Effect of Nano NPK Fertilizer on Growth and Early Yield of Eggplant

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Abstract

Field-based experiment was conducted during 2020 – 2021 in green house to evaluate the response of eggplant (Solanum melongena L.) in Al-Rifai District- DhiQar Governorate. The experiment included two factors: First one was NPK (3.6.15) nano fertilizer from Agrisenses company (N1=Zero and N2= 1.25) ml. L⁻¹ after 30,60 and 90 days of planting, the second factor was fertilizer recommendation treatments (T1=Zero, T2= 50% and T3=100% fertilizer recommendation ). The experiment was carried out using the randomized complete block design (RCBD) with three replications. The averages of all study indicators were compared according to L.S.D test at a probability level of 0.05. The results showed the following: N2 was significant and superior compared to other treatments in plant height (65.11 cm), No. leaves (82.8 leaf ), leaves area (133.84 cm²), No. branches (8.11 branch) and early yield (1180 g), as well as T3 treatment was significant and superior compare to other treatments in plant height (75.67 cm), No. leaves (92.7 leaf ). Results also indicated that the interaction of N2T2 had significant increase in number of branches and early yield reached (10.33 branches, 1235 g) respectively.

Keywords: Eggplant, Early yield, Nano fertilizer, Fertilizer recommendation.

1. Introduction

Eggplant (Solanum melongena L.) is one of the important vegetable crops in the world. As a result of its nutritional and health value, as it contributes to reducing cholesterol in the blood, it can also be used in cases of severe diarrhea [1]. Research also confirmed that eggplant is beneficial for health, especially in the treatment and prevention of atherosclerosis, and contributes to the prevention and removal of obesity because it is low in calories [2]. In order to increase the demand for this crop throughout the year, it required its production in the off-season, and the excessive use of chemical fertilizers when planting and for the purpose of raising production, which resulted in the emergence of some problems and obstacles in the soil, especially when planting it in the case of the basal soils prevailing in Iraq, the decline in the production rate requires us to promote this crop and work to raise its production efficiency by using modern technologies, including nano-fertilizer technology, and employing this technology in the agricultural field and improving plant production [3]. In order to increase production, the use of chemical fertilizers, represented by mineral fertilizers added to the soil, and nano-fertilizers, which have appeared in recent years as environmentally friendly fertilizers and have an important role in treating and improving plant production by spraying them on the vegetative system. The combined use of these fertilizers will lead to a strong effect on plant growth, development and production, and thus obtain greater production [4]. The aims study to find the best concentration of nano-fertilizer and its effect on vegetative growth and early yield of eggplant.

2. Materials and Methods

The experiment was carried out in DhiQar Governorate / Al-Rifai District in greenhouses for the winter agricultural season 2020-2021. In the experiment, eggplant seedlings of Barcelona variety which produced by Vito Spanish company, were used. Then it was transferred to the soil in plastic house (30 days after sowing the seeds on 11/2/2020). The distance between the plants is 50 cm. Urea fertilizer was added in three batches, di ammonium phosphate fertilizer was added in two batches, and high-potash fertilizer was added in two batches. The first batch was added before planting, the second batch was added after 30 days of planting, and the third batch of nitrogen was added after 60 days of planting. The experiment includes the study of two factors: First one NPK (3.6.15) nano-caliber fertilizer from Agrisenses company at a rate of (0 N1 and 1.25 ml L⁻¹ N2) after (30,60,90) days of planting, the second factor are Ground fertilization (T1= Zero, T2= 50% fertilizer recommendation, T3= 100% fertilizer recommendation). Plant height, leaf area, number of leaves, branch and early yield were recorded. Randomized Completely Block Design (R.C.B.D) were used with three replicates. The means were compared according to L.S.D test at the level of 0.05.
Table 1. Soil texture and physical properties and water.

| Soil Particulate | Volume Ratio (%) |
|------------------|------------------|
| pH              | 7.4              |
| EC              | 4.46 ds.m        |
| Clay            | 27.8%            |
| Silt            | 22.75%           |
| Sand            | 49.44%           |
| Soil texture    | Sandy clay       |
| Chemical Analysis |                 |
| O.M             | 0.7%             |
| N available     | 36.4 mg.kg⁻¹     |
| P available     | 14.3 mg.kg⁻¹     |
| K available     | 155.2 mg.kg⁻¹    |

3. Results

3.1 Plant height (cm)

Table 2 showed that N2 was significantly superior in plant length (65.11 cm) comparing to (55.44 cm) in N1. Moreover, T3 was highest in plant height (75.67 cm) compare with T1, T2 (34.67, 70.50 cm) respectively. Interaction between Nano fertilizer and Fertilizer recommendation treatments that, combination of N2T3 gave the highest average 80.33 cm while N1T1 gave 32.33 cm.

Table 2. Effect of fertilizer recommendation, Nano fertilizer treatments and their interaction on plants height (cm).

| Nano fertilizer | Fertilizer recommendation treatments | Mean of Nano fertilizer |
|-----------------|------------------------------------|-------------------------|
|                 | T1       | T2       | T3       |                        |
| N1              | 32.33    | 63.00    | 71.00    | 55.44                  |
| N2              | 37.00    | 78.00    | 80.33    | 65.11                  |
| Mean of treatments | 34.67  | 70.50    | 75.67    |                        |
| L.S.D. 0.05     | N=3.413  | T= 4.179 | NT= 5.911 |                        |

3.2 Number of leaves (leaf. plant⁻¹)

The results presented in Table 3 showed that, no significant between N1 and N2 in related to number of leaves, T3 had the highest number of leaf, 92.7 leaf. plant⁻¹, which was significantly higher than the other treatments. The interaction analysis between number of leaf and fertilizer recommendation treatments that, highest number of leaf93.00 leaf. plant⁻¹ in combination of N1T3 while lowest mean reached61.3 leaf. plant⁻¹ in combination of N1T1. The treatment of N2T3(92.3) was showed no significant differences between them, perhaps the reason that nano-fertilizers was not useful with adding the full fertilizer recommendation.

Table 3. Effect of fertilizer recommendation, Nano fertilizer treatments and their interaction on number of leaves (leaf. plant⁻¹).

| Nano fertilizer | Fertilizer recommendation treatments | Mean of Nano fertilizer |
|-----------------|------------------------------------|-------------------------|
|                 | T1       | T2       | T3       |                        |
| N1              | 61.3     | 81.7     | 93.0     | 78.7                   |
| N2              | 66.7     | 89.3     | 92.3     | 82.8                   |
| Mean of treatments | 64.0   | 85.5     | 92.7     |                        |
| L.S.D. 0.05     | N= N.S   | T= 7.32  | NT=10.35 |                        |

3.3 Leaf area (dcm²)

The results presented in Table 4 showed that Cultivar N2(133.84 dcm²) significantly exceeded than N1(78.27 dcm²). T3 and T2 had the highest number of leaf(139.21 and 136.07 dcm²) respectively, which were significantly higher than T1 (56.39 dcm²). The combination of N2T3 Gave higher leaves area (178.84 dcm²) while the N1T1 gave the lowest area (49.50 dcm²).
Table 4. Effect of fertilizer recommendation, Nano fertilizer treatments and their interaction on leaf area (dcm²).

| Nano fertilizer | Fertilizer recommendation treatments | Mean of Nano fertilizer |
|-----------------|------------------------------------|------------------------|
|                 | T1  | T2  | T3  |                 |                        |
| N1              | 49.50 | 108.74 | 103.58 | 78.27 |                        |
| N2              | 63.28 | 163.41 | 174.84 | 133.84 |                        |
| Mean of treatments | 56.39 | 136.07 | 139.21 |              |                        |

L.S.D. 0.05 N=15.35 T=18.80 NT=26.59

3.4 Number of branches (branch. plant⁻¹)

Table 5 showed that N2 was significantly superior in number of branches (8.11 branch. plant⁻¹) comparing to (7.33 branch. plant⁻¹) in N1. T2 was significantly higher than the other treatments with average of 10.17 branch. plant⁻¹. there are significant differences in interaction between Nano fertilizer and Fertilizer recommendation treatments, N2T2 gave highest mean that reached to 10.33 branch. plant⁻¹, but N1T1 have less value (5.00 branch. plant⁻¹).

Table 5. Effect of fertilizer recommendation, Nano fertilizer treatments and their interaction on number of branches(branch. plant⁻¹).

| Nano fertilizer | Fertilizer recommendation treatments | Mean of Nano fertilizer |
|-----------------|------------------------------------|------------------------|
|                 | T1  | T2  | T3  |                 |                        |
| N1              | 5.00 | 10.00 | 7.00  | 7.33  |                        |
| N2              | 4.64 | 10.33 | 9.33  | 8.11  |                        |
| Mean of treatments | 4.83 | 10.17 | 8.17  |              |                        |
| L.S.D. 0.05 N= 0.759 | T=0.930 | NT=1.315 |

3.5 Early yield (g. plant⁻¹)

Based on the results in (Tab.6), showed that, no significant between N1 and N2 in related to early yield. In same table showed that, no significant between T2 and T3 in early yield reached (1235 and 1198 g) respectively, but both of them significantly than T1 (733g). The combination of N2T2 gave higher rate 1307g while the N1T1 gave the lowest average 601g.

Table 6. Effect of fertilizer recommendation, Nano fertilizer treatments and their interaction on early yield (g).

| Nano fertilizer | Fertilizer recommendation treatments | Mean of Nano fertilizer |
|-----------------|------------------------------------|------------------------|
|                 | T1  | T2  | T3  |                 |                        |
| N1              | 601  | 1163 | 1029 | 931  |                        |
| N2              | 866  | 1307 | 1366 | 1180 |                        |
| Mean of treatments | 733  | 1235 | 1198 |              |                        |
| L.S.D. 0.05 N=NS | T=334.4 | NT=472.9 |

4. Discussion

The increase in vegetative growth (table 2,3,4 and 5) may be attributed to the role of nitrogen and its availability in the ready form in the form of NO3 and NH4, which greatly enhanced plant growth and production through the vital role in the biochemical and physiological functions of the plant [5]. All of this would work to build larger cells, as well as an increase in the number of cells, and then an increase in the general growth of the plant, which is an indication of increased vegetative growth [6]. In addition to the efficient absorption and permeability of the nano-fertilizer into the plant tissues through the stomata holes, whose ions sizes are smaller than the diameter of the stomata and cell wall holes. In addition, the nano-particles are characterized by their high specific surface area and energy, which is consistent with what was mentioned [7]. In addition of the fertilizer recommendation and its effect on providing the plant with important nutrients, including nitrogen, which is important in amino acids and proteins formation, cell division and elongation, as well as potassium, which is important in the formation of important enzymes for growth, and finally phosphorus, which is important in the formation of energy compounds, thus increasing roots formation and increasing vegetative growth. Thus, it reflects positively on yield (table 6). This agree with [8-12].
Conclusion

The treatment 1.25 ml. L⁻¹ of Nano fertilizer with 50% of fertilizer recommendation treatments is the best treatment is recommended to give leaf area, number of branches and early yield.

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