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Effect of Different Fertilizers on Tomato Plant Growth

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Abstract

The study was conducted to evaluate the effect of different concentrations of fertilizers on tomatoes (Solanum Lycoperscon) grown in a greenhouse. The study determined the effect of different doses of fertilizer on tomato yield by measuring the height, stem diameter, leaf area index, and SPAD value of tomatoes under different treatments, it aimed at the yield response of tomatoes to various fertilizer concentrations and determines the best dosages for increased yields. The result showed that the high concentration of inorganic fertilizer T3 had a positive significant result on tomato yield compared with other treatments applied in this experiment.

Keywords

Inorganic Fertilizers; Organic Fertilizers; Tomato Yield.

1. Introduction

Fertilizer types and applications have a major impact on crop productivity and cropping systems (1). Fertilizers have played a vital role in improving the yield and quality of crops (2). The organic and inorganic fertilizers increase the vegetable's yield, growth, and nutrient content in the leaves (3). The organic fertilizers are slow-release fertilizers since they release nutrients gradually over a longer period, in general three main macronutrients required for plant growth are nitrogen (N), phosphorous (P), and potassium (K) (4). In agriculture, nitrogen is essential nutrient because it increases crop output. Nitrogen helps crops become higher quality as well as more productive (5). Potassium (K) is an essential macronutrient that plays important roles in plant development, adaptation to stress, cotransport of carbohydrates, osmoregulation, and membrane potential regulation (6). Numerous cellular functions, such as the production of proteins, the preservation of membrane structures, and the creation of high-energy molecules, depend on phosphorus (7). Nutrients play a crucial role in plant growth and development, due to their specialized functions, these nutrients must be given to the plant in the proper amounts and at the appropriate times. It is generally acknowledged that using organic inputs in farming improves the biological and fertility of the soil (8).Both organic and inorganic fertilizers are essential parts of agricultural practices because they provide the vital nutrients that increase crop productivity, plant development, and ecological system health (9) .One of the key elements in increasing yield is correct fertilization; however, using inorganic fertilizers carelessly without adding organic supplements pollutes the environment and degrades the physical, chemical, and biological qualities of the soil (10). The mixture of organic and inorganic fertilizers enhanced tomato yield, which maybe explained by nutrients from the inorganic and organic fertilizers being released at different periods throughout the mineralization (11). Although fertilizers have varying effects on your soil, their primary function is to supply your plants with nutrients. Fertilizer restores nutrient deficits in your soil and fosters healthy plant growth, much like a daily vitamin makes up for what you don't get from meals. The choice of fertilizer may also alter the pH of your soil or provide more organic matter, which will enhance microbial activity and water retention (12). There are so many vegetables, and this experiment took tomatoes as the research subject. The tomato (Solanum

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lycopersicum L.) is a vegetable grown all over the world and is a good source of vitamins A, B6, C, K, and E (13). It is also a good source of dietary fiber and includes manganese, copper, potassium, and molybdenum (14). Nitrogen (N) levels in tomato cultivation can affect tomato quality in both positive and negative ways (15). The availability of nutrients is one of the many factors that affect tomato quality, a low tomato yield can be caused by a number of things, including poor nutrition, pest and disease infestation, improper planting timing, and insufficient irrigation (16). However, it has been shown that using NPK fertilizers which include nitrogen, phosphorous, and potassium improves tomato quality (17).

This experiment analyzed the application of organic and inorganic fertilizers with different dosages on tomato plants. In this paper, the purpose is to provide the theoretical for promotion of the application of inorganic and organic fertilizers on tomato (Solanum Lycopersicon) planting and growth under moistube irrigation.

2. Methods and Materials

2.1 Experiment Design

The experimental planting was tomato (solanum lycopersicum), different fertilizers were set up, and there were 7 treatments in this experiment as shown respectively in table 1. The fertilizer application methods were no fertilizer application (CK), the fertilization of local farmers T2 (N:P:K=300:120:240kg/hm2) was used as a reference setting. Different concentrations of inorganic fertilizer treatment T1, T2, T3, and low concentrations of inorganic fertilizer were combined with different concentrations of organic fertilizer M1, M2, and M3, a total of 7 treatments, each with three replicates. The specific dosage of fertilizers is shown in Table1. laboratory, Inorganic fertilizers were urea (N 46%), potassium dihydrogen phosphate (P2O5 52%, K2O 33.8%), potassium sulfate (K2O 52%), Organic fertilizers are commercially soluble organic fertilizers (N 13%, P2O5 5%, K2O 13%, organic matter ≥40%). The fertilizers were applied five times as top dressing during the entire growth period of tomatoes. The plant spacing was 40cm, and the spacing of rows was 30cm. The irrigation method used during the experiment is moistube irrigation with a reservoir water source and the pressure head is 2m.

Table 1. Fertilizer dosage under different fertilization treatments.

CK: no fertilizer application
T1: inorganic fertilizer N: P: K=150:60:120kg/hm^2
T2: inorganic fertilizer N: P: K=300:120:240kg/hm^2
T3: inorganic fertilizer N: P: K=450:180:360kg/hm^2
M1: inorganic fertilizer N: P: K= 150:60:120kg/hm^2+ organic fertilizer 75kg/hm^2
M2: inorganic fertilizer N: P: K=150:60:120kg/hm^2+ organic fertilizer 225kg/hm^2
M3: inorganic fertilizer N: P: K=150:60:120kg/hm^2+ organic fertilizer 375 kg/hm^2

2.2 Results

2.2.1 Growth Parameters of Tomato Plant

1) Effect of different concentration of fertilizers on tomato height

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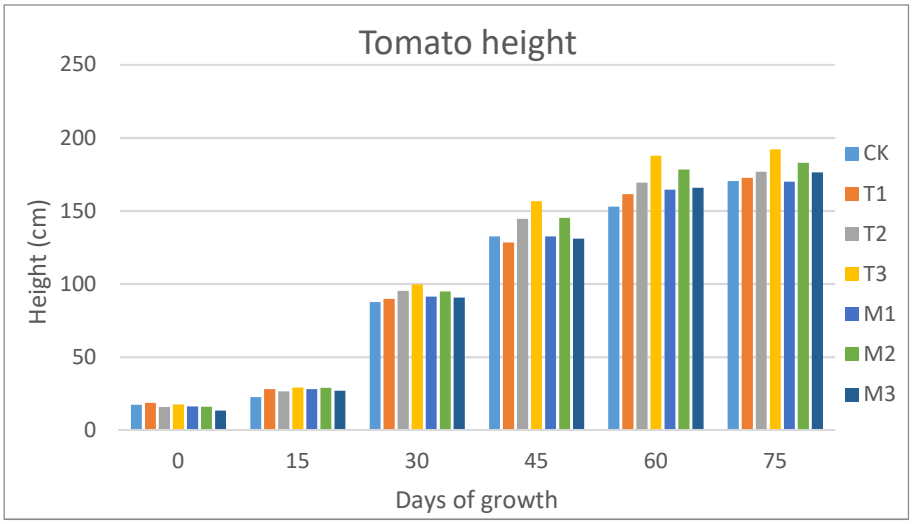

Figure 1. Effect of different concentration of fertilizers on tomato height (cm) from the planting day up to 75days with average of three replications.

At planting day it was found that plants grown under T1 with low concentration of inorganic fertilizer treatment were significantly higher with mean height of 17.46cm compared with other treatments. The shortest tomato plants were observed under M3 with a mean height of 13.233 cm. At 15th day after planting day, it was found that plants under T3 treatment were significantly the tallest with a mean height plant of 29.033cm compared to other treatments. The shortest plants were observed under no fertilizer application CK with a mean height of 22.433cm compared to the other treatments. From 30th day up to 75 days after planting days it was found that tomato plants under T3 treatment were significantly higher than other treatments and the shortest tomato plants were found under no fertilizer application. In this present study, different treatments of fertilizers increased tomato height from the planting day up to 75th day compared to the no fertilizer application, it was found that T3 treatment with high concentration of nitrogen, phosphorus and potassium had a significant result compared to the other treatments. The plant height of tomato increased rapidly from seedling stage to the fruiting stage, and the tomato turned to reproductive growth after fruit expansion stage, and the hanging height of tomato seedlings in field management was mostly about 1.8m.

2) Effect of different concentration of fertilizers on tomato stem diameter

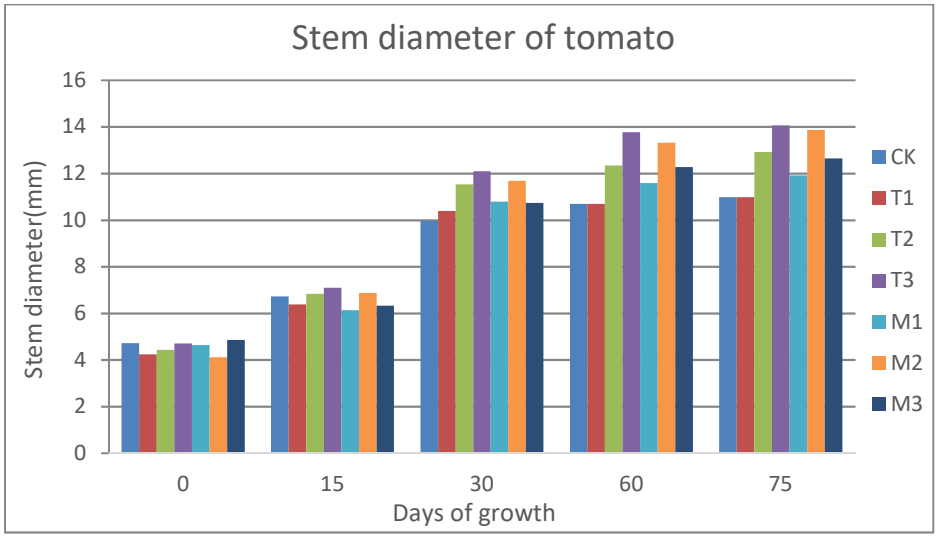

Figure 2. Effect of different concentration of fertilizers on tomato stem diameter from the planting day up to 75 days average of three replications.

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At planting day it was found that plants grown under M3 treatment with low inorganic and high organic fertilizer were significantly higher with a mean stem diameter of 4.85m than others treatments, there is no significant difference compared with no fertilizer application. The shortest plants were observed under M1 with a mean stem diameter of 4.11mm compared to the others treatments of fertilizers. At 15th day after planting day, it was found that plants grown under T3 treatment with high concentration of fertilizers were a significantly higher with a mean stem diameter of 7.093mm. The shortest plants stem diameter was observed under M1 with a mean stem diameter of 6.13mm compared to other treatments. From 30th day up 90th day after planting, it was found that plants grown under T3 treatment were significantly higher than other treatment and the smallest stem diameter was found under no fertilizer application CK. In this study, different treatments of fertilizers increased stem diameter of tomato plants from planting day up to 75thday.

3) Effect of different concentration of fertilizers on SPAD value

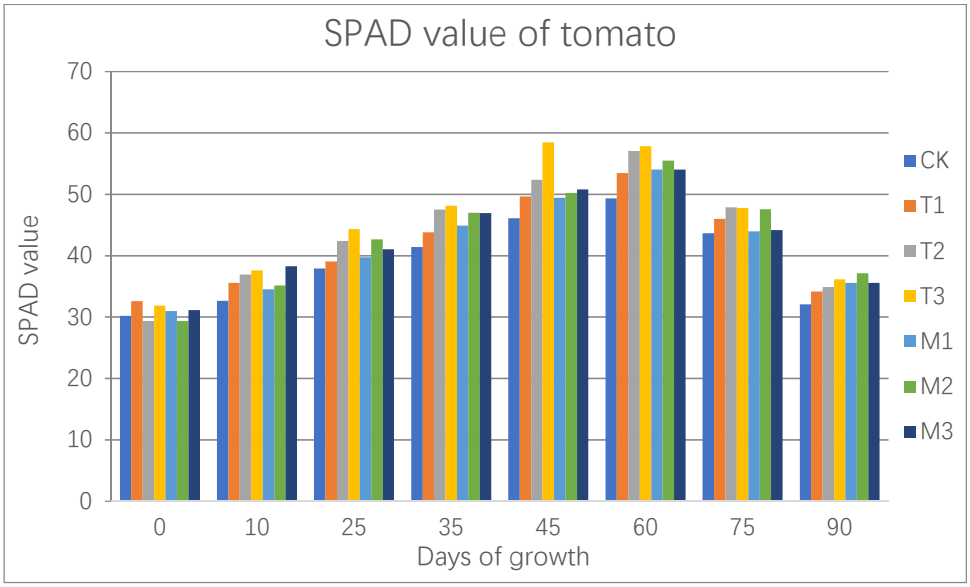

Figure 3. Effect of different concentration fertilizer on SPAD value of tomato from the planting day up to 90 days with average of three replications.

At the planting day, it was found that the plants grown under T1 (150:60:120kg/hm2) were significantly higher with a mean SPAD value of 32.56 than other treatments. The smallest SPAD value was observed under T2 and M2 with a mean average of 29.33. At 10th day, it was found that the plants grown under M3 treatments were significantly higher with a mean SPAD value of 38.26 than other treatments and the low SPAD value was observed under no fertilizer application CK with a mean SPAD value of 32.63. From30th day up 60th day after planting day, it was found that the plants grown under T3 treatment were significantly than other treatments, and the smallest SPAD value was found under no fertilizer application CK. From 60th day to 90th day the SPAD value decreased at the stage of maturity. At 75th day after planting, it was found that the SPAD value decreased compared to the 60th day as it shown that the plants grow under T2 treatment were significantly higher with a mean SPAD value of 47.86 than other treatments. The plants with low mean SPAD value were observed under no fertilizer application CK with a mean of 43.63. At 90th day after planting, it was found that plants grown under T3 treatments were significantly higher with a mean SPAD value of 36.13 compared than other treatments. The plants with a low mean SPAD value were found under no fertilizer application (CK) with 32.06. In this present study, it was found that different treatments increased tomato SPAD value from the planting day up to 60th day compared

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to the various dosages used in the experiment then decreased from 60thday to 90thday. Throughout of the growth period, the tomato SPAD value showed a trend of first increasing and then decreasing.

4) Effect of different concentration of fertilizers on tomato leave area index

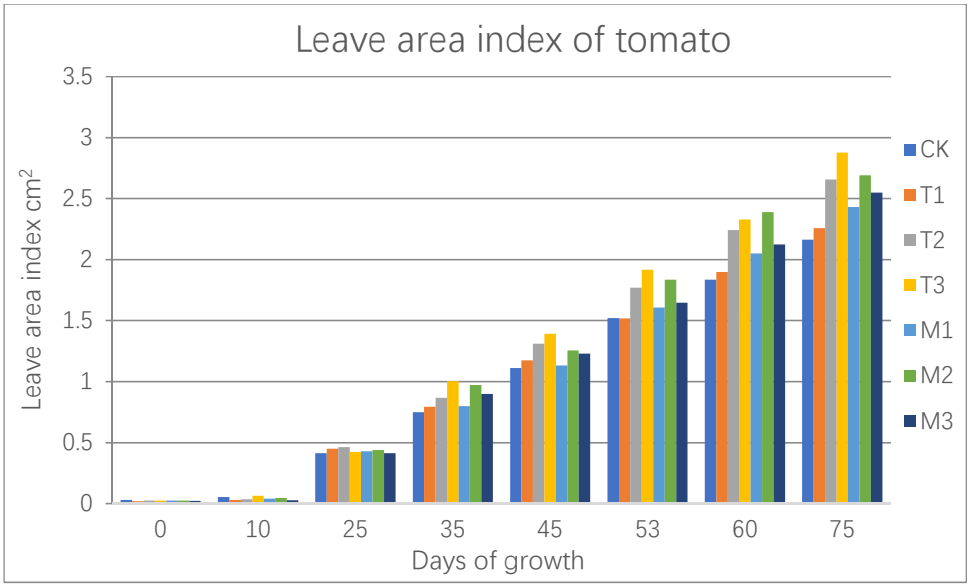

Figure 4. Effect of different concentration fertilizers on leave area index of tomato since planting day up to 75day.

On the day of planting, it was discovered that CK, T1, T2, T3, M1, M2, and M3 did not significantly differ from one another. On the tenth day following the planting date, it was discovered that the plants grown in the T3 treatment had a mean leave area index that was 0.06 higher than those grown in the other treatments. With a mean leaf area of 0.025 , the plants with the shortest left area index were seen under M3 treatment. When the leaves area index of the T2 treatment was measured 25 days after planting, it was found to be significantly greater than that of the other treatments and fertilizers 0.4608. Using 0.412 of M3 treatment, the plants with low leaf area index were observed. The plants produced with T3 treatment were found to be significantly higher than other treatments from the 35th to the 53rd day after planting day, and the plants with the smallest leave area index were identified under no fertilizer application (CK). At 60th day after planting day, it was found that M2 treatment were a significantly higher with a mean leave area index of 2.388 than other treatments. The smallest plants with a mean leave area were found under no fertilizer application CK with 1.834. At 75th day after planting day, it was found that plants grown under T3 treatment were significantly higher with a mean leave area index of 2.876 than other treatments. The lowest plants with mean leave area index were found under no fertilizer application with a mean leave area of 2.163. In this present study, different treatments of fertilizers increased tomato leave area index from the planting day up to 75th day compared to the no fertilizer application CK. Plant canopy productivity is mostly dependent on the leaf area, which is a quantitative indicator of plant population structure and can show how successfully plants interact with their environment. It also acts as a crucial growth status indicator for plants, which is closely linked to their ability to transpire, photosynthesise, and respire.

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3. Effect of Different Concentration of Fertilizers on Tomato Yield

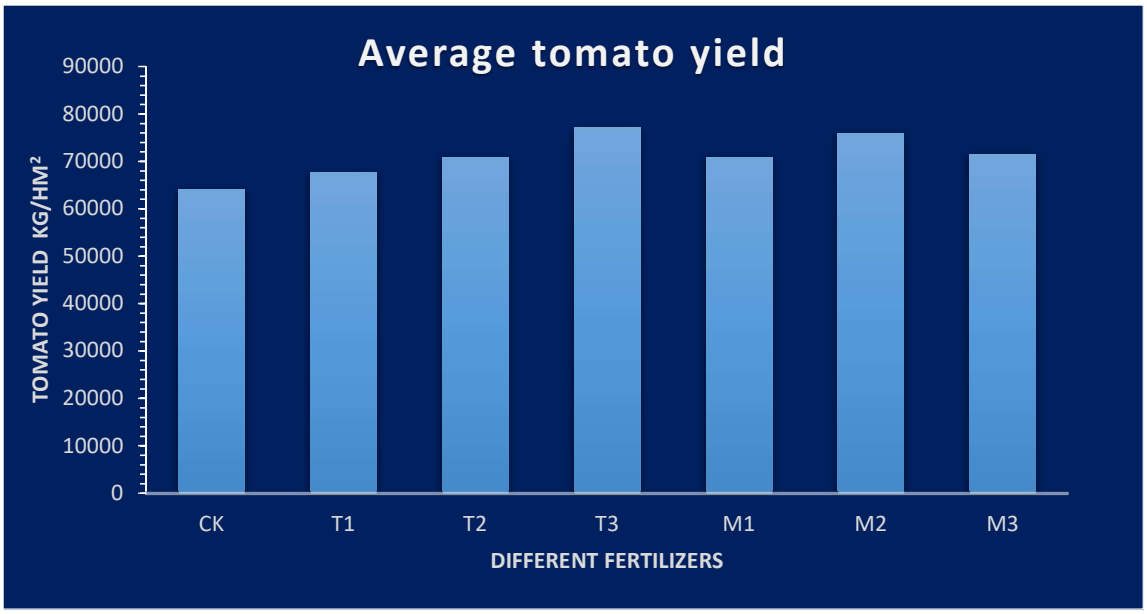

Figure 5. Effect of different concentration of fertilizers on tomato yield

The effect of different fertilization treatments on tomato yield is shown as T3>M2>M3>T2.M1>T1>CK, T3 treatment was significantly higher than the rest of the treatments, compared with CK tomato yield increased by 20.5%, M2 treatment was second after T3 treatment, compared with CK tomato yields increased yield by 18.6%, T2,M1 and M3 treatments , yields were not significantly different, respectively tomato yields increased by 10.8%, 10.7%,11.8% in all fertilization treatments, T1 treatment was significantly lower than the rest of the treatments, only increased yield by 5.7%, compared with CK.

4. Discussion

The yield of tomatoes was significantly impacted by the different fertilization treatments; the yield of tomatoes increased with the amount of fertilizer applied in each single application of inorganic fertilizer treatment (T1~T3); T3 treatment was significantly higher than other treatments; and the three groups of combination fertilizer treatments (M1~M1) showed a significant tomato yields compared with T1 treatment. Adekiya has reported that the combination of inorganic and organic fertilizers increased tomato yields; however, in this experiment, it was found that high concentration fertilizers had a significant yield that was influenced by increasing nitrogen, phosphorus, and potassium, three components of nutrients needed for plant development and growth, based on the combination of fertilizer treatments, T3 showed the best yield. Nowadays, a lot of researchers are concentrating on finding ways to grow tomatoes that are both higher quality and still yield. The results of field testing show that appropriate fertilization is largely necessary to increase tomato yield and efficiency (18), showed that applying the appropriate amount of organic fertilizer and reducing the amount of inorganic fertilizer might improve tomato output and fruit quality.

The height of tomato plants and the thickness of their stems were significantly impacted by different fertilization treatments. Tomato plant height and stem thickness can be greatly increased by applying the right amount of organic fertilizer and inorganic fertilizer. Throughout the whole growth period, tomato plants fluctuate in height and stem thickness, growing quickly in the early stages and slowly in the latter stages.

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In this experiment, tomato plant height and stem thickness increased as the concentration of inorganic fertilizer increased; the plants treated with high concentrations of inorganic fertilizer (T3) had the highest levels, followed by plants treated with low concentrations of inorganic fertilizer and medium organic fertilizer (M2). During the growth phase and the middle growth stage, the tomato's leaf area index showed rapid growth, respectively. T3>M2>T2>M3>M1>T1>CK, a high concentration of inorganic fertilizer (T3), the treatment with medium concentration organic fertilizer (M2) performed in the treatment of each applied organic fertilizer, and the treatment with a single application of high inorganic fertilizer performed best when the tomato was subjected to different fertilization treatments. Throughout the growing season, tomato leaf SPAD values show a parabolic growth pattern with a downward opening. The SPAD value of leaves decreases with the number of planting days following peaking, indicating that the SPAD value of tomato leaves can be increased by using appropriate amounts of organic and inorganic fertilizer. After the tomato leaf SPAD value peaked, the SPAD value of each treatment that received inorganic fertilizer as well as the combination of low-inorganic and organic fertilizers decreased slightly.

5. Conclusion

In this study, the application of high concentration of inorganic fertilizer (T3) treatments had a significant outcome of yield when compared to various dosages. Furthermore, in comparison to the no fertilizer application (CK) scenario, it can be said that the application of various fertilizers had a substantial impact on plant height, stem diameter, SPAD value, and leaves. When compared to the other fertilization treatments, the application of inorganic fertilizer (T3) treatments and the mixture of medium organic and low inorganic fertilizers (M2) had a notable impact on tomato yield.

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