



Plant Archives

Journal homepage: <http://www.plantarchives.org>
doi link : <https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.011>

RESPONSE OF TOMATO, EGGPLANT, AND PEPPER TO NANO FERTILIZERS AND THE METHOD OF THEIR ADDITION

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ABSTRACT

Nanotechnology is modern science that would play an important role in improving agricultural production through the production of nano fertilizers, which have unique features that can have an effective effect on that. Within the framework of this, the experiment was conducted with plastic pots of (5 kg) capacity in the greenhouse belonging to the college of Agriculture, Al-Qasim Green University on 1/10/2017, and the treatments included control (spraying with water only), the ground addition of nano fertilizer of 2 g.L⁻¹. Foliar spraying of nano fertilizer 2 g.L⁻¹, and the above treatments were applied in three plant species, which are tomato, eggplant and pepper. tomato seeds hummer cultivar of French origin, and eggplant, Barcelona cultivar of Spanish origin, and pepper, charisma cultivar of French origin were cultivated in cork dishes. The results were as follows: The effect of Nanos fertilizer was significant in most of the traits of all plant species. The foliar addition of tomato, eggplant and pepper significantly excelled in the traits of plant height, and the stem diameter for tomato and pepper. While there were no significant differences in the leaf area, the number of branches, the dry matter, the number of leaves, and the number of flowers for tomato and eggplant. Foliar fertilizer did not affect the leaf area of tomato and pepper plants.

Keywords: tomato, eggplant, pepper, nano fertilizers

Introduction

Nanotechnology, or nanoscience, is one of the sciences that study the processing of materials on the atomic scale 10⁻⁹ From a meter because nanomaterials exhibit properties of materials that differ from them when they are with their conventional dimensions of more than 100 nanometers (Saleh, 2015). Nano fertilizers have unique features due to their small size and large surface area, which leads to an increase in the absorption surface and thus high photosynthesis and increased production of active substances in plants (Singh *et al.* 2016). It is in the position that nanotechnology represents new frontiers in modern agriculture, a major driving force in the near future by introducing potential applications and enhancing efficiency in promoting fertilizers and overcoming nutritional enrichment. Nano fertilizers are the best alternative as they help with environmental sustainability (Mishra *et al.*, 2017). Fertilization is also one of the most important crop operations and one of the important agricultural production methods in increasing the quantitative and qualitative production for its great effect on regulating the nutritional conditions of the plant, especially the abundance of the macronutrients needed by the plant in large quantities (Hawkesford, *et al.*, 2012). Al-Khlifawi (2017) indicated at a concentration of 2 g.L⁻¹ of nano Fe-EDTA led to a significant increase in most of the vegetative growth traits of the Moringa tree, as well as achieving the highest percentage of nitrogen, protein, phosphorous, potassium and calcium and the highest percentage of active substances. While the concentration 1 g.L⁻¹ was excelled in the percentage of magnesium and zinc content in the leaves. Nanotechnology has proven its

importance in agricultural production as a multidisciplinary technique and has many applications in the stages of production, processing, storage and packaging, as well as transportation of agricultural products (Umesh and Ashok, 2012). It also contributed to improving the ability of plants to absorb nutrients from fertilizers (Al-Rubaie *et al* 2012). Almutairi (2015) indicated in her study on a tomato plant in silver nanoparticles in 5 concentrations (0.05, 0.5, 1.5, 2 and 2.5) ml.L⁻¹, which led to improved germination rate and increased root length and fresh and dry weight of the plant compared to the control plants. Bjai (2017) that nanosilver at a concentration of 15 ml. L⁻¹. It had a significant effect on plant height, the number of leaves, total chlorophyll content, dry weight of the Vegetative growth, root length, nitrogen concentration, total protein and iron of carrot plants. The study aims to determine the best methods to add nano fertilizer and study the response of tomato, eggplant and pepper to nano fertilizers.

Materials and Methods

The experiments was conducted in the greenhouse belonging to the college of Agriculture, Al-Qasim Green University, on 1/10 2017, to study response of tomato, eggplant, and pepper to nano fertilizers and the method of their addition. Tomato (*Lycopersicom esculentum* L) seeds were cultivation, hummer cultivars of French origin, and eggplant (*Solanum melongena* L), Barcelona cultivars of Spanish origin, and *Capsicum annuum* L, charisma cultivars of French origin, in cork dishes. On 1/10/2017, and after 38 days, it was transferred to pots of 5 kg capacity and agricultural medium composed of sand and decomposed animal fertilizer (cow waste) in a ratio of 3: 1. The

experiment included the application of the following treatments to the three plants (tomato, eggplant, pepper), as follows:

The first treatments (A1): Control treatment

The second treatment (A2) : Foliar spraying for nano fertilizers that content from it (2 g.L⁻¹ macronutrients 20-20-20 (NPK) and micronutrients (8% Iron, 1.5Zinc, 1.5 Manganese, 0.5% copper, 0.5% Boron 0.5% molybdenum)

The third treatment (A3): the ground addition for nano fertilizers that content from it 2 g.L⁻¹ macronutrients 20-20-20 (NPK) and micronutrients (8% Iron, 1.5Zinc, 1.5 Manganese, 0.5% copper, 0.5% Boron 0.5% molybdenum). The experiment was conducted according to a complete randomized design (CRD) with ten pots for each treatment and one plant for each pot, and the following characteristics were studied: Plant height, leaf area cm², number of branches in the plant, number of leaves per plant, percentage of dry weight, stem diameter mm, number of leaves per plant, number of flowers per plant, number of flowers per inflorescence, number of fruits for three harvests, average fruit weight, The results of the experiments were analyzed by means of the ANOVA test, and the Least Significant Difference test (L.S.D) was used to indicate the significance of the results. (Al-Rawi and Khalaf Allah, 2000).

Results and Discussion

Table 1 data indicate the presence of significant differences in the traits of plant height, where the ground addition (nano fertilizer) for tomato, eggplant and pepper plants excelled and gave the highest average (95.30, 1.44 and 1.54 cm), respectively, while we did not see significant differences in the traits of leaf area, the number of branches, stem diameter, dry matter and number, The leaves per plant and the number of flowers per tomato plant gave the control treatment the lowest average. As for the leaf area, we notice the presence of significant differences, where the ground treatment excelled on the rest of the treatments and gave the highest average of eggplant plants, reaching (131.20), while there are no significant differences for tomato and pepper plants for this traits. In the trait of the stem diameter, we note the excelled of the ground treatment with Nano fertilization of pepper plants and it gave the highest average of (8.22). As for tomato and eggplant plants, we notice that there are no significant differences. As for the trait of the percentage of the dry matter of the plant and the number of leaves in the plant, we note from the table that there are no significant differences between the treatments and for all plant types of tomato, pepper and eggplant. The trait of the number of flowers in the plant, we note from the table significant differences for the pepper plant only, and the foliar treatment gave the highest average compared with the rest of the treatments in the experiment, it reached (12.20) m². As for tomato and eggplant plants, we note that there are no significant differences between ground and foliar treatments for nanofertilization. In the trait of the inflorescences number of the tomato plant, we note that there are significant differences between the treatments for nanofertilization, where we notice the excelled of the ground treatment of Nano fertilization and gave the highest average of the inflorescences number (5.67) per plant compared to other treatments. Significance between treatments, where the control treatment excelled and gave the highest average of length of inflorescences (26.40) cm compared to the rest of

the treatments, Table (1) showed that the significant effect of nano fertilization on a number of traits, and this can be due to the fact that nanotechnology is the application of chemical, physical, biological, pharmaceutical and engineering sciences. And the idea of using nanotechnology is summarized in the arrangement of the atoms that make up the material, which produces other materials with different chemical and mechanical properties (Habashi, 2009). It also has new applications in agricultural, biological and fertilizer industries, as nanoparticles have unique chemical and physical properties due to their large surface area and high efficacy (Siddiqui *et al.*, 2015) and everything that has been mentioned is reflected positively in agricultural production, and the plant is of high productivity and excelled in its traits when using the best methods to add nano fertilizer to the plant in this experiment. The nanoscale leads to a change in the activity, solubility, and all properties related to the temperature, mass, speed of reaction activity, etc., and because of those changes between the atoms and molecules that make up those nanoparticles in terms of attachment, it leads to an increase in the effectiveness of the particles on the surface of the plant body and thus the speed of their entry into the plant as well as their effectiveness. Which leads to the emergence of different traits of the large non-nano particles and thus leads to excel in the traits when treating plants with it (Hosokawa *et al.*, 2007). Through the results in Table 1, we note that the plants used in the research are responsive to Nano elements (Macro and Micro nutrients). The use of nano-materials in fertilization achieves many advantages with great effectiveness compared to conventional fertilizers, due to their use in a smaller quantity and their high efficiency, as well as the role of nano fertilizers in increasing resistance The plant is due to drought, diseases and insects due to its high permeability and works to improve plant metabolism because it gives a large surface area and then increases the contact area with the plant, which leads to increased growth, improved production and reduced loss of nutrients when using nano fertilizers compared to conventional fertilizers (Siddiqui *et al.* 2015). The positive role of nano fertilizers can be due to the role of the nitrogen component through which the process of building protein and nucleic acids leads to an increase in the division of chloroplasts and an increase in the activity of enzymes responsible for forming the chlorophyll molecule. Also, potassium is important in increasing plant height through its positive effect in the process of cell division and expansion by providing appropriate Turgor pressure as well as its role in activating a number of enzymes responsible for building synthetics that are involved in building the plant's structure, which leads to increased growth. In addition, the major and minor elements have a role in the biological processes inside the plant that increase the efficiency of photosynthesis and increase the metabolic processes inside the cells as well as the role of the important element zinc in building the amino acid tryptophan, which is the basis for building Indole acetic acid (IAA) and is important in the process of cell division that helped In improving the Vegetative growth of the plant. Iron spraying also performs an important function because of iron participation in the metabolic processes of forming chlorophyll and increasing the number of grana in chloroplasts, where iron accompanies enzymes for the representation of chlorophyll, and there is 80% of the iron in chloroplasts, which have a major role in the process of photosynthesis (Guller and Krucka, 1993). It can be due to

the role of boron and potassium in activating a large number of enzymes and forming some of the raw materials needed for metabolic reactions, and their participation in the transfer of sugars from the places of their production in the leaves to the storage areas. The ground addition maintains the activity of the nutrients for a longer period, which leads to an increase in their usefulness for the plant, which is summarized by the rapid absorption of nano fertilizer in compared with conventional fertilizers (Shahraki and Naderi 2015, Arshad and Ditta). As we note that the ground addition of nano fertilizer has a significant effect in comparison with other methods for a number of traits, perhaps the reason for this is due to the long stay of the fertilizer in the soil and the plant's benefit from it is more than what led to an increase in the height of the plant and its significantly excelled to tomato, eggplant and pepper, And that the leaf area for the eggplant plant was excelled, Perhaps the reason is that the use of nanomaterials in plant nutrition has an important role

where it increases the absorption of light and then increases the processes of photosynthesis by raising the proportion of chlorophyll in the leaves due to the increase in the leaf area resulting from the use of nanomaterials (Lue *et al.*, 2002), It also improves plant resistance to diseases and also its tolerance to different stress conditions (Ali *et al.* 2014), as well as the use of nanomaterials, achieve many advantages with great efficiency compared to traditional fertilizers for its use in a lower quantity and its high efficiency and the nutrients retain their activity for a longer period, which leads to an increase in their usefulness to the plant, which is summarized quickly. Absorption by the plant compared to other fertilizers (Ditta and Arshad, 2013; Naderi and Shahraki, 2015). Bozorgi (2012), showed when spraying 2 g of nano-iron on eggplant plant, it led to a significant increase compared to not spraying in total yield, the number of fruits, plant height and number of branches.

Table 1: The effect of nano fertilizer and method of their addition on the growth and flowering of tomato, eggplant and pepper

The number of flowers per plant	The number of leaves per plant	The percentage of dry matter (%)	Stem diameter (cm)	The number of branches	The leaf area (cm ²)	Plant height (cm)	Treatments	
4.64	38.00	14.10	7.25	2.31	80.10	76.80	Control (A 1)	Tomato
5.00	34.33	14.84	7.94	2.41	96.20	77.30	Foliar spraying (A 2)	
6.41	38.33	14.58	8.39	2.50	92.30	95.30	Ground addition (A 3)	
N.S	N.S	N.S	N.S	N.S	N.S	16.00	L.S.D	0.05
4.03	17.17	12.46	6.40	2.16	97.5	33.25	Control (A 1)	Eggplant
4.70	18.72	13.02	6.75	2.86	111.20	31.53	Foliar spraying (A 2)	
4.60	20.03	11.91	6.39	2.23	131.20	37.42	Ground addition (A 3)	
N.S	N.S	N.S	N.S	N.S	28.40	1.44	L.S.D	0.05
8.78	55.70	12.08	7.43	2.66	39.50	39.67	Control (A 1)	Pepper
12.20	55.70	12.20	8.10	3.19	44.50	40.33	Foliar spraying (A 2)	
9.96	56.70	12.33	8.22	2.80	45.00	42.94	Ground addition (A 3)	
3.10	N.S	N.S	0.35	0.24	N.S	1.54	L.S.D	0.05

Conclusion

Nano fertilizers showed a significant and positive effect in a number of traits. This indicates the vital role of nano fertilizers in improving growth indicators. The study also showed that the ground addition of nano fertilizers is more beneficial and influencing the growth and yield indicators of the plants under study.

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