



THE POSSIBILITY OF USING NANOFERTILIZERS TO IMPROVE THE QUALITY AND RAISE THE EFFICIENCY OF VEGETABLE CROPS PRODUCTIVITY AND REDUCE THE DAMAGE OF BIOLOGICAL STRESSES (Review Article)

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ABSTRACT: Several methods were used to increase productivity and improve the quality of the product for vegetable crops and prolong their presence in the markets, including the treatment of various vegetable crops with industrial growth regulators and mineral fertilizers, whether fertilizers containing in their composition contain micronutrients or major nutrients. Global statistics have shown in many studies that there are large numbers of people in the world whose number exceeds 3 billion peoples who suffer from undernutrition, especially the shortage of micronutrients, as this problem can be overcome by adding fertilizers containing these elements to agricultural production fields in different ways, but the use of these chemical fertilizers may have negative harmful effects on the environment and public health in addition to the high prices, which constitute an economic burden on farms, so the researchers moved not long ago to adopt the idea of using nanofertilizers to raise production efficiency and reduce the harm of biological stresses reduce the cost of production processes as well as it is the safest food source compared to chemical fertilizers in vegetable crops, which have been used and utilized in many scientific fields in many countries of the world.

Key words: Nano, nano-fertilizer, biological stresses.

INTRODUCTION

As a result of the possibility of growing vegetable crops in more than one growing season in many countries of the world, their cultivation may reach three growing seasons per year, this has led to an increase in the amount of mineral fertilizers added in the commercial production fields of vegetable crops compared to other crops such as fruit, which has hurt to exacerbate and increase the harmful effects of the environment and the general health of society, especially the residual effect of nitrates that cross the most dangerous to human health (Othman, 2007), Therefore it was obligatory for researchers in the agricultural field to think about finding alternative means of chemical fertilizers to ensure the reduction of environmental pollution and biological stresses

to which microscopic soil organisms benefiting the plant are exposed as a result of excessive use of chemical fertilizers, and that the use of the newly introduced nano system in agriculture is one of the revolutions scientific to achieve the highest production in vegetable crops at a lower cost, which can reduce some of the vital stresses that affect vegetable crops and the beneficial microorganisms of soil and plants.

What is the concept of nano

The word Nano has been defined in the Greece language as a derivation from the word dwarf or the finite thing in infancy, while the word Nano scientifically indicates that it is a material whose dimensions are one billionth of a meter per square meter, as this unit It is used to measure the microscopic particles, atoms and

minutes of complex materials (Raab *et al.*, 2011).

The unique properties of nanoparticles to reduce the biological stresses that affect plants and soil

Depending on the concept of nanotechnology, given that particles with very small sizes are less than 1000 nanometers, they provide materials that have in their composition essentially different features and behaviors than those of the larger minutes, the smaller of nanoscale size of a particle, the more of its atoms that make up its surface relative to the number of particles intering inside the body and this change between the ratio of the surface atoms to the internal atoms of the nanoparticles is what explains the change in the chemical and physical properties of the nanocomposites (Bajai, 2017), and one of the most important of these characteristics is the characteristic of hardness as the small size of nanoparticles the presence of huge numbers of atoms on their outer surfaces increases the hardness of materials and increases their resistance to vital stresses. The nanoparticles are also characterized by a few melting point that is less than many times larger than they are in the natural state. Also, the nanoparticles have very high chemical activity as they are used to convert toxic and harmful gases into safe gases (Al-Mutairi, 2012) and this is thus reflected in reducing the vital stresses they are exposed to soil and plants. Nano fertilizers are characterized by their high solubility in addition to their high efficiency in penetrating plant tissues and used in small quantities and with high efficacy and thus play an important role to solve many of the problems that agriculture is exposed to, including chemical fertilizers and fertilizers that were and are still a subject of controversy about its negative effects on soil and plants due to its decomposition slow growth and increased accumulation in the soil, which increases the soil and plant stress (Monreal *et al.*, 2016). The large surface area characteristic of nanofertilizers is that it participates in increasing the activity of enzymes that are directed to increasing the speed of chemical and biological reactions of the plant cell, increasing the synthesis of amino acids and nucleic acids, as well as the role that nanomaterials play in inhibiting the formation of free radicals which appear when the plant is exposed to stress due to the lack of irrigation

water and this leads to less oxidative processes and thus to encourage vegetative growth of the plant and delay aging (Morteza *et al.*, 2013).

Nanomaterials can be used as carriers of insecticides and fungi to control insect and fungal diseases, which are considered vital enemies of vegetable plants, as nanoparticles contribute to the slow release of a chemical to a specific host to control pathogenic insects from a liberating mechanism that includes disintegration or biodegradation, diffusion, and osmotic pressure at a certain PH (Ali and El-Jawadry, 2019). In general, coated insecticides and fungicides have the ability to target a specific insect or fungus and thus the quantity of the added pesticide is less than the usual pesticide as the insecticide and nanoparticle absorbs on plant surfaces and is slowly released and for a longer period of time than the conventional pesticide that is lost by washing (Scrinis and Lyons, 2007). *Tribolium castaneum* insect could be eliminated by using nanoparticles loaded with garlic oil (Barik *et al.*, 2008). Sarlak *et al.* (2014) observed that when encapsulating the mancozeb fungicide with multiple layers of carbon nanotubes inlaid with citric acid this process transformed the large fungicide into a nano fungicide and the effectiveness of this pesticide on the fungus *alternaria alternata* was studied and the results confirmed that the nanocide was significantly superior to the pesticide the traditional inhibitory effect on the fungus. At the present time, there are many pesticides and fungicides in the form of nanoparticles, which are used in commercial production, which leads to reducing the quantities of pesticides used in the prevention of insect and fungi diseases that affect vegetable plants, as the intended matter was achieved in the fight against various pests in small quantities, given that it can be used on only affected plant parts, thus reducing environmental pollution and reducing the cost of the resistance process as a result of the use of nanocides.

Significant results in increasing yields and improving the quality of many vegetable crops achieved through the use of nanofertilizers

The use of Zn nanoferture at a spray rate of 0.28 g.L⁻¹ significantly increased corn plant height, dry weight gain, and improved product

quality when compared to control plants (Adhikar, 2011). It was observed that the eggplant plants which nanostructures were added sprayed on vegetative growth at a concentration of 1 and 2 g.L⁻¹, that the height of the plant and the average number of branches and fruits increased significantly when using the concentration of 2 g.L⁻¹ compared to the comparison plants (Bozorgi, 2012). The seedlings of *Sitrullus lanatus* and the dry weight of the root and vegetative population increased significantly when using nano-silver fertilizer at concentrations of 0.05 - 2.5 mg.L⁻¹ in the study conducted by (Almutairi and Alharbi, 2015). In the potato tubers production field an experiment was conducted by Mohsen *et al.* (2016) to compare the use of N₂₀P₂₀K₁₅ mineral fertilizer at a rate of 200 kg. ha⁻¹ and potassium and zinc mixed with nanoparticles with chelated form at a rate of 1 kg ha⁻¹, the results of this study showed that there are significant differences between chemical and nanofertilizers in all studied vegetative characteristics and yield, which indicates the efficient use of nanofertilizers in these fields due to the small amount of fertilizers used compared to chemical fertilizers. Ezzat and Mohammad (2016) reported that the hardness of tomato plant fruits, soluble solids, and fruit content of vitamin C when fertilizing with calcium, iron, and zinc nanoparticles increased significantly. Bajai (2017) achieved a significant effect on carrot plant height, number of leaves, total chlorophyll content, root length, nitrogen, protein and iron concentrations, and beta-carotene content in the root total when using nano-silver fertilizer at a concentration of 15 ml.L⁻¹ versus increased potassium and zinc at a concentration of 30 ml.L⁻¹, phosphorus and calcium at a concentration of 45 ml.L⁻¹. Red and broccoli plants are among the plants of the Brassicaceae family, which are very important in terms of indicative health, as it is possible to reduce the incidence of many cancerous diseases by eating these crops in the authorities or cooked, so some studies focused on increasing productivity and improving the quality of these crops. Ahmed *et al.* (2018) studied the effect of adding nanofertilizer, organic and mineral fertilizers in the red cabbage and broccoli plants, as the results of this study showed that the use of nanoparticle fertilizer and nanoselenium with organic fertilizers gave the best significantly results in the growth and

yield characteristics studied in this Plants compared with the use of chemical fertilizers. In a study by Ahmed *et al.* (2019) to explain the physiological role of nanofertilizers on summer squash plant, the study included the use of three types of nanofertilizers (Fe₂O₄, Mn₃O₄ and ZnO nanofertilizer) individually for each fertilizer in addition to the use of these fertilizers in a joint combination of each fertilizer and combination, the three types of these fertilizers included a concentration of 20 ml. L⁻¹, the study continued for two years. results of this study showed that the use of all these fertilizers individually and in a double form between each fertilizer has led to a significant increase in all studied vegetative growth characteristics represented by plant height, number of leaves and leafy area of plant and the fresh and dry weight of the plant in addition to improving the qualitative yield characteristics related to the length and diameter of the fruit and the yield of the plant in addition to the qualitative characteristics of the fruits that included increasing the ratio of protein, oils, carbohydrates and fibers. Al-Khafaji (2019) connected that the use of a combination of nanofertilizers containing the major elements NPK, microelements Co, Mn, Fe, Zn, Mo, B and compound fertilizer N₁₅P₁₅K₁₅, this combination achieved significant superiority in the characteristics of vegetative growth, yield and quality, as each number of stems increased the height of the plant, number of leaves, percentage of chlorophyll in the leaves, leafy area, percentage of dry matter in the vegetative total, number of markatable tubers, markatable yield, percentage of dry matter in the tubers, percentage of starch, protein, nitrogen and phosphorus in the tubers of potato plants. Researcher Ahmed (2019) reached a significant increase in root length, plant height, leafy area, leafy area index, increase in the ratio of free water to restricted water, stem content of chlorophyll a and chlorophyll b, in sweet pepper plant fruits of total carbohydrates, total sugars, nitrogen, potassium, and phosphorus in addition to the increase significance in fruit yields when spraying plants with Lithovit nanofertilizer, which contains in its composition calcium, nitrogen, phosphate, potassium, magnesium and selenium in the nanostructure form, as this fertilizer was used in a concentration of 2.5 and 5 g.L⁻¹.

Based on the above, this article can be connected with a number of important conclusions

1- The use of fertilizers with nanostructures may help us reduce soil and water pollution problems.

2- Reducing the use of chemical fertilizers, which reduces the residual effect of chemical fertilizers, which may lead to climatic changes that are inappropriate for humans and plants.

3- The quantities of nanofertilizers used in agriculture are very small when compared to chemical fertilizers, which leads to an increase in the economic yield and a reduction in the problems of soil and air pollution.

4- The use of pesticides and fungi in the nanostructure reduces the quantities of pesticides used in the control and thus reduces vital stresses.

5- Improving the characteristics of the vegetative growth of many vegetable crops that were enriched with nanofertilizers

6- Improving the quality of vegetable products by increasing the percentage of nutrients in vegetable plants that have been treated with nanostructures.

The aforementioned about the properties of nanofertilizers and their role in reducing vital stresses and increasing the productive yield in vegetable crops and useful conclusions from the use of nanofertilizers for humans, plants and the agricultural environment this does not mean that there are no side risks from the use of nanofertilizers on it we recommend in this article to conduct future research specializing in the side effects that Nanofertilizers may cause it to the general health of society.

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