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# Nanomaterial's Manufactured By Bacteria and Plants and Their Role in Pathogen Resistance

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## Abstract

Nanotechnology is one of the modern technologies that are used in many fields, including agriculture. The biosynthesis of nanoparticles is carried out in many ways, and the biological method is one of the easy, fast, cheap and environmentally safe methods that is done by using bacteria and plants. As bacteria are prokaryotic microorganisms with a simple structure and the absence of a nucleus in the cell and among the microorganisms, bacteria have taken a greater interest in the field of biosynthesis of nanomaterials One of the main advantages of bacteria is the synthesis of nanomaterials as well as the ease of dealing with them as they can be genetically modified using genetic engineering techniques by expressing specific enzymes due to the loss of the nucleus  The process of biological formation, or what is called green technology, can be used to obtain stable nanostructures from biological resources. It has advantages and is better than other biological systems because it is used in the wider production of nanoparticles. This reference study deals with the latest studies on the biosynthesis of nanoparticles using bacteria and plants, and some examples of using these nanomaterials in resistance and control of some plant diseases.

**Keywords**: Nanomaterial's, bacteria, plants, pathogen resistance

## Introduction

Nanotechnology has received great attention at the global level due to its complete changes in the properties of physical, chemical, magnetic and electronic materials (Mansoori, 2005). Among the applications of nanotechnology that drive development (energy storage, production and transfer, improvement of Agricultural production, Drinking water treatment, Disease diagnosis and follow-up, Food processing and Storage, Air pollution treatment,  Construction, Health monitoring and pest and insect resistance and that one of the most important challenges obverse  humanity in the twenty-first century, we find that capacity comes first, followed by providing healthy water, safe food and a clean environment (Ghorbanpour, 2015).The field of nanotechnology is not a field separate from science, but rather works on the basic components of matter, namely atoms and molecules (Mansoori et al., 2016). Nanotechnology has become at the forefront of the most substantial and thrilling fields in Physics , Chemistry , Biology , Engineering and many other fields, and that nanotechnology has a great future in all Medicainal , Martial , Informatics, Eelectronic, Computational, Petrochemical, Agricultural, Biological and Other fields(Priyanto et

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al., 2001). As a result of the use of nanotechnology, the physical, biological and chemical characteristics of materials can be combined so that they can be used in any field, whether in the human body or in the aircraft engine. Then standardizing the quality of the product, as well as reducing the cost of production and reducing the energy expend, and there are system at the nanoscale standerd capable of directing the atoms and placing them in their correct place during the reaction proces( Nordmann, 2004).

The field of environmental protection is one of most prominent applied fields that nanotechnology pays great attention to, due to the interconnectedness between human health and the environmental conditions in which he lives and as a result of the increase in population growth rates that the world is witnessing, the quantities of pollutants that result from (sewage water, fertilizer and agricultural pesticides drainage) and Industrial waste disposal Human skill and abilities lead to the creation of nanomaterials that lead to environmental protection through (cleaning the environment and ridding it of accumulations of environmental pollutants, developing and updating the methods currently used in removing pollutants and producing advanced nanomaterials(Alia et al., 2016).

**research aims-:**

1- Learn about the concept of nanotechnology.
2- Recognizing the importance of nanotechnology inthe field of agriculture.
3- Applications of nanotechnology in the field of plant protection.
4- The importance of actinomycetes in resisting plant pathogens.
5- Biological methods using bacteria and plants to produce nanoparticles.

**1- Learn about the concept of nanotechnology- :**

The beginning of nanotechnology goes back to the physicist Richard Feunman in 1959 , The Scanning tunneling microscope was invented in 1982, which illuminated the world of nanoscopy for the first time in history and opened great prospects for the advancement of nanosciences and technologies. After that, developments followed and led the tunnel scanning microscope to develop another microscope called the atomic force microscope.

In 2002, IBM announced that it had developed a new electron microscope with very high energy. These microscopes are now considered important tools in the research and development of nanoscience and technology, and that these microscopes allow us to indirectly see atoms and molecules, and what we see is a representation of them on a computer screen and not enlarging them as well. In standard microscopes( **Azamal Husen**

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**& Khwaja Salahuddin Siddiqi** , 2014). The National Initiative for Nanotechnology in 2000 provided a clear qualifier of nanotechnology as the development of discuss and techniques at the level of measurements between (1:100) nanometers to understand the phenomena and manner of materials at this scale with the aim of creating small-sized structures, devices and systems with new properties and assianment. Nanomaterials have basic characteristics such as conduction, stiffness and fusion And other characteristics depend on the size, which makes the nanoparticles of the material appear unique to this size that is not shown in the normal size of the material .( Christian , 2014)

## 1- **The importance of nanotechnology in the field of agriculture-** :

The agricultural sector has witnessed terrible changes at the level of global production, as it has become, through the use of modern technology, easy to intensify crops at the farm level, develop modern irrigation systems, and follow modern post-harvest systems with the possibility of using different and improved crop varieties or strains of high production, so the importance of nanotechnology emerged as one of the The most important solutions proposed to increase global agricultural production, as it is noticed that the number of nanoproducts has exceeded 800 products in the global markets, which is expected to double in the coming days, as nanoproducts represent more than 15% in global markets represented in preservation and storage packages for agricultural products, fertilizers, nanopesticides and others (Husen and siddiqi, 2014 ).

The uses and applications of nanotechnology in agriculture are important, including how to produce more quantities of food at lower costs with lower energy consumption rates and less waste (Servin and White, 2016). At the level of studies that dealt with the relationship between nanotechnology and its applications in the agricultural sector, it has increased dramatically in recent times to the point that the number of studies published on studying the effect of manufactured nanoparticles on the health and safety of the environment has exceeded 90,000 articles, as for the most important applications of nanotechnology in Agriculture is confined to precision agriculture through Nanosensore or agricultural nanochemicals, represented by nanopesticides and nano fertilizers (Ngo and Vande voordes, 2014).

## 2- Applications of nanotechnology in the field of plant protection- :

Plants are exposed to plant disease at different stages of production, starting from the stage

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of germination until the stage of harvest and post-harvest as well, and these diseases are caused by parasites and non-parasites, which leads to a decrease in the productivity and production of different crops, as the attack of diseases to cultivated plants results in damage to part or all of the plant even after Harvesting, noting that plant diseases are one of the most important sources of crop productivity loss, which is estimated at about 14%, and that plant diseases cause annual crop losses in the world, ranging between (20-30)% (Kashyap et al., 2017).It is also known that there is an excessive use of pesticides and chemicals to resist and protect plants against infections or pathogens ) Fungi – Parasitic plants – Nematodes – Viruses and viroids - Mycoplasma – Bacteria and protozoa Which had a significant impact on threatening the environment, human health and cultivated crops (Sharma et al., 2016) .

The need to find alternatives to resist pests and diseases without causing any environmental disruption and one of the most important solutions that have been put forward has gained great acceptance and acceptance by researchers, farmers and investors, which is the nanotechnology sector as it seeks to reduce and limit the damages resulting from the use of various pesticides and reduce them with the use of safer technological alternatives that prepare materials Agricultural nanotechnology (which is a nano-scale material with biological or biological origin or organic materials with biological functions There is also the possibility of using applications of nanotechnology in Nanotechnology - derived devices through which it is possible to penetrate the field of plant breeding and reduce the chemicals that are sprayed on plants while reducing the loss of fertilizers, thus increasing the productivity of the resulting crop to increase the user efficiency of water and nutrients as behave as nanoparticles or nanomaterials behave. As magic pellets in targeting specific parts of the plant and dispersing chemicals such as pesticides from the plant or increasing the efficiency of nanopesticides through the so-called nanocapsules with Cuticle or plant parts to a certain depth with moderate release of active substances (Kashyapet and others, 2016).There is a possibility of relying on the so-called functional nanoparticles, whether in the case of optical, electronic, magnetic or structural functions, as these nanomaterials are associated with biological molecules such as lipids, proteins and nucleic acids, which allows for an accurate and rapid system for integration between nanotechnology sciences and between these diagnostic molecules, i.e. to discover Pathogenesis and thus plant protection (Wang et al., 2016). Some studies indicate that nanoparticles have the ability to control pests through nanopesticides through nanocomposites that have been mixed and prepared within the limits of the nanoscale

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level, which are pesticides with a high ability to select pests and infect them in addition to that nanocides have a positive effect on the environment in a permanent way that is incomparable with an effect Ordinary pesticides with many environmental problems and biological diversity in the environment, etc. (Kashyap et al., 2017

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**3-The importance of actinomycetes in resisting plant pathogens- :**

The first person to study the ability of filamentous bacteria to resist Pythium on sugarcane was the researcher Tims in 1932, after which Waksman in 2010 conducted a detailed study on the role of filamentous bacteria in enzymatic degradation (Dhanasekaran et al., 2012).

The term biological control agen (BCA) is given to the organism used to reduce plant disease damages (Stirling et al., 2017).The microorganisms that grow in the root zone are considered one of the most important factors used in the biological control of plant diseases, because these bacteria possess the characteristics of producing antibiotics and their role in reducing the damage caused by plant diseases (Wyllie, 1988).

Filamentous bacteria are one of the most prevalent organisms in the soil and are responsible for the smell of wet soil and grow in the form of fungal strings that transform the soil into a suitable environment for plant growth (Sprusansky et al., 2005 ). Soil is the main source for it and the genus Streptomyces is the most prevalent among the other races in the Rhizoplane region. The researchers focused on isolating this bacteria from the area surrounding the roots and it represents a large group of microorganisms widely distributed in the ecosystem around the world (Srinivasan et al.,1991).The reason for its wide spread in nature is due to its high ability to consume a wide range of carbon sources, it has the ability to adapt in extreme environments such as temperature and salinity, and it grows weakly in areas with little ventilation (Hasani et al., 2014).

Streptomyces spp. Was used to control root rot caused by Rhizctonia solani on tomato plant (Goudjal et al., 2014). Streptomyces and Micromonospora were also used to control root rot on lettuce caused by the fungus Sclerotinia minor (El-Tarabily, 2000). Streptomyces SP was also used to control the wilt disease caused by Fusarium (Bubici, 2018). In addition, a study was conducted on the role of filamentous bacteria in inhibiting the growth of Rhizctonia solani and Pythium sp. The causative agents of seedling death disease. Six isolates were obtained that proved their efficiency in reducing the disease, including Streptomyces griseas and Brevibacterium (Fayyadh & Awad, 2018) .A biocide containing Streptomyces griseoviridis was produced in the United States and Europe to

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resist many plant diseases (Polonenko & Cross, 1996).

**Biological methods using bacteria and plants to produce nanoparticles - :**

Nanoparticles are biosynthesis. is done by using the metabolites of microorganisms (viruses, bacteria, yeasts, algae) or plant extracts. The advantages of these methods are that they are environmentally friendly, energy-free, cheap, and fast (Ribeiro et al., 2020). The biogenesis process can be use to obtain stable nanostructures from biology resources. There are different machines (primitive & Eukaryotes) that can be used to collect the nanomaterials. With regard to this type of organism, the different cultures of isolation will be used As antibiotics for fungi such as nystatin are used to isolate bacteria, and antibiotics for bacteria such as Chloramphenicol, which are used to isolate fungi, and then the biomass is insular by centrifugation, and this biomass can be used as a resource for the synthesis of nanomaterials and alltho the stability of biology nanomaterials, it is no monophonic and rapid Their formation is slow and to outdo these trouble, there are sundry operator such as microbial culture procedure and extraction techniques must be ideal. Combined methods such as photobiological style can be used (Narayanan & Sakthivel,2010).

In general, biological nanostructures are best than chemical and physical synthesis methods, for the following reasons :

1- The biosynthesis of nanomaterials will have greater commercial significance, significant savings in energy costs and a higher production rate compared to normal methods (Mukherjee et al , 2002) .
2- Mass output by chemical and physical methods can generally lead to the production of nanoparticles several micrometers larger than normal, while biosynthesis can be used on a large scale to produce small nanoparticles (Joerger et al , 2000) .
3- Clean, non-toxic and environmentally cordial method (Senapati et al . 2005).
4- Physical methods require high temperatures and chemical methods require high squeeze and are difficult to implement (Bansal, 2004).

**5-1 The biomaterials of nanomaterials bymeans of bacteria: -**

Bacteria are prokaryotic micro organisms that have a simple temple and the absence of a nucleus in the cell. Bacteria have taken a great attention in the field of biosynthesis of nanomaterials and one of the main features of bacteria is the synthesis of nanomaterials as well as the ease of dealing with them because they able genetically modified using fetal

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engineering technicality through expression. On private enzymes due to nucleus loss (Vaidyanathan et al , 2010).

Gold nanoparticles have been used for their possibility in therapeutic applications as anti-malarial representative and anti-arthritis agent, which have made a breakthrough in the field of nanotechnology ( Tsai et al , 2007).

Studies revealed that Bacillus subtilis estimate reduce Au + 3 ions to output nanoscale octahedral gold particles inside bacterial cells by incubating the cells with gold chloride (Beveridge &Murray , 1980).

Kashefi et al(2001) display that iron (lll) reduced by Geobacter ferrireducens had deposited gold within cells in the vicinity of the plasma. Faghri Zonooz et al (2012) display that Streptomyces sp is capable of producing extracellular gold nanoparticles of cylindrical and spherical shapes and by a similar study between Khadivi derakhshan et al (2012) that Streptomyces griseus can be synthesized as extracellular spherical gold nanoparticles. Silver nanoparticles have many important implementation in the field of bio-numbering, tracer, antibiotics, filters, and silver nanoparticles are able to purify drinking water, analyze pesticides, and kill pathogenic bacteria to humans (Srikar et al , 2016). Streptomyces hygroscopicus was used for the biological reduction of hydrous silver ions by extracellular components (Sadhasivam et al , 2010). Microorganisms, especially bacteria, have been used to produce large quantities of mineral nanoparticles in the environment, such as minerals based on iron, silicon and calcium (Sharma et al , 2015) . These biological nanoparticles are found everywhere and the morphology of these particles varies from wire-shaped to spherical or cubic shapes (Leung et al., 2013). The micro organisms that output nanoparticles are bacteria, fungi, and yeast (Prasadet et al , 2016). Some kinds of bacteria in response to environmental exertion (such as toxicity of metal ions) establish apology mechanism that allows them to survive and grow in environments with high metallic ion concentrations (Prasad et al , 2016). outcome, many bacterial species are currently being used to reproduction metallic nanoparticles as an alternative pathway for chemical texture. This simple biomechanical method of producing particles display healthy cells and cell extracts. The synthesis of nanoparticles by bacteria can be an intracellular or extracellular operation , depending on the kind of bacteria and the substance (Sharam et al., 2015). Bacillus subtilis was used in the preparation of silver nanoparticles and was used with success against fungi (Alternaria alternate, Aspergillus niger, Rhizopus oryzae). Pyrobaculum islandicum was used in preparing copper nanoparticles as it was used to successfully control Fusarium oxysporum (Banerjee and Quester (2013)).

**5.2 The biosynthesis of nanomaterials by plants**

Plants contain organic compounds such as flavonoids, amino and carboxylic acids, ketones, phenols, and proteins, as these materials play an important role in returning mineral salts and producing nanoparticles in easy, fast and environmentally safe methods such as biosynthesis of silver nanoparticles using plant extracts such as using aqueous extract of ginger root ( Barman et al., 2020).The aqueous extract of beetroot roots was also used to obtain nanoparticles of silver (Bin - Jumah et al., 2020). As for plant leaves, they were widely used in the field of biomechanics of silver nanoparticles. These particles have antifungal activity (Jebril & Dridi, 2020). Copper nanoparticles were also used in several areas, including inhibiting the growth of pathogens and as a fertilizer (Buazar et al., 2019). Several plant extracts were used to manufacture iron oxide nanoparticles such as Ziziphus mauritian leaf extract (Pansambal and others, 2017) and rhubarb roots (Rheum palmatum). (Bordbar et al., 2017). Plants have several behavior towards the overflowing mineral ions sitting in the outgrowth medium, plants that tolerate mineral ions determine the absorption of nanoparticles into the tissues of photosynthesis by transferring mineral ions within the inner epidermis and storing them on the root peel, while superaccumulative plants have the ability to absorb and transfer excess amounts of ions. Cationic mineral and stored in the portions to be harvested (Manceau et al , 2008). The absorption of nanoparticles by majestic plants is a mechanism for carry from deep residue to the roof of the earth, and eucalyptus trees have been shown to be able to transport gold from mineral deposits at a depth of more than 30 meters, and gold particles were found in the leaves of the studied eucalyptus trees (Lintem et al., 2013). Rice (Oryza sativa) raises silica from the soil as salicylic acid and collect it around small cellulose compartments and is the second largest yield grown in the world, and rice has the possibility to become an important exporter of silica nanoparticles (Mohammadinejad et al , 2016). The manufacture of nanoparticles in the presence of plants includes various substantial factors such as the concentration of the plant reproducer or biomass, the mineral salt concentration, the reaction time, incubation, temperature, and the degree of interaction of the pH of the solution, and by incropration the relationship between these factors with the size and shape of the required nanoparticle, the nanoparticle can be obtained with the desired specifications and in a manner. Controlled, The plantextract or plant biomass can be obtained from different parts of the plant (leaves, roots, stems, fruits and some flower parts or from the whole plant).

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For the purpose of obtaining the extract, the part to be extracted is soaked with a specific solvent and then the extract containing the reducing substances positive mineral ions is obtained And either fresh or dry parts are used, but there are advantages to drying the parts before soaking and extraction, which is the possibility of storing for a longer period because the soft plant or its parts must be stored under the freezing temperature of -20 ° C, and drying reduces the negative effects of the daily and seasonal changes in the plant components (Sheny et al. 2007 and Huang et al. 2011). The plant and its various parts contain nanoscale parts in the form of biological molecules like proteins, aminoacids, sugars, enzymes , and abundant quantities ofpositive metal ions. Metabolites participate strongly in the biological reduction processes. The biorevitalization operation generally works well for metal ions with high electrochemical energy with gold and silver ions (Haverkamp & Marshall,2009). The synthesis process carried out and the representation of nanoparticles of gold by( Shankar et al , 2003) using the leaves Geranium extract (Pelargonium graveolens) The forms of nanoparticles ball-shaped , triangular and multiple surfaces were ending interaction within 48 hours, as it assumed the scientists that the Terpenoides found in the leaves extract can be responsible On the decrease of gold ions and the pointing of gold nanoparticles. It has also become possible to cultivate plants in order to produce nanomaterials, an example of this is planting alfalfa in a soil rich in gold, where the plant collects nanoparticles in its tissues and then extracts them (Amish, 2012). The bacterial leaf blight disease is one of the most serious diseases affecting rice caused by the bacterium Xanthomonas oryzae pv. Oryzae, as a group of researchers studied the effect of biosynthetic silver nanoparticles (18 - 39 nm) to control the pathogen in the laboratory, and it showed a significant inhibition of bacteria. In addition, in the potting experiment, the silver nanoparticles were effective in controlling bacterial leaf blight and increasing antioxidant enzymes ( Ahmed et al., 2020). A study by Noshad et al. (2020) recommended the commercial production of biofabricated silver nanoparticles for use in combating tomato bacterial ulceration disease. Recently, many studies have been conducted on the use of nanoparticles as pesticides for fungal pathogens (Rai et al., 2018). As in this study I refer to the role of biofabricated nanoparticles in combating the fungal pathogens of the roots on the ginger plant caused by the species of the genus Pythium and Fusarium spp. The nanoparticles break down the cell wall by creating openings in it that lead to the flow of internal compounds of the fungal spinning in the cell membrane. Which leads to a change in its structure, just as the nanoparticles affect the germination of conidia spores and prevent their development. The interaction between the nanoparticles and the cell wall of the spores also affects the gas exchange necessary for their germination. Researchers (Khatami et al.,

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2019) used bio-manufactured copper oxide nanoparticles with dimensions less than 80 nm in the control of Fusarium solani in the laboratory. A study by (Fouda et al., 2019) indicated that the production of biofabricated silver nanoparticles as these particles showed anti-activity against the following fungi Alternaria alternate, Fusarium oxysporum, Pythium ultimum, Aspergillus niger.The effect of foliar spraying with different concentrations with particles of silicon oxide and titanium oxide biologically produced to control Erysiphe sp and downy pseudoperonospora cubensis on zucchini was also studied (Soubeih & Agha, 2019).

The study conducted by Hassan et al., (2019). demonstrated the ability of biofabricated nanoparticles to inhibit the growth of fungal plant pathogens Fusarium oxysporum, Pythium ultimum and Alternaria alternate in vitro compared to the control treatment. From the foregoing, we can conclude that the use of plant and bacterial extracts in the biosynthesis of nanoparticles is an easy, fast, economical and environmentally safe method, which contributes to a promising role in controlling pathogens due to their use with an application rate 10-15 times less than traditional pesticides and with the great benefits of using nanomaterials except The environmental risks of these materials must be measured before their application can be adopted on a large scale.

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