

# NANOTECHNOLOGY IN AGRICULTURE

## Overview

Nanotechnology refers to controlling, building, and restructuring materials and devices on the scale of atoms and molecules. A nanometer (nm) is one-billionth of a meter. To get the sense of the nano scales, the width of the human hair is 80,000 nm and the smallest things visible with the naked human eye are 10,000 nm across. 1 nanometer may contain 1 thousand microorganisms.

Nanoparticles can serve as ‘magic bullets’, containing herbicides, chemicals, or genes, which target particular plant parts to release their content. Nanocapsules can enable effective penetration of herbicides through cuticles and tissues, allowing slow and constant release of the active substances.

Advances in science and biology have resulted in the emergence of fertilizers that harness Nano technology, which result from applying precision agriculture and increased nutrient use efficiency. Nano sized particles are delivered at a cellular level which is more effective than conventional delivery.

## Food Security

The prediction that in 2050 our planet will be populated by over 9 billion people is quite reliable. This will pose serious problems with food, water and energy supply, particularly in less-developed countries. Agencies such as the World Bank and UN Food and Agriculture Organization (FAO) are constantly soliciting scientific research in order to identify innovative solutions to support the primary sector. ***Nanotechnology is a rapidly evolving field with the potential to take forward the agriculture and food industry with new tools which will increase food production in a sustainable manner and to protect crops from pests.***

## Precision Farming

Precision farming encapsulates formulas tailored to provide optimal inputs to stimulate growth, in highly concentrated format. Nano sized particles are delivered at a cellular level which is more effective than conventional delivery.

### *Crop Enhancement*

Accelerated germination  
Reduced nursery holding  
Improved plant health  
Reduced pest pressure  
Increased yields  
Improved nutrition



### *Water benefits*

Water purification  
Water quality remediation  
Reduced irrigation demand

### *Soil benefits*

Reduced fertilizer  
Improved water retention  
Balanced pH  
Improved soil health  
Improved vermi activity

### ***Specific agricultural applications of nanotechnology include::***

- (i) enabled delivery systems of release of agrochemicals allowing a controlled release of fertilizers, pesticides and herbicides
- (ii) field-sensing systems to monitor the environmental stresses and crop conditions
- (iii) improvement of plant traits against environmental stress and diseases.

## Clean Environment

Agriculture uses inefficiently the conventional inputs (land, water, energy, chemical fertilizers, Insecticides and pesticides), and a large fraction of plant protection products applied per year are lost or are unavailable to support the target. In addition, agriculture (cultivation of crops, livestock and deforestation) is a major contributor to greenhouse gas emissions producing about 24% of the total annual worldwide amount. Waste production is another relevant issue of the primary sector. European countries produce approximately 90 million tons of agricultural wastes per year. ***Nanotechnology has been recognized by the European Commission as one of its six “Key Enabling Technologies” that contributes to sustainable competitiveness and growth in agricultural sector, underpinning the shift to a greener economy***

## Nano AG Fertilizer Application in Agriculture

Controlled released Nano Ag fertilizer improve crop growth, yield and productivity. Nano-based target delivery approach (gene transfer) is used for crop improvement. Nanopesticides can be used for efficient crop protection. Uses of nanosensors and computerized controls greatly contribute to precision farming. Nanomaterials can also be used to promote plant stress tolerance and soil enhancement..

