

APPLICATION OF NANOTECHNOLOGY IN AGRICULTURE

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Introduction

Agriculture is always the backbone of many developing countries. In agriculture, the main reason to use fertilizer is to give full-fledged macro and micronutrients which usually soil lacks. 35-40% of the crop productivity depends upon fertilizer, but some of the fertilizer affects plant growth directly.

To overcome all these drawbacks a smarter way i.e., nanotechnology can be one of the sources. Since fertilizers are the main concern, developing nano-based fertilizer would be a new technology in this field. Nanotechnology is a promising field of interdisciplinary research. The potential uses and benefits of nanotechnology are enormous. The application of nanotechnology to the agriculture and food industries is also getting attention nowadays.

What is Mean by Nanotechnology

“Nanotechnology is the art and science of manipulating matter at the nanoscale (1 to 100 nm) to create new and unique materials and products with enormous potential to change society.” (National Nanotechnology Initiative). It is emerging as the sixth revolutionary technology in the current era.



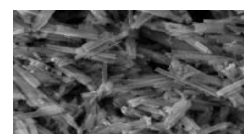
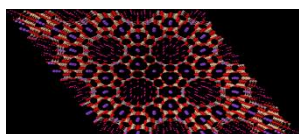
Fig 1. Application of Nano Technology.

What Nano technology offers for Agriculture ?

Major Challenges	What do the applications of nano technology offer
Food security for growing numbers.	New tools for disease detection, targeted treatment, enhancing the ability of plants to absorb nutrients, effective systems for processing, storage and packaging.
Low productivity in cultivable areas	Precision farming- use of computers, global satellite positioning systems, and remote sensing devices to measure various parameters.
Large uncultivable areas	Bringing more areas under cultivation by nanotech enabled environmental monitoring and management
Shrinkage of cultivable lands	To enhance productivity through nano tech driven precision farming
Wastage of inputs	Will help to reduce agricultural waste and thus keep environmental pollution to a minimum.
Perishability/ low shelf life	Use of nano technology in sensing applications will ensure food safety and security.
Skill limitations	Nanotechnology applications have the potential to produce easy-to-handle devices.

What are Nano Fertilizers?

Molecular modified or synthesized materials with the help of nanotechnology used to improve the fertility of the soil for a better crop yield and quality “. Greek word - nano (dwarf). The size of nano fertilizers between 1 to 100 nm. These are synthesized to regulate the release of nutrients depending on the requirements of the crops. An Indian agro-scientist, Dr. J. C Tarafdar has innovated nano-fertilizers using biosynthesis, for the first time in the world.



Nano-zeolite Nano-Mont clay Nano-Halloysit

Types of Nano Materials

- 1) Nanoporous Zeolite
- 2) Zinc Nano Fertilizer
- 3) Carbon Nanotube
- 4) Boron Nano fertilizers
- 5) Nanomagnets
- 6) Nano pesticides
- 7) Nanosensors etc...

Role of Nano Fertilizer

- Nano-sized TiO₂ promotes photosynthesis and nitrogen metabolism.
- Fertilizers have an axial role in enhancing food production in developing countries especially after the introduction of high yielding and fertilizer responsive crop varieties
- Carbon nanotubes; seed germination and enhances root elongation.
- Nano fertilizers combined with nanodevices synchronize the release of fertilizer N and P with their uptake by crop, so preventing undesirable nutrient losses to the soil, water, and air.
- Nano clay and zeolites are a group of naturally occurring minerals with a honeycomb-like layered crystal structure, which can be filled with NPK, Ca and a complete set of minor and trace nutrients. This helps to achieve maximum nutrient use efficiency.
- The application of nano-composite consists of N, P, K, micronutrients, mannose, and amino acids enhance the uptake and use of nutrients by grain crops.
- Fertilizers incorporation into cochleate nanotubes had improved crop yield.

Conclusion

The emerging new science and enabling technology, working with the smallest particle, the nanotechnology raises hope for innovations in the field of biology, especially in agriculture. Many unsolved and bottlenecks in the field of life sciences and agriculture could be addressed through this technology. More focused research is required in the area of energy, environment,



crop improvement, disease management, and efficient resource utilization for increasing productivity, profit, without hampering the natural ecosystem.

