

# Nanochemistry and biotechnology

## Nanotechnology in agriculture production

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Nanotechnology is recognised by the European Commission as one of its six “Key Enabling Technologies” that contribute to sustainable competitiveness and growth in several fields of industrial application [1]. Agricultural management with nanotechnology must rely on two important parameters, i.e., ions must be present in plant-available forms in the soil system, and since nutrient transport in soil-plant systems relies on ion exchange (eg,  $\text{NH}_4^+$ ,  $\text{H}_2\text{PO}_4^-$ ,  $\text{HPO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{Zn}^{2+}$ ), adsorption-desorption (eg, phosphorus nutrients) and solubility-precipitation (eg, iron) reactions, nanomaterials must facilitate processes that would ensure availability of nutrients to plants in the rate and manner that plants demand [2].

Claudia Parisi, Mauro Vigani, Emilio Rodríguez-Cerezo note that according to leading R&D analyses, research on agricultural nanotechnology applications has been ongoing for largely a decade by now, searching for solutions to several agricultural and environmental challenges, such as sustainability, improved varieties and increased productivity. The agro-nanotech innovative products are experiencing difficulties in reaching the market, making agriculture still a marginal sector for nanotechnology. This is due in particular to the high production costs of nanotech products, which are required in high volumes in the agricultural sector, unclear technical benefits and legislative uncertainties, as well as public opinion. Nevertheless, the R&D landscape is very promising and the possibilities offered by nanotechnology in several agricultural applications are being actively explored [3]. Thus, nanotechnology is an efficient tool for increasing agricultural productivity. The main problems of implementation with regard to the nanomaterials are high production costs of nanomaterials and the lack of enough information about the opportunities associated with nanomaterials.

1. EC, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. ‘A European strategy for Key Enabling Technologies - A bridge to growth and jobs’*, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM>.
2. *Mukhopadhyay S.M.* Nanotechnology in agriculture: prospects and constraints // *Nanotechnology, Science and Applications*. – 2014. - № 7. – P. 63-71.
3. *Parisi C., Vigani M., Rodríguez-Cerezo E.* Agricultural Nanotechnologies: What are the current possibilities? // *Nano Today*. - 2015. - № 10.-P. 124-127.