

# Nanochemistry & Agriculture

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## **Abstract -**

*Nanochemistry in recent times can lead to revolutionary development in agro-industry. It is commonly used for generating nanoparticles which can be utilized as slow & controlled release fertilizers, herbicides, pesticides, fungicides, and nano-sensors. Nanochemistry can thus help in improving the crop quality and quantity by supplying essential nutrients and protecting crops against microbial/pest infections and environmental stresses. Their use will also decrease the environmental pollution caused by the use of toxic chemical fertilizers and pesticides.*

**Keywords -** Agriculture, pesticides, fertilizer, nanochemistry, nanotechnology

## **Introduction -**

Global warming, adverse climatic conditions and decreased quality of soil in recent times are some challenges faced by agricultural economy. Nanotechnology promotes sustainable agriculture by improving soil quality, ensuring plant nutrition and protecting plants thereby increasing crop production.

The word "nano" in nanochemistry means a billionth dimensions of the order of a billionth of meter. "Nanomaterials" are the particles having the size between 1 - 100 nm. Nanotechnology is defined as the study of design, synthesis, characterization and application of nano materials. Nanochemistry deals with synthesis and characterization of materials at nano scale. Nanoparticles have wide array of applications in medicine, environmental science, agriculture and food processing.

Based on chemical nature the nanomaterials can be classified as:

1. Carbon-based nanomaterials structures: fullerenes, graphene, and carbon nanotubes.

2. Ceramic based; inorganic solids made of metal-oxide compounds such as TiO<sub>2</sub>, ZnO, and FeO<sup>2</sup> and
3. Metal nanomaterials ; based on Au, Ag, Cu, and Ni.
4. Organic nanomaterials; dendrimers, which are derived from organic Nanoparticles.

There are three methods of synthesis of nanoparticles: physical, chemical & biological. Focus is recently being laid on nanoparticle synthesis from plant extracts because this "GREEN METHOD" is eco-friendly and does not generate environmental pollutants.

The following are the applications of nanotechnology in agriculture:

1. **Nano fertilizers** - These are controlled release nano-particles which provide slow and sustained release of necessary micro-nutrients resulting in increased crop growth and crop production. They can be manufactured of zinc, silica, titanium dioxide, Cu and polymeric Nanoparticles. ZnO nanofertilizer has been shown to reduce arsenic and cadmium contents in rice cultures and is used for fortification of rice.
2. **Nano pesticides** - Certain nanoformulations can efficiently serve as nanopesticides and provide effective crop protection. These particles can be encapsulated for controlled and prolonged release decreasing the rate of chemical decomposition, photodecomposition, and soil absorption and increasing bioavailability. The life of active compound increases which decreases the cost and overall pesticide toxicity.
3. **Nano herbicides & Nano fungicides** - Nanoparticles can function as herbicides and fungicides. They also serve to decrease the adverse environmental effect of chemical herbicides and fungicides. eg. Nickel ferrite nanoparticles and copper nanoparticles, have a strong antifungal property and are used in fungal infestations like *Colletotrichum gloeosporioides*, *Fusarium oxysporum*, *Fusarium solani* infections and TiO<sub>2</sub> has antifungal activity against wheat rust.
4. **Nanosensors** : These have a very high sensitivity and are used in "Precision Farming" or "Smart Agriculture" The uses are:

- To identify nutrient requirement of crop and soil quality.
  - To evaluate pesticide residue, toxins and heavy metal contaminants.
  - For detecting pathogens on crops.
  - To assess the soil humidity.
  - To detect plant biotic and abiotic stresses.
5. Nanomaterials can also be used to promote plant stress tolerance and soil enhancement.
  6. Nano-based target delivery approach (gene transfer) is used for crop improvement.
  7. Transport of genetic materials for crop development and seed improvement. Germination percentage in soyabean, tomato and corn seeds can be increased when sprayed with a carbon nanotube.

#### Conclusion -

The farmers should be trained about the application of nano particles and the precise method of use by professional experts. However it has been recommended that biosafety of nanoparticles being used should be evaluated following the guidelines of Food Safety and Standards Authority. The impact of nanoparticles on safety of aquatic fauna should also be considered

#### References -

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