Application of Nano-Technology in Increasing Food Health and Improving Industrial Agriculture

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Agriculture industry 4.0 is using the advanced technologies to improve the product and efficacy. In this paper the application of Nano technology in fertilizers usage is presented to increase the products quality and health. Increasing the production of agricultural products to meet the needs of society requires the use of fertilizers. Farmers and agricultural producers use fertilizers in order to strengthen agricultural lands, improve soil fertility and increase production. Nowadays, it is very important to eliminate or reduce the consumption of chemical fertilizers such as phosphate and nitrate and replace them with organic, nano and biological fertilizers. The use of chemical fertilizers for the production of more agricultural products has significant and irreparable environmental effects, which include reducing the quality of soil, water and their pollution, affecting living organisms, reducing soil nutrients, reducing microbial activity, and destroying Organic materials and soil fertility, environmental degradation, soil and accumulation of heavy elements. In this article, the effect of organic fertilizers that are added in order to supply nutrients needed by the plant and improve the soil is investigated. The results showed that organic substances are important factors in soil fertility due to their positive effects on physical, chemical and biological properties. Being cheap, less pollution than chemical fertilizers and reducing the negative environmental effects of using chemical fertilizers, improving crop production, increasing fertility, preventing erosion and improving soil performance, increasing the plant's ability to absorb nutrients and adapt to it, among other features. And the advantages of using these fertilizers are. This article deals with the importance and use of organic and biological fertilizers in agriculture and examines its effect on the growth of lettuce as an example. This article has been done in order to investigate the effects and harms of using chemical fertilizers, the use of organic and biological fertilizers, which can be used by practitioners in the field of agriculture.

Keywords: sustainable agriculture, Nano technology, agriculture industry, food health,

chemical fertilizer, Nano and organic fertilizer.

1. Introduction

Since a long time ago, mankind realized the importance of the role of mineral and organic elements in plant growth and crop production. The most important of these elements (nitrogen, phosphorus and potassium) were used as chemical synthetic fertilizers with the aim of increasing the production of agricultural products [1-3]. The increasing use of chemical fertilizers has caused irreparable environmental, health and economic damage. The use of nitrogenous chemical fertilizers causes water and soil pollution due to their remaining in nature, and on the other hand, the production of each kilogram of nitrogenous chemical fertilizers requires the consumption of 1155 kilocalories of energy. This amount of energy is generally provided from oil sources and petrochemical industries. These disadvantages of chemical fertilizers caused the production of organic and biological fertilizers to be given serious attention. Considering the compatibility of microorganisms with the environmental and climatic conditions of their habitat, the use of non-native bacteria obtained from areas with different characteristics compared to the climatic conditions of the country, for the production of biological fertilizer and their use in the climatic conditions of the country, will certainly not have the necessary efficiency. Therefore, the use of native bacteria that are compatible with the country's soil and climate conditions is of special value for the production of biological fertilizer

In recent years, due to the global issue of climate change and soil management, it has received much attention. Currently, organic amendments are an acceptable choice for soil bioremediation. Carboxyl, phenolic hydroxyl, and other functional groups that include surface oxygens enable biochar to reduce emissions from organic pollutants. Biochar has functional groups on its surfaces and the negative charge of functional groups increases over time and during oxidation in the soil [4, 5].

2. Nano technology application in agriculture industry

2.1 Nano pesticides and nano herbicides

In recent years, pesticides have been developed that are surrounded by nanoparticles. The characteristic of these pesticides is that they can be designed in such a way that the release time of the pesticide or herbicide increases, or their release begins with the occurrence of certain environmental conditions. By using the integration of this type of pesticides and intelligent release systems, in addition to increasing the production of agricultural products, injuries to workers in agricultural fields are also reduced.

2.2 Nanosensors

Precision agriculture, which has always been a long-standing dream, helps to obtain the maximum output (product performance) with the least input (fertilizers, pesticides, herbicides, etc.); this goal can be achieved by examining environmental variables and targeted actions. Nanosensors are used to investigate and identify pollutants, pests, the

amount of nutrients in the soil, as well as stresses caused by drought, temperature or pressure. Also, these sensors increase the efficiency and productivity of agricultural lands and their products through the use of agricultural inputs when they are needed. In precision agriculture, by using computers, global positioning satellite systems (GPS) and remote control sensor devices, it is possible to make a correct decision about the quality of the growth of agricultural products, accurate diagnosis of the nature of the region and its problems. He stated that in addition to reducing costs, this work has helped to reduce agricultural waste and minimize environmental pollution. Small sensors and control and monitoring systems made with the help of nanotechnology can have an important impact on this new way of agriculture.

2.3 Nanofertilizers

The amount of nutrients in the soil should be appropriate and can provide these nutrients well to the plant. One of the ways to supply soil nutrients is the use of suitable fertilizers. In addition to increasing production, the use of fertilizers should also improve the quality of agricultural products. Another point is not to cause environmental pollution by fertilizer; Because otherwise, the health of humans, animals and plants will be endangered. Nano technology can play an important role in this field by changing and influencing the formulation of fertilizers and producing materials with suitable and unique properties (chemical nano-fertilizer, organic nano-fertilizer and biological nano-fertilizer), and the use of this technology in the production of fertilizer increases the quantity and the quality of agricultural products and reducing the process of environmental degradation.

Biochar is obtained as a result of the thermal decomposition of biomass, such as wood, plant leaves, agricultural residues, and animal manure, which is produced under high heat and under oxygen-free or limited oxygen conditions [6, 7] the production process of biochar is different from the actual burning of biomass; Because in real burning conditions, in the conversion of biomass to CO2, a large amount of oxygen is available for the complete oxidation of carbon, so most of the biomass carbon is converted to carbon dioxide (CO2) and only ash and a small amount of carbon remain. During the process of biochar production, which is based on limiting access to oxygen, it causes more stabilization of carbon in the biomass [8].

Every year, about 15 billion tons of the surface soil of the world's farms are lost through erosion, and about 2 million hectares of agricultural land undergo irreversible desertification. Although the increasing reduction of soil is an important issue [9-12]; But other factors such as the speed of water flow, reduction of water storage capacity in the soil, organic matter, nutrients and biological factors of the soil following soil erosion will equally reduce the fertility of the land. Importing different materials and inputs into agricultural systems in order to increase soil fertility increases the flow of energy in this system. Soil fertility describes the ability of the soil to provide stable, optimal and favorable plant growth conditions. In the past, soil fertility was only to meet the elemental needs of nitrogen (N), phosphorus (P) and potassium (K). During many studies, the biodynamic system was investigated. This system was presented by a German scientist named Rudolph Steiner, who introduced agriculture as a sustainable system within the ecosystem, and its name comes from the Greek word bio, which means biological energy. In this system, animals are

considered as a part of the agricultural ecosystem. Biodynamic standards were more limited than organic agriculture, and in biodynamic agriculture, methods similar to current isotherapeutic methods have been common, and finally the discussion of organic agriculture was raised. Although the use of mineral fertilizers is apparently the fastest and most reliable way to ensure soil fertility, the high costs of fertilizer consumption, pollution and destruction of the environment and soil due to the use of these chemical fertilizers are worrying. Therefore, the full use of available renewable plant food resources (organic and biological) along with the optimal use of minerals plays an important role in maintaining the fertility, structure and vital activity of the soil.

Although the use of green fertilizers is effective in providing nutrients and improving soil properties, it should be noted that these fertilizers are not able to provide all the plant's nutritional needs. Therefore, it seems that combining these fertilizers with reduced amounts of mineral fertilizers, in addition to meeting the plant's nutritional needs, increases soil organic matter and its physical and chemical quality. The mung bean plant (Vigna radiata) is one of the crops of the legume family that is able to biologically fix nitrogen and is cultivated as a green manure in some tropical and subtropical regions. In [13] regarding the effect of cultivating this plant as Green manure and also its interaction with different levels of nitrogen and inorganic phosphorus on soil characteristics as well as the yield and yield components of wheat have been conducted and nitrogen on soil quality characteristics and wheat grain yield in hot and dry environmental conditions.

3. Method

Nanotechnology allows to arrange desired components and compounds inside the cell and create new materials and products using new methods of self-organization and gene modification. The use of these types of capabilities leads to the production of plants, livestock and in general organisms with superior characteristics such as the production of plants that are resistant to pests, viruses, bacteria, fungi and herbicides. In the last few decades, due to the use of chemical fertilizers, there have been many environmental effects, including water and soil pollution and problems related to the health of humans and other living organisms. The policy of sustainable agriculture and sustainable development of agriculture prompted experts to get as much help as possible from living organisms in the soil in order to meet the plant's nutritional needs, and this is how the production of biofertilizers began. The first biological (biological) fertilizer was used at the end of the 19th century, and other biological fertilizers were made from that date onward. Organisms (organisms) used in the production of biological fertilizers are mainly isolated from the environment. In laboratory conditions, they are propagated and cultivated in special culture environments, prepared and consumed. The use of biofertilizers takes a long time. Producers of crops used to cultivate a dark plant called leguminous to strengthen agricultural lands and they believed that by cultivating it, soil fertility would increase.

This experiment was carried out in the 2022 crop year in a farm located 6 kilometers south of Baghdad. The test site is located at latitude 32 degrees and 34 minutes north and longitude 48 degrees and 31 minutes east. The experiment site has a hot and dry climate with mild winters and hot and dry summers. The research was carried out in the form of a factorial

split-plot experiment with three replications without fertilizer, phosphorus and nitrate fertilizers.

Table 1: Soil characteristics of the test site

depth	EC	pH	Organic materials	phosphorus	potassium	soil texture			
						clay	Silit	Sand	Texture
0-25	1	7.33	0.66	191	49	40	35	27	clay - sand
25-50	0.8	7.87	2.7	144	45	43	40	17	clay - sand

The wheat field preparation operation included deep plowing, two perpendicular disks and a trowel. The amount of cultivated wheat seeds was determined based on research recommendations with a density of 400 seeds per square meter. The amount of mung bean used was 100 kg per hectare. Nitrogen fertilizers from urea source and phosphorus from triple superphosphate source were added to the soil according to the amount of fertilizer treatment. Half of the nitrogen fertilizer and all the phosphorus fertilizer were distributed in the field after the first disk and mixed with the soil by the second disk. The rest of the nitrogen fertilizer in each fertilizer treatment was used in the form of vinegar in the shoot stage (one second). The land preparation operation for mung bean cultivation included deep plowing, two perpendicular discs and a trowel. In the middle of the flowering stage, the mung bean was returned to the soil by the plow and was well crushed and mixed with the soil by the rotivator. Wheat was planted on January 10. Some soil characteristics such as the amount of organic matter, phosphorus, nitrogen, potassium, acidity and the state of soil texture were measured. Sampling was done from the soil of the test site before planting mung bean and from two depths of 0-30 and 30-60 cm.

4. Results

The use of nanocapsules containing enriched foods that gradually deliver nutrients and antioxidants to certain parts of the body can, in addition to turning old food into nano-sized particles, so that they can be released inside the body and absorbed well, considering According to a person's taste or according to the temperature and pH conditions of his mouth, he can change the parameters of color, taste, taste and smell of food. The use of Nano technology includes the preparation of a wide range of interactive food and drink products that are compatible with the taste and individual needs of the consumer and includes a wide range, from color changing drinks to new foods compatible with the consumer's sensitivity (or his nutritional needs). In Iraq, with the predominant dry and semi-arid climate, not only are the soils poor in terms of organic matter (less than one percent), but due to the high temperature, it is very difficult to keep the amount of organic matter in the soil constant. Soil is a living environment, depending on its type, millions of living organisms such as fungi, bacteria, etc. live in each cubic centimeter, and they play the most important role in the destruction and transformation of organic matter in the soil, and speed up the humus and

mineralization stages of organic matter.

Farmers and gardeners will see a reduction in evaporation and an increase in water storage capacity by using organic fertilizers. Among the benefits of organic and Nano fertilizer in plant growth and root improvement, the following can be mentioned: The root system in soils containing organic fertilizer is more developed and developed. The effect of organic fertilizer on soil granulation improves soil granulation in soils containing organic fertilizer. Reducing soil erosion with organic fertilizer leads to raw plant remains and remaining organic materials, which reduce the speed of wind and runoff on the soil surface. Also, organic fertilizer is referred to as a reservoir of nutrients for plants. Organic fertilizer can be considered as an effective factor in preventing the appearance of seams and cracks in the soil. Reduction of piles in soils with heavy texture will be one of the effects of using organic fertilizer in the soil. In addition to showing the health and quality of the soil, the presence of organic matter is a suitable indicator for its fertility, which is the result of the interaction of the physical, chemical and biological processes of the soil. By improving the conditions of soil formation, organic matter improves the state of porosity and permeability of the soil. As a result of mineralization, organic materials release a significant amount of high-consumption and low-consumption nutrients in the soil and contribute a lot to balanced plant nutrition. The amount of soil organic matter is a function of various factors, including climate, soil characteristics, agricultural management, etc.

The highest and lowest number of spikes per unit area were assigned to mung bean planting dates on 10th of July and fallow, respectively (Table 3). The number of spikes on planting dates of June 10 and August 20 was 5.14 and 7% higher, respectively, compared to the fallow treatment. Nitrogen and phosphorus significantly increased the number of spikes. With the consumption of 120 kg of nitrogen and 90 kg of phosphorus per hectare, the number of spikes in the control plot without fertilizer increased by 20 and 13%. These results are in accordance with the report of [13], based on the increase in the number of spikes per unit area, [11] reported that nitrogen deficiency decreased the number of spikes per unit area through the reduction of the number of fertile tillers showed that the highest number of spikes per unit area was assigned to the treatment combination of 120 kg nitrogen + 90 kg phosphorus on the date of planting green manure on June 10.

Table 2: Comparison of average seed yield and related traits in the studied treatments by nano technology

Treatments	Spike in m2	Spikelet in a spike	Seed in a spike	Seed in a spikelet	Grain per m2	Weight of 1k seed (gr)	Seed yield (gr/m2)	Biological performance (gr/m2)
fallow	394	11.8	20.1	1.7	7829	39	414	765
10 Jun	451	11.9	22.1	1.8	9845	40	475	899
20 Aug	449	12.6	22.4	1.7	9218	39	441	841
Nitrogen kg in Hectare								
No	369	11.4	18.6	1.6	6844	38	377	744

fertilizer								
65	443	12.2	21.4	1.6	9089	39	466	822
130	473	12.5	23.2	2.0	10431	40	501	922
phosphor kg in Hectare								
No fertilizer	392	11.9	21	1.7	7999	39	406	811
50	425	11.9	22	1.8	8995	39	441	840
100	466	12.2	23	1.9	9689	40	462	853

The effect of planting date of green manure and the interaction of treatments on the number of spikelets per spike was significant at the five percent probability level and the effect of nitrogen on this trait was significant at the one percent probability level. The effect of phosphorus fertilizer on the number of spikelets in the spike was not significant (Table 2). The results showed that the increase of nitrogen and phosphorus caused an increase in the number of spikelets in the spike. The increase in the supply of photosynthetic materials required for spiked growth and this reaction resulted in an increase in the production of spikes in the spike [10]. While the effect of phosphorus treatment on this trait was not significant, increasing the amount of nitrogen caused a significant increase in the number of seeds in the spike. In [9] concluded that with the decrease in nitrogen, the number of fertile flowers in each spike decreased significantly, in this research showed that the number of seeds in each spikelet decreased due to the increase in the number of sterile florets. The date of planting green manure on the 10th of July and the fallow treatment had the highest and lowest average number of seeds in each spikelet respectively.

5. Conclusion

Now, with the passage of years since the occurrence of the green revolution and the reduction of the growth ratio of agricultural production to the world's population, the need to apply new technologies in the agricultural industry is obvious before any other time. In the meantime, nanotechnology as an interdisciplinary technology and the vanguard of solving problems and deficiencies in many scientific and industrial fields has well proven its position in agricultural sciences and related industries. Nanotechnology has wide applications in all stages of production, processing, storage, packaging and transportation of agricultural products. The introduction of nanotechnology into the agricultural and food industries implies an increase in the amount of production and their quality, along with preserving the environment and the resources of the planet. In general, the results of this research showed that planting mung beans for use as green manure on June 10 increased wheat grain yield compared to fallow conditions. It was also found that when mung bean was used as a green manure, the grain yield in nano-fertilizer treatments of 60 kg nitrogen and 45 kg phosphorus per hectare was higher than in the treatment of 120 kg nitrogen + 90 kg phosphorus per hectare under fallow conditions. The increase in grain yield in the green manure treatments compared to the fallow treatment by Nano technology was due to the increase in the number

of seeds per unit area and biological yield. It seems that the use of green and mineral fertilizers by the Nano technology at the same time increased the absorption of mineral fertilizers and also increased the use of wheat from the nutritional elements in green fertilizers.

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