨ % و ٢,٩٥ و ٢,٨٩ % في ٢٠١٩ و ٢٠٢٠ على التوالي. فيما يتعلق بالبوتاسيوم، تم تسجيل أعلى تركيز بمعالجة السماد الحيواني ، ٤,٢ % و ٤,٦٦ % في عامي ٢٠١٩ و ٢٠٢٠ على التوالي. اما صفة الصلابة سجلت قيم معنوية عالية وقد سجلت مع معاملة سماد الدواجن ٠,٣٦ رطل / بوصة في كلا الموسمين. ووجد أن إجمالي محصول النبات ووزن المحصول القابل للتسويق لكل نبات سجل أعلى القيم مع سماد الدواجن ١٦٧٣ و ١٥٨٦ جم (وزن المحصول غير القابل للتسويق للنبات ٨٧ جم) في موسم ٢٠١٩ و ١٦٢٨ و ١٥٤٠ جم (وزن المحصول غير القابل للتسويق لكل نبات ٨٨ جم) في موسم ٢٠٢٠ ، على التوالي. في معظم الحالات ، لم تظهر فروق ذات دلالة إحصائية بين سماد الدواجن ومعاملات السماد الكومبست النباتي. تم تحقيق أقل القيم المعنوية لجميع المعاملات المقاسة لنباتات الطماطم عندما معاملاتها بالأسمدة الكيماوية أو معاملاتها بحمض الهوميك.