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REPLACING CHEMICAL FERTILIZER WITH COW MANURE FERTILIZER FOR SUMMER TOMATO PRODUCTION IN EL-ARISH REGION

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ABSTRACT

At the Experimental Farm of Environmental Agricultural Sciences Faculty, Arish University, North Sinai, Egypt, a field study was carried out during two summer seasons of 2021 and 2022. The aim of this study was studying how tomato plants (*Solanum Lycopersicon* L.) respond if organic fertilizer utilized in El-Arish area instead of chemical fertilizer. In both seasons, "GS12 F1" tomato seedlings were transplanted on April 9. The experimental unit had a drip irrigation system and was 12 m^2 in area (10 m in length and 1.2 width), organic fertilizer was cow manure. The study employed five alternative treatments of recommended chemical (RCF) and recommended organic fertilizers (ROF) with replacing the RCF with equivalent part of organic fertilizer. The highest values of vegetative growth traits, fresh weight, dry weight, marketable yield, and the lowest unmarketable yield of tomato were not significantly different among the treatments of 0.0% of RCF + ROF + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer) applied in both seasons, 25% of RCF + ROF with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer), 50% of RCF + ROF+50% of recommended RCF (equivalent for 50% of chemical fertilizer as organic fertilizer), and 75% of RCF+ROF+25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer).

INTRODUCTION

Tomatoes are a necessary component of the human diet since they are a strong provider of vitamins and minerals. According to **Adekiya and Ojeniyi (2002)**, tomatoes need nutrients (N, P, K, Mg, Ca, *etc*.) that must be provide to plants in the proper proportion for healthy growth and reproduction. To increase the yields of different field crops, high quantities of chemical fertilizers and pesticides are employed today. Chemical fertilizers reduced the soil fertility increase soil problems including salinity and had negative effect on consumer health. Thus, interest in using organic manure has been stimulated. To satisfy crop needs, the soil's natural stocks of plant nutrients release too slowly. According to **Chen (2006),** nutrients supply already present in the soil. Maintaining fertile soil is necessary for long-term sustainable crop productivity since it is vital for higher crop yield.

Improved nitrogen use efficiency and micro-and macronutrient recovery may have led to tomatoes growing and producing more successfully. According to **Reddy *et al.* (2000),** organic manure not only replenishes the soil's organic matter content but also provides plant nutrients. **Moral *et al*. (2005)** provided evidence for the significance of soil organic matter for crop productivity and long-term soil fertility**.** Organic manures are suitable for use as fertilizers because they contain a significant amount of organic matter, nitrogen, and other plant nutrients

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(**Cayuela *et al.*, 2008)**. Significant levels of minerals, organic matter, and a range of micronutrients are present in organic fertilizer, particularly that made from animal manure. Using organic manure instead of simply chemical fertilizers could increase soil quality and is beneficial for the environment's preservation. In order to preserve soil fertility, **Olatunji and Oboh (2012)** reported that there is an increasing interest in applying organic manure in the right way. Additionally, **Schoebitz and Vidal (2016)** pointed out that an integrated strategy for optimum nutrient utilization that makes use of both organic manures and inorganic fertilizers raises the effectiveness of chemical fertilizers while reducing nutrient losses. According to study by **Loss *et al.* (2019)**, the addition of mineral fertilizers often intensifies this effect since higher crop phytomass production results in the addition of total organic manure (TOC) to the soil in the form of straw and roots. Application of animal dung induces a rise in TOC content that has both immediate and long-term impacts. When the manure has a high dry matter content and greater C: N ratio, as found in poultry litter, deep litter, and cattle dung, as well as in organic compounds, a larger increase in TOC is anticipated. The use of manure considerably increases the microbial population, but has little to no impact on the edaphic mesofauna. The main reasons why manure application promotes biological activity are increased soil organic matter and soil aeration. Compared to using exclusively chemical fertilizers for environmental preservation, this is more profitable.

Because manure application increases soil organic matter and enhances soil aeration, it encourages biological activity. Profitable compared to using only chemical fertilizers to protect the environment. Additionally, combining chemical and organic fertilizers increases fertilizer efficiency (**Xu *et al.*, 2008)**. To maintain crop yields without reducing soil fertility, **Ali *et al.* (2009)** suggested that a balance between the use of organic manure and chemical fertilizers is essential. The balanced release of nutrients and a decrease in nitrogen loss are made possible by the application of blended organic manure and inorganic fertilizers as a total basal dressing **(Liu *et al.*, 2008). Pan *et al.* (2009)** found that mixing inorganic and organic fertilization boosted soil carbon storage while reducing the emissions caused by nitrogen fertilizer use. The highest tomato fruit production was observed when commercial organic manure (matured pig manure) was applied combined with chemical fertilizer, according to experimental research on tomatoes conducted by **Lu *et al.* (2011)**. Marketable vegetable crop yields may be achieved if commercial organic manure is used in place of chemical fertilizers. When compared to the use of chemical fertilizer, commercial organic manure application is recognized as an effective method to meet the nutritional need and maintain tomato productivity. Comparing the effects of organic and inorganic fertilization on the yield and quality of processed tomatoes, **Bilalis *et al.* (2018)** found that inorganic fertilization led to the highest fruit production (168.0 t ha^{-1}), average fruit weight (63.6 g), and fruit number per plant (98.5). For long-term soil health in sustainable agriculture, a combination of chemical and organic fertilizer application is essential.

Therefore, the purpose of this study was to investigate whether tomato production and development in El-Arish were affected by the use of organic fertilizers as an alternative to chemical ones.

MATERIALS AND METHODS

This study was carried out at Arish University's Experimental Farm of Environmental Agricultural Sciences over the two summers of 2021 and 2022. The goal of this study was to find out how tomato plants [*Solanum Lycopersicon* L.] growth and yield would change when chemical fertilizers were totally or partially replaced with organic fertilizers under El-

Arish soil conditions. The soil used in the experiment had a sandy loam texture, a pH of 8.11, EC of 1.04, 19.78% $CaCaO_3$, and an organic matter content of 0.156%. Irrigation water was obtained from underground well in the experimental farm with EC of 5.93 which is high saline water. Cow manure was taken (fully decomposed) from a private farm in El Arish city and utilized as organic fertilizer.

In both seasons on April 9, tomato seedlings of the hybrid "GS12 F1" were transplanted. Drip irrigation system was used, each plot had one dripper line, and one row of plants. Plants in the same row were separated by 50 cm between each other and by 1.2 m between dripper lines. The experimental unit area was 12 m^2 (10 m length and 1.2 m width). 1.67 plants per square meter were planted. Along with the soil preparation, organic fertilizer was added. Chemical fertilizers should be supplied directly to the soil after soil preparation (20 kg N, 45 kg P_2O_5, 20 kg K_2O), but drip irrigation should be used to add the recommended weekly dose of 100 kg N, 15 kg P_2O_5, and 100 kg K_2O for seedlings that have already been planted.

Treatments and Experimental Designing

The experiment includes the five treatments listed below to replace chemical fertilizers with organic ones: The study employed five alternative treatments: 1) 100% of recommended chemical fertilizer (100kgN of ammonium sulphate fertilizer, 60kg P_2O_5 of agricultural phosphoric acid 38%, and 100kg K_2O of potassium sulphate fertilizer) + recommended organic fertilizer (20m^3 of cow manure fertilizer); 2) 75% of recommended chemical fertilizer + recommended organic fertilizer plus 25% recommended chemical fertilizer (equivalent for 25% of chemical fertilizer as organic fertilizer), 3) 50% of recommended chemical fertilizer + recommended organic fertilizer plus 50% of recommended (equivalent for 50% of chemical fertilizer as organic fertilizer); 4) 25% of the recommended chemical fertilizer plus recommended cow manure with 75% of recommended chemical fertilizer (equivalent for 75%% of chemical fertilizer as organic fertilizer), and 5) 0.0% of the recommended chemical fertilizer plus recommended cow manure plus 100% of the recommended chemical fertilizer (equivalent for 100% of chemical fertilizer as organic fertilizer. With preparing soil all organic fertilizer was added in addition to 20kg of chemical N fertilizer and 20kg of chemical K2O chemical fertilizer. The rest portion of chemical fertilizers was added twice a week as fertigation with irrigation. A complete randomized block design with three replicates was used to arrange the treatments. The typical agricultural procedures were carried out as they are frequently in El-Arish region.

Data Collected

Growth parameters of plants

After 60 days of transplanting, three plants at random from each experimental plot were picked, and the following traits were recorded:

Plant height (cm)

Plant height was measured from the lowest point on the plant's base to its highest point.

Number of Leaves and Branches Per Plant

Plant leaf area index

Leaf surface area per plant was calculated according to the method described by **Ackley (1964).**

Fresh weight and dry weight of stem, leaves, branches and total fresh weight of shoot.

Tomato plant samples were oven dried at 70°C until their weight remained constant to determine the dry weight of branches, leaves, and other plant parts. Next, the total dry weight was calculated (Mg g^{-1} fw).

The quantity of leaf photosynthetic pigments (mg g^{-1} fw)

a) Chlorophyll a and chlorophyll b.

b) Carotenoids.

Five leaf discs from the fifth leaf closest to the plant's apex were taken off 60 days after transplantation and extracted using 5 ml of N-dimethylformamide. The procedure outlined by **Moran (1982**) was used to extract and determine the quantity of chlorophyll a, b, and carotenoids.

Fruit Yield

Marketable and unmarketable yield

At the end of the experiment, fruits from each picking were counted and weighed, and the following data was calculated:

a. Fruits that offer a marketable yield (in grades A and B), as grade A fruit weighed more than 70g.

b. Unmarketable yield resulting from physiological disorders.

Statistical Analysis

The gathered data were statistically analyzed using the variance analysis method developed by **Snedecor and Cochran in 1980**, and means separation was performed using **Duncan's procedures in 1955** at the 0.05 level.

RESULTS AND DISCUSSION

Effects of Using Cow Manure Instead of Chemical Fertilizers

Vegetative growth

The results showed that partially replacing chemical fertilizers with organic manure increased all measured vegetative growth parameters including plant height, the number of leaves and leaf area per plant, significantly changed (Table 1).

The highest value for each of plant height and the number of leaves per plant in the first season was obtained with the application of 0.0% recommended chemical fertilizer + 100% recommended organic cow manure treatment, with no significant variations within other treatments. For plant height and the number of leaves per plant in the first season, the highest values were obtained with the application of 25% chemical fertilizer + 75% organic cow manure in both seasons, 50% chemical fertilizer + 50% organic cow manure, and 75% chemical fertilizer + 25% organic cow manure. For plant height in the second season only, there were no significant differences between 50% chemical fertilizer + 50% organic cow dung.

An improvement in the biological, physical, and chemical properties of the soil as well as organic manure decreased the effect of salinity of irrigation water (used for irrigation) may be the cause of the improvement in all examined parameters that followed the application of organic cow manure to the desired result. **Saha *et al.* (2008**) found that using organic manures alongside inorganic fertilizers improved soil organic matter (SOM), soil structure, water holding capacity, and nutrient cycling while preserving soil nutrient status, cation exchange capacity (CEC), and biological activity. **Hepperly *et al*. (2009)** noted that although chemical fertilizers are an essential input to boost agricultural productivity, a strong reliance on them can result in significant issues with the soil, such as soil degradation, as well as long-term losses in various soil properties and crop yields. A sustainable method for efficient nutrient utilization, according to **Schoebitz and Vidal (2016**), is the integrated use of inorganic fertilizers and organic manures. This strategy maximizes the effectiveness of chemical fertilizers while reducing nutrient losses.

Plant fresh weight

Cow manure fertilizer treatments had a pronounced impact on all of the plant fresh weight characters that were examined, including leaves, branches, and total shoot fresh weight (leaves and branches/plant) (Table 2). The highest results were obtained with the administration of 0% chemical fertilizer+100% organic fertilizer treatment

Table 1. Effect of replacing chemical fertilizers with organic cow manure on some vegetative development parameters of tomato plant after 60 days following transplanting in the 2021 and 2022 seasons

Parameter / Treatment	Plant height (cm)	No. leaves/ plant	No. branches/ plant	Leaf area/ plant (m^2)
		First season (2021)		
T1	71.22b	75.00b	10.11a	1.351d
T2	73.56ab	78.89ab	11.00a	1.416c
T3	75.89ab	81.89ab	11.78a	1.511b
T4	78.89ab	84.56a	12.78a	1.594a
T5	81.00a	86.33a	13.33a	1.624a
		Second season (2022)		
T1	73.67c	76.33d	11.00a	1.410c
T2	76.22bc	79.44cd	12.11a	1.467c
T3	80.78ab	82.00bc	12.22a	1.546b
T4	81.89ab	85.78ab	13.67a	1.620ab
T5	83.89a	88.22a	14.11a	1.663a

T1): 0.0% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer),

T2): 25% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer),

T3): 50% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) +50% of RCF (equivalent for 50% of chemical fertilizer as organic fertilizer),

T4): 75% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer), and

T5): 0.0% recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% RCF (equivalent for 100% of chemical fertilizer as organic fertilizer).

According to Duncan's multiple range analysis, means that shared the same alphabetical letter(s) did not significantly differ.

Table 2. Effect of replacing chemical fertilizers with organic cow manure on the fresh weight (grammes) of tomato plants 60 days after transplanting in the seasons of 2021 and 2022

Parameter / Treatment	Leaves fresh weight	Branches fresh weight/ plant	Total fresh weight	Leaves fresh weight	Branches fresh weight/ plant	Total fresh weight
	First season (2021)			**Second season (2021)**		
T1	489.1d	244.0e	733.1e	504.8e	237.7d	742.4e
T2	512.4c	260.9d	773.3d	526.4d	280.4c	806.9d
T3	531.4b	271.9c	803.3c	548.1c	280.1c	828.2c
T4	565.4a	284.1b	849.6b	568.2b	314.9b	883.1b
T5	568.3a	307.0a	875.3a	583.4a	333.2a	916.7a

T1): 0.0% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer),

T2): 25% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer),

T3): 50% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) +50% of RCF (equivalent for 50% of chemical fertilizer as organic fertilizer),

T4): 75% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer), and

T5): 0.0% recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% RCF (equivalent for 100% of chemical fertilizer as organic fertilizer).

According to Duncan's multiple range analysis, means that shared the same alphabetical letter(s) did not significantly differ.

in both seasons, with no discernible difference from 25% chemical fertilizer + 75% organic fertilizer treatment for weight of leaves/plant in the first season.

With the application of organic cow manure, improvements in soil fertility, ventilation, structure, and beneficial microbial activities may be the cause of an increase in all studied traits. These factors are reflected in high values of plant height, number of branches and leaves, and leaf area (Table 1).

Plant dry weight

There were significant effects on branch dry weight per plant (Table 3) when cow manure fertilizer treatments were used in place of chemical fertilizer, but there were no significant effects on the dry weight of leaves/plant in both seasons and branches/ plant in the first season. With the exception of the second season, the highest values for total dry weight were obtained with a treatment of 0.0% chemical fertilizer and 100% organic manure. There were not significant variations among these values and those obtained with treatments of 25% chemical fertilizer and 75% organic manure, 50% chemical fertilizer and 50% organic manure, and 75% chemical fertilizer and 25% organic manure. Additionally, there were insignificant differences in the dry weight of the plant branches between the 25% chemical fertilizer and the 75% organic fertilizer used in the second season.

These findings could be the result of the maximum vegetative growth brought on by effects of organic fertilizer on enhancing soil physical, chemical and biological properties, which were reflected on increasing plant vegetative growth and the buildup of dry matter. The combination of organic manure and inorganic fertilizers encouraged plant development and supported higher nutrient consumption efficiency with regard to the nutritional condition in the soil. Additionally, the application of chemical fertilizer alone may resulted in less nutrient availability and microbial activity stimulation (especially with high irrigation water salinity) than the combination of organic amendments and low dosages of chemical fertilizers. **Birkhofer *et al.* (2008)** demonstrated that organic manures had more advantageous effects than inorganic fertilizers, increasing nutrient release and the availability of those nutrients to the plants. **Hao *et al.* (2008**) came to a similar result where they observed that the addition of organic amendments improved soil N, P, and K concentrations when compaired with inorganic fertilizers.

Leaves' Photosynthetic Pigment Content

All of the leaf photosynthetic pigments that were being studied—chlorophyll a, b, carotenoids, total pigments (chlorophyll a, b, and carotenoids), and chlorophyll a/b—were significantly affected by cow manure fertilizer treatments (Table 4). The highest values for chlorophyll b were obtained with 25% chemical fertilizer + 75% organic fertilizer treatment and for carotenoids with 50% chemical fertilizer + 50% organic fertilizer treatment, respectively, in the first season. Chlorophyll, a/b, on the other hand, had the highest values with 100% chemical fertilizer treatment in both seasons.

According to **Mahmood *et al.* (2017)**, the addition of organic manures only boosted the soil's organic carbon, which led to the maximum amount of vegetative development, as seen by the leaves' size and their healthy levels of pigments used for photosynthetic growth. The application of organic fertilizer, either alone or in conjunction with inorganic fertilizer, resulted in this enhanced soil organic carbon and total N concentration.

Table 3. Effect of replacing chemical fertilizers with organic cow manure on the dry weight (grammes) of tomato plants 60 days after transplanting in the seasons of 2021 and 2022

Parameter Treatment	Leaves dry weight	Branche dry weight / plant	Total dry weight	Leaves dry weight	Branche dry weight / plant	Total dry weight
	First season (2021)			Second season (2022)		
T1	48.78a	24.78a	73.56b	50.89a	24.11c	75.00c
T2	50.86a	29.39a	80.24ab	52.87a	27.56bc	80.42bc
T3	53.08a	27.44a	80.52ab	55.13a	28.14bc	83.28abc
T4	56.78a	28.78a	85.56ab	57.06a	31.59ab	88.64ab
T5	56.67a	30.83a	87.50a	58.78a	34.00a	92.78a

T1): 0.0% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer),
T2): 25% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer),
T3): 50% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) +50% of RCF (equivalent for 50% of chemical fertilizer as organic fertilizer),
T4): 75% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer), and
T5): 0.0% recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% RCF (equivalent for 100% of chemical fertilizer as organic fertilizer).
According to Duncan's multiple range analysis, means that shared the same alphabetical letter(s) did not significantly differ.

Table 4. Effect of replacing chemical fertilizers with organic cow manure on the content of chlorophyll and carotenoids in tomato leaves 60 days after transplanting in the seasons of 2021 and 2022

Parameter Treatment	Chl. a (mg g^{-1}fw)	Chl. b (mg g^{-1}fw)	Carot. (mg g^{-1}fw)	Total (mg g^{-1}fw)	Chl. a/b
		First season (2021)			
T1	3.485e	1.711d	2.151d	7.347d	2.044a
T2	3.658d	1.918c	2.242c	7.818c	1.906b
T3	3.858c	2.102b	2.715a	8.675b	1.831b
T4	3.991b	2.224ab	2.575b	8.791b	1.794b
T5	4.111a	2.278a	2.765a	9.154a	1.803b
		Second season (2022)			
T1	3.485e	1.711e	2.152e	7.348e	2.043a
T2	3.715d	2.042d	2.274d	8.031d	1.818b
T3	3.896c	2.215c	2.488c	8.600c	1.753c
T4	4.058b	2.338b	2.650b	9.046b	1.737c
T5	4.345a	2.511a	2.998a	9.855a	1.737c

T1): 0.0% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer),
T2): 25% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer),
T3): 50% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) +50% of RCF (equivalent for 50% of chemical fertilizer as organic fertilizer),
T4): 75% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer), and
T5): 0.0% recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% RCF (equivalent for 100% of chemical fertilizer as organic fertilizer).
According to Duncan's multiple range analysis, means that shared the same alphabetical letter(s) did not significantly differ.

Fruit Yield

Marketable yield

Grade A fruits

All grade A marketable yield characteristics that were studied, including mean fruit weight, number of fruits/m^2, and weight of fruits/fad^{-1}, with the exception of weight of fruits/m^2 in both seasons, were significantly influenced by cow manure fertilization (Table 5). The highest values were obtained by applying 0% chemical fertilizer + 100% organic manure treatment, which did not significantly differ from 25% chemical fertilizer + 75% organic manure for all grade A fruit traits, 50% chemical fertilizer + 50% organic manure, and 75% chemical fertilizer + 25% organic manure treatment for only the number of fruits in the first season, and 25% chemical fertilizer + 75% organic manure treatment for mean fruit weight.

Grade B fruits

The grade B marketable yield characteristics examined, such as the amount and weight of fruits in both seasons, with the exception of quantity of fruits only in the second season, were unaffected by cow manure fertilizer treatments in place of chemical fertilizer (Table 5). The most fruits were produced when a mixture of 25% chemical fertilizer and 75% organic fertilizer was used.

Total grade A and B yields

The overall marketable yield of grade A and B was significantly impacted in the first seasons by cow manure fertilizer treatments, but there were no noticeable impacts in the second seasons (Table 5). The highest values were achieved with the application of 0% chemical fertilizer + 100% organic fertilizer, with no appreciable differences between the treatments of 25% chemical fertilizer + 75% organic manure and 50% chemical fertilizer + 50% organic manure.

These results can be attributable to the impact of organic fertilizer, which led to maximum vegetative growth and higher tomato yield per plant. Better management techniques, such as the exclusive use of fertilizers and the use of organic manures, can be used to increase crop output with low or no environmental impact. The application of both organic and inorganic sources of nutrients improved growth and production, according to the findings of individual and integrative studies on the productivity of organic and inorganic manures on tomatoes. According to **Lu *et al.* (2011),** commercial organic manure (matured cow dung) application with chemical fertilizer resulted in the highest tomato fruit yield when compared to other treatments. Also, claim that simultaneous administration of organic and inorganic nutrients enhanced the timing and synergy between nutrient release and plant recovery, resulting in increased crop growth and production.

Unmarketable yield

All of the evaluated unmarketable yield parameters, including weight of fruits/m^2 and weight of fruits/fad., except number of fruits/m^2, were significantly effected by replacing chemical fertilizer with organic cow manure treatments (Table 6). The application of 0% chemical fertilizer plus 100% organic fertilizer produced the lowest values.

Total yield

The highest values were obtained with the application of 0.0% chemical fertilizer + 100% organic fertilizer. In the early seasons, replacing chemical fertilizer with cow manure fertilizer treatments had a significant impact on the overall output. In the second seasons, there were no significant differences between the treatments of 25% chemical fertilizer + 75% organic manure and 50% chemical fertilizer + 50% organic manure (Table 7).

According to experimental research on tomatoes conducted by **Lu *et al.* (2011**), it is believed that applying commercial organic

Table 5. Effect of replacing chemical fertilizers with organic cow manure on the tomato plant's marketable yield in 2021 season

Parameter / Treatment	Grade A fruits				Grade B fruits		Total (Grade A and B Yield) (ton fad^{-1})
	Mean fruit weight (g)	No. Fruits/m^2	Weight of fruits/m^2(kg)	Weight of fruits (ton fad^{-1})	No. Fruits/m^2	Weight of fruits (ton fad^{-1})	
First season (2021)							
T1	75.67b	40.44b	3.044a	12.80d	17.22a	3.948a	16.75c
T2	75.00b	44.11ab	3.309a	13.90cd	16.56a	3.541a	17.44bc
T3	76.33b	46.56ab	3.557a	14.94bc	17.00a	3.118a	18.06abc
T4	79.33ab	47.44ab	3.770a	15.65ab	17.22a	3.321a	18.97ab
T5	82.33a	48.89a	4.033a	16.95a	17.22a	2.741a	19.69 a
Second season (2022)							
T1	77.32d	42.89c	3.311a	13.91c	15.22c	3.922a	17.83a
T2	79.65c	42.89c	3.429a	14.40bc	15.33c	3.471a	17.87a
T3	80.99b	43.78c	3.571a	15.22bc	14.22d	3.048a	18.27a
T4	83.32a	46.33b	3.869a	16.25ab	19.00a	3.000a	19.25a
T5	83.99a	49.11a	4.137a	17.36a	17.67b	2.952a	20.31a

T1): 0.0% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer),

T2): 25% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer),

T3): 50% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) +50% of RCF (equivalent for 50% of chemical fertilizer as organic fertilizer),

T4): 75% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer), and

T5): 0.0% recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% RCF (equivalent for 100% of chemical fertilizer as organic fertilizer).

According to Duncan's multiple range analysis, means that shared the same alphabetical letter(s) did not significantly differ.

Table 6. Effect of replacing chemical fertilizers with organic cow manure on tomato plant yields that were unsuitable for market in the 2021 and 2022 growing seasons

Parameter / Treatment	No. Fruits/ m^2	Weight of Fruits/ m^2	Yield (ton fad^{-1})
First season (2021)			
T1	11.67a	529.9a	2.283ab
T2	11.00a	551.1a	2.257b
T3	10.78a	519.6a	2.319a
T4	9.889a	480.2ab	2.016c
T5	8.556a	431.7b	1.814d
Second season (2022)			
T1	11.33a	566.0a	2.377a
T2	11.44a	571.8a	2.401a
T3	10.11a	516.3b	2.168ab
T4	9.444a	474.0c	1.992ab
T5	8.667a	440.1d	1.783b

T1): 0.0% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer),

T2): 25% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer),

T3): 50% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) +50% of RCF (equivalent for 50% of chemical fertilizer as organic fertilizer),

T4): 75% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer), and

T5): 0.0% recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% RCF (equivalent for 100% of chemical fertilizer as organic fertilizer).

According to Duncan's multiple range analysis, means that shared the same alphabetical letter(s) did not significantly differ.

Table 7. Effect of replacing chemical fertilizers with organic cow manure on yield of tomato plants in the 2021 and 2022 seasons

Parameter / Treatments	Marketable Yield (ton fad^{-1})	Unmarketable yield (ton fad^{-1})	Total Yield (ton fad^{-1})
First season (2021)			
T1	16.75c	2.283ab	19.03b
T2	17.44bc	2.257b	19.70ab
T3	18.06abc	2.319a	20.38ab
T4	18.97ab	2.016c	20.99ab
T5	19.69 a	1.814d	21.50a
Second season (2022)			
T1	17.83a	2.377a	20.21a
T2	17.87a	2.401a	20.27a
T3	18.27a	2.168ab	20.44a
T4	19.25a	1.992ab	21.24a
T5	20.31a	1.783b	22.09a

T1): 0.0% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% of RCF (equivalent for 100% of chemical fertilizer as organic fertilizer),
T2): 25% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) with 75% of RCF (equivalent for 75% of chemical fertilizer as organic fertilizer),
T3): 50% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) +50% of RCF (equivalent for 50% of chemical fertilizer as organic fertilizer),
T4): 75% of recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 25% RCF (equivalent for 25% of chemical fertilizer as organic fertilizer), and
T5): 0.0% recommended chemical fertilizer (RCF) + Recommended organic fertilizer (ROF) + 100% RCF (equivalent for 100% of chemical fertilizer as organic fertilizer).
According to Duncan's multiple range analysis, means that shared the same alphabetical letter(s) did not significantly differ.

manure in replacement of chemical fertilizers could maintain marketable vegetable crop yields. According to **Felix *et al.* (2012),** using commercial organic manure is recognized as an efficient way to meet nutrient needs and maintain tomato productivity when compared to using chemical fertilizers. To maintain soil health and improve nutrient efficiency, it is necessary to apply high portion of organic fertilizer with low portion of chemical as sources of nutrients at the same time.

REFERENCES

Ackley, W.B. (1964). Seasonal and diurnal changes in the water content and water deficit of 'Bartlett' pear leaves. Plant Physiol., 29: 445-448.

Adekiya and Ojeniyi (2002). Evaluation of tomato growth and soil properties under methods of seedling bed preparation in an Alfisol in the rainforest zone of southwest Nigeria. Soil Tillage Res. 64: 275-279.

Ali, M.E.; Islam, M.R. and Jahiruddin, M. (2009). Effect of integrated use of organic manures with chemical fertilizers in the rice-rice cropping system and its impact on soil health. Bang. J. Agric. Res., 34: 81-90.

Bilalis, D.; Krokida, M.; Roussis, I.; Papastylianou, P.; Travlos, I.; Cheimona, N. and Dede, A. (2018). Effects of organic and inorganic fertilization on yield and quality of processing tomato (*Lycopersicon esculentum* Mill.). Folia Hort., 30 (2): 321-332.

Birkhofer, K.; Bezemer, T.M.; Bloem, J.; Bonkowski, M.; Christensen, S.; Dubois, D.; Ekelund, F.; Fließach, A.; Gunst, L.; Hedlund, K.; Ma¨der, P.; Mik, J.;

Robin, C.; Seta¨la, H.; Tatin-Froux, F.; Van Der Putten, W.H. and Scheu, S. (2008). Long-term organic farming fosters below and aboveground biota: implications for soil quality, biological control and productivity. Soil Biol. Biochem., 40: 2297–2308.

Cayuela, M.L.; Sinicco, T. and Mondini, C. (2008). Mineralization dynamics and biochemical properties during initial decomposition of plant and animal residues in soil. Appl. Soil Ecol., 41: 118-127.

Chen, J.H. (2006). The combined use of chemical and organic fertilizers and/or biofertilizer for crop growth and soil fertility. Paper presented at International Workshop on Sustained Management of the Soil Rhizosphere System for Efficient Crop Production and Fertilizer Use, Bangkok, Thailand.

Duncan, B.D. (1955). Multiple Range and Multiple F test. Biomet., 11: 1-42.

Hao, X.; Liu, S.; Wu, J.; Hu, R.; Tong, C. and Su, Y. (2008). Effect of long-term application of inorganic fertilizer and organic amendments on soil organic matter and microbial biomass in three subtropical paddy soils. Nutr. Cycl. Agroecosys, 81: 17–24.

Hepperly, Y.P.; Lotter, D.; Ulsh, C.Z.; Siedel, R. and Reider, C. (2009). Compost, manure and synthetic fertilizer influences crop yields, soil properties, nitrate leaching and crop nutrient content. Compost Sci. Util., 17: 117-126.

Liu, J.; Xie, Q.; Shi, Q. and Li, M. (2008). Rice uptake and recovery of nitrogen with different methods of applying 15N-labeled chicken manure and ammonium sulfate. Plant Prod Sci., 11: 271-277.

Loss, A.; da Rosa Couto, R.; Brunetto, G.; da Veiga, M.; Toselli, M. and Baldi, E. (2019). Animal manure as fertilizer: changes in soil attributes, productivity and food composition. Int. J. Res., Granthaalayah, 7 (9): 307-331. https://doi.org/10.5281/zenodo.3475563

Lu H.J.; Ye, Z.Q.; Zhang, X.L.; Lin, X.Y. and Ni, W.Z. (2011). Growth and yield responses of crops and macronutrient balance influenced by commercial organic manure used as a partial substitute for chemical fertilizers in an intensive vegetable cropping system. Phys Chem. Earth., 36: 387-394.

Mahmood, F.; Khan, I.; Ashraf, U.; Shahzad, T.; Hussain, S.; Shahid, M.; Abid, M. and Ullah, S. (2017). Effects of organic and inorganic manures on maize and their residual impact on soil physico-chemical properties. J. Soil Sci. and Plant Nutr., 17 (1): 22-32.

Moran, R. (1982). Formulae for Determination of Achlorophyllous Pigments Extracted with N, N-Dimethylformamide. Plant Physiol. 69:1376-1381.

Moral, R.; Caselles, J.M.; Murcia, M.D. P.; Espinosa, A.P. and Rufete, B. (2005). Characterisation of the organic matter pool in manures. Bioresour Technol., 96: 153-158.

Olatunji, O. and Oboh, V.U. (2012). Growth and yield of Okra and Tomato as affected by Pig dung and other manure issue for Economic Consideration in Benue state. In: Nigerian J. Soil Sci., 22 (1): 103-107.

Pan, G.; Zhou, P.; Li, Z.; Pete, S. and Li, L. (2009). Combined inorganic/ organic fertilization enhances N efficiency and increases rice productivity through organic carbon accumulation in a rice paddy from the Tai Lake region, China. Agric. Ecosyst Environ., 131: 274-280.

Reddy, D.D.; Rao, A.S. and Rupa, T.R. (2000). Effect of continuous use of cattle manure and fertilizer phosphorus on crop yields and soil organic phosphorus in a vertisol. Bioresource Technol., 75: 113-118.

Saha, S.; Mina, B.L.; Gopinath, K.A.; Kundu, S. and Gupta, H.S. (**2008).** Organic amendments affect biochemical properties of a subtemperate soil of the Indian Himalayas. Nutr. Cycl. Agroecosys, 80: 233-242.

Schoebitz, M. and Vidal, G. (2016). Microbial consortium and pig slurry to improve chemical properties of degraded soil and nutrient plant uptake. J. Soil Sci. Plant Nutr., 16 (1): 226-236.

Snedecor, G.W. and Cochran, W.G. (1980). Statistical Methods 7 Ed. Iowa State Univ. Press. Ames. Iowa, USA.

Xu, M.G.; Li, D.C.; Li, J.M.; Qin, D.Z. and Kazuyuki, Y. (2008). Effects of organic manure application with chemical fertilizers on nutrient absorption and yield of rice in Hunan of Southern China. Agric. Sci. in China, 7: 1245-1252**.**

الملخص العربي

استبدال السماد الكيماوي بسماد روث الأبقار لإنتاج الطماطم الصيفية بمنطقة العريش

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نُفذت دراسة حقلية بالمزرعة التجريبية لكلية العلوم الزراعية البيئية بجامعة العريش شمال سيناء خلال موسمي صيف 2021 و2022 لدراسة تأثير استبدال الأسمدة الكيماوية بالأسمدة العضوية على نمو وإنتاجية نباتات الطماطم [*Solanum Lycopersicon* L.) تحت ظروف منطقة العريش .تم زراعة شتلات طماطم هجين الجيل الأول "جي إس $_{12}$ " في 9 أبريل من الموسمين. تم استخدام نظام الري بالتنقيط، وكانت مساحة الوحدة التجريبية 12 م^2 (طول 10 م وعرض1.2م)، وكان السماد العضوي هو روث الأبقار. اشتملت التجربة على خمس معاملات: (أ) 100% من الأسمدة الكيماوية الموصي بها + الأسمدة العضوية الموصي بها، (ب) 75% من الأسمدة الكيماوية الموصي بها + الأسمدة العضوية الموصي بها ب+ 25% من الأسمدة الكيماوية الموصي بها في صورة سماد روث الأبقار، و(ج) 50 %من الأسمدة الكيماوية الموصي بها + الأسمدة العضوية الموصي بها + 50% من الأسمدة الكيماوية الموصي بها في صورة سماد روث الأبقار، و(د) 25% من الأسمدة الكيماوية الموصي بها + الأسمدة العضوية الموصي بها + 75% من الأسمدة الكيماوية الموصي بها في صورة سماد روث الأبقار، و(هـ) 0.0% من الأسمدة الكيماوية الموصي بها + الأسمدة العضوية الموصي بها + 100% من الأسمدة الكيماوية الموصي بها في صورة سماد روث الأبقار. كانت أعلى القيم لجميع صفات النمو، والوزن الطازج، والوزن الجاف للنبات، والمحصول القابل للتسويق، والمحصول الكلي، وأقل محصول غير قابل للتسويق مع استخدام 0.0% سماد كيماوي % +100روث الأبقار دون فروق معنوية عن 25% سماد كيماوي % +75سماد روث الأبقار في الموسمين، و50% سماد كيماوي +50 % سماد روث الأبقار، و75 % سماد كيماوي 25% + سماد روث الأبقار.

الكلمات الاسترشادية: الطماطم، والأسمدة الكيماوي، والأسمدة العضوية، و النمو الخضر، والمحصول.

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