

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 micro nutrients which usually soil lacks. 35-40% of the crop productivity depends upon fertilizer, but some of the fertilizer affects the 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 agriculture and food industries has been gaining attention now a days.

What do you 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.

What does Nano technology offer 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 incultivable	Precision farming- use of computers, global

areas	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 soil for a better crop yield and quality. Greek word - nanomeaning dwarf. The size of nano fertilizers is between 1 to 100 nm. These are synthesised in order 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) Nano porous Zeolite
- 2) Zinc Nano Fertilizer
- 3) Carbon Nano tube
- 4) Boron Nano fertilizers
- 5) Nanomagnets
- 6) Nano pesticides
- 7) Nano sensors etc.

Role of Nano Fertilizer

- Nano sized TiO_2 promotes photosynthesis and nitrogen metabolism.

- Fertilizers have an axial role in enhancing the food production in developing countries especially after the introduction of high yielding and fertilizer responsive crop varieties
- Carbon nano-tubes - 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 soil, water and air.
- Nano clay and zeolites that are a group of naturally occurring minerals with a honey comb-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 a nano-composite consists of N,P,K, micronutrients, mannose and amino acids enhance the uptake and use of nutrients by grain crops.
- Fertilizer's incorporation in to co-chelate nanotubes had improved crop yield.

Conclusion

The emerging new science and enabling technology, working with the smallest particle, the nanotechnology raises hope for new innovations in the field biology, especially in agriculture. Many unsolved and bottle necks 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 the productivity, profit, without hampering the natural ecosystem.