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Advancement of Nanoparticles in Agriculture and Factors Affecting the Synthesis of New Approach on Green Nanoparticle

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SUMMARY

Nanobiotechnology is getting a lot of traction in this period because of its ability to modify metals into Nano scales and change their chemical, physical, and optical properties efficiently. As a result, the development of novel methodologies for the synthesis of various types of nanoparticles of precise composition and size from biological sources is receiving a lot of interest. However, the majority of currently accessible techniques are costly, detrimental to the environment, and inefficient in terms of material and energy utilization. The quality and quantity of generated nanoparticles, as well as their characterization and uses, are highly influenced by several aspects such as the synthesis technique, pH, temperature, pressure, time, particle size, pore size, environment, and proximity.Characterization of the produced nanoparticles is also required before they can be used in drug delivery and biological applications. The current study focuses on the numerous factors that influence the synthesis of nanoparticles using green nanobiotechnology, as well as the various approaches for characterizing nanoparticles for biomedical and environmental applications.

INTRODUCTION

The use of contemporary technology to synthesize nanoparticles has become a popular application in the biomedical and human health care fields for a variety of products. Nanotechnology is described as the atomic-level modification of materials using a combination of engineering, chemical, and biological methods. Nanotechnology, which is present study suggested to be the most widely studied topic in science, has a history reaching back to the ninth century, when Mesopotamian artists utilized gold and silver nanoparticles to create a sparkling effect on pots and other objects. Michael Faraday, in his famous publication "Experimental Relations of Gold and Other Metals to Light," presented the first scientific description of nanoparticle qualities Fig 01.

Richard Feynman coined the term "nanotechnology" for the first time in 1959, which is widely regarded as the start of modern nanotechnology. Efforts are being undertaken all over the world to develop environmentally friendly technologies that use green nanotechnology and biotechnological tools to make ecologically benign, nontoxic products.Even if they are made using a one-step approach, nanoparticles made utilizing biological means or green technology offer a variety of properties, including increased stability and acceptable dimensions. Various undesired processing conditions are thereby avoided by allowing synthesis to take place at physiological temperatures, pH, pressure, and at a cheap cost. As a result, particular characterization procedures might be used to assess the potential for produced nanoparticles to be used in medication delivery and biological applications.

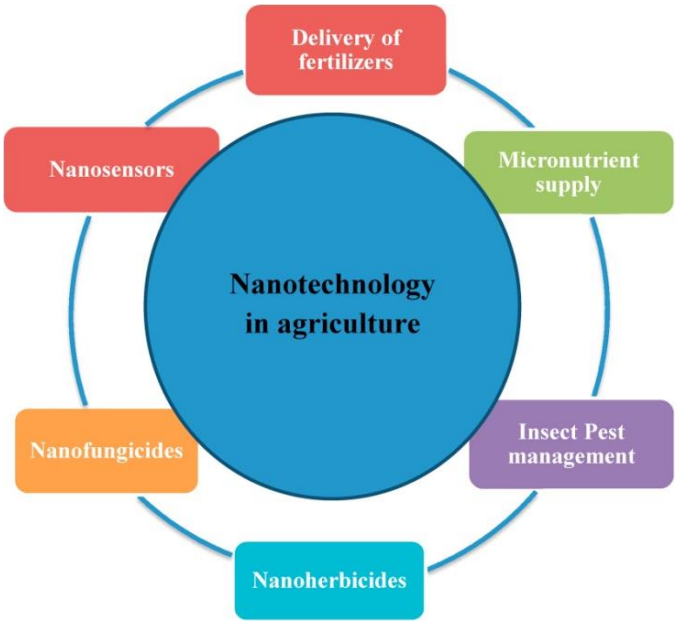
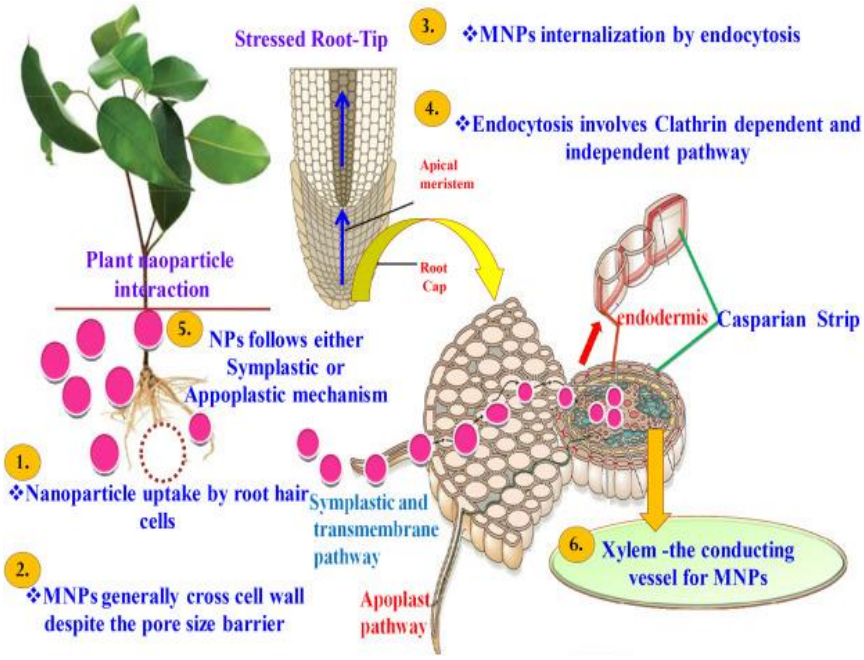


Fig 01. Nanotechnology in Agriculture

Green Nanotechnology

Nanoparticles can be made in a variety of ways, including physical, chemical, biological, and hybrid approaches. The creation of nanoparticles using traditional physical and chemical procedures produces hazardous byproducts that are harmful to the environment. Furthermore, due to health concerns, these particles cannot be used in medicine, particularly in clinical settings. Traditional methods can be used to generate vast quantities of nanoparticles with predetermined sizes and shapes in a shorter amount of time; but, these processes are complicated, costly, inefficient, and antiquated.The synthesis of ecologically friendly nanoparticles that do not produce harmful waste products during the manufacturing process has piqued interest in recent years. This can only be accomplished through biologically benign synthesis procedures using biotechnological instruments that are regarded safe and environmentally friendly for nanomaterial fabrication as an alternative to traditional physical and chemical approaches. The term "green technology" or "green nanobiotechnology" was coined as a result of this.The biological-based synthesis of nanoparticles follows a bottom-up method, in which the synthesis is carried out with the assistance of reducing and stabilizing agents. For the synthesis of nanoparticles utilizing a biological system, three primary processes are followed: selecting the solvent medium, selecting an ecologically acceptable and benign reducing agent, and selecting a nontoxic material as a capping agent to stabilize the generated nanoparticles.Owing to the accessibility of additional components by biological systems for the production of nanoparticles, nanotechnology offers more advantages than other conventional methodologies. Bionanomaterials, which are ecologically friendly and may be employed in a variety of medical applications, have been synthesized using the vast biodiversity of such biological components.

The type of adsorbate and the activity of the catalysts utilised in the production process are represented by synthesised nanoparticles. Some of them have described the dynamic character of manufactured nanoparticles, citing various sorts of symptoms and consequences as a result of changes in time and environment, among other things Fig 02. The pH of the solution, temperature, concentration of the extracts utilised, concentration of the raw materials used, size, and, most all, the protocols followed for the synthesis process are all critical aspects that affect nanoparticle synthesis.



Some dominant factors that affect nanoparticle biosynthesis are described below.

Particular Method or Technique. Synthesizing nanoparticles can be done in a variety of ways, from physical approaches involving mechanical procedures to chemical or biological protocols involving organic or inorganic compounds and living organisms. Each process has its own set of advantages and disadvantages. Biological approaches for nanoparticle production, on the other hand, utilise nontoxic and environmentally favorable materials in combination with green technology, rendering them more environmentally friendly and acceptable than traditional methods.

pH: It is a significant component that determines nanoparticle creation using green technology methods. The size and texture of manufactured nanoparticles are influenced by the pH of the solution media, according to researchers. As a result, changing the pH of the solution media can control nanoparticle size. The influence of pH on the form and size of silver nanoparticles produced was demonstrated.

Temperature: Temperature is another significant factor that influences nanoparticle production in all three approaches. The physical procedure necessitates the maximum temperature (>350°C), whereas chemical methods necessitate a lower temperature (below 350°C). In most cases, green technology nanoparticle production necessitates temperatures of less than 100°C or ambient temperature. The nature of the nanoparticle generated is determined by the temperature of the reaction medium.

Proximity: In most circumstances, when individual or isolated nanoparticles come into touch with or near the surface of other nanoparticles, their properties are altered. The nanoparticles' shifting behavior can be used to create more precise nanoparticles. The proximity effect of nanoparticles has numerous ramifications, including particle charging and substrate contact.

Characterization of the Synthesized Nanoparticles

Nanoparticles present a variety of characterization challenges that affect nanoparticle characterization in a detailed and appropriate manner. Understanding the issues that arise during nanoparticle characterization and selecting an appropriate characterization technique are thus critical. Nanoparticle characterization includes determining surface area and porosity, pore size, solubility, particle size distribution, aggregation, hydrated surface analysis, zeta potential, wettability, adsorption potential and shape, size of the interactive surface, crystallinity,

fractal dimensions, orientation, zeta potential. Nanoparticles and nanotubes intercalation and dispersion in nanocomposite materials. UV visible spectroscopy, atomic force microscopy (AFM), transmission electron microscopy, scanning electron microscopy, dynamic light scattering, X-ray photoelectron spectroscopy, thermo gravimetric analysis, powder X-ray diffraction, and Fourier transform infrared spectroscopy are some of the techniques that can be used to determine nanoparticle parameters (MALDI-TOF), Particle size analysis, dual polarisation interferometry, nuclear magnetic resonance (NMR), and nanoparticle tracking analysis (NTA) for evaluating Brownian motion.

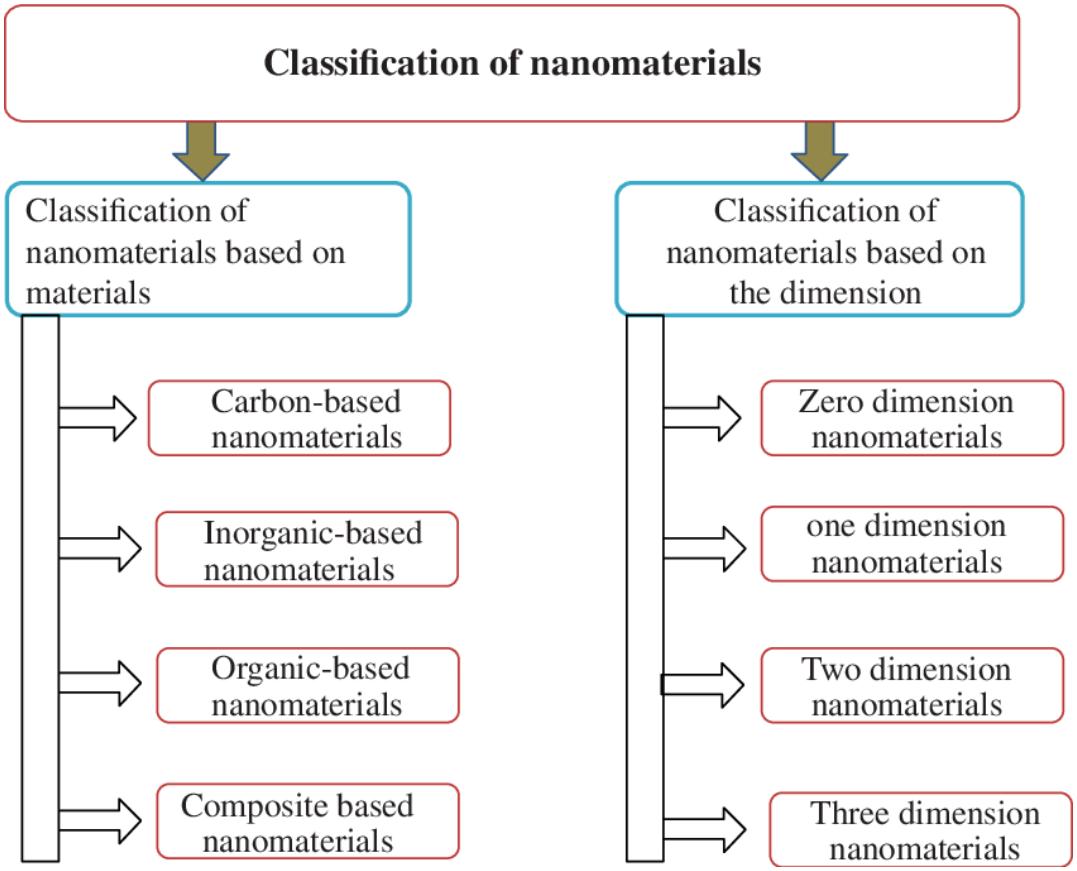


Fig 02: Classification of Nanomaterial

CONCLUSION

The use of nanoparticles in the medical, food, pharmaceutical, and agricultural industries has piqued attention, with an emphasis on developing more convenient methods for producing eco-friendly, nontoxic, and environmentally benign nanoparticles utilising green biotechnology technologies. The quality and quantity of produced nanoparticles for their potential use in diverse applications are influenced by a number of factors.Appropriate characterization approaches are required to efficiently analyse produced nanoparticles and thereby improve their use in environmental, electrical, and medicinal applications, as well as drug delivery applications. Different parameters influencing nanoparticle creation and various approaches used to characterise them were addressed in detail in this paper. Current and future green nanotechnology research will provide a more comprehensive understanding of the various factors that influence green nanoparticle synthesis, as well as the most advanced technology that can be used to characterise the synthesised nanoparticles for more efficient future applications.

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