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Editorial

A Short Note on Nanotechnology in Agriculture

Jiayi Li*

Beijing Key Laboratory of Bioprocess, Department of Agriculture research, East Road, ChaoYang District, Beijing, 100029, People's Republic of China

ABSTRACT

Agriculture has always been the most important and stable sector because it produces and supplies raw materials to the food and feed industries. The scarcity of natural resources (production land, water, soil, etc.) and the world's growing population require agricultural development to be economically sustainable, viable, environmentally friendly, and efficient. Agricultural nutrient balances differ noticeably with economic growth, and as a result of this assumption, the development of soil fertility is very important in developing countries.

Agriculture development is a necessary phenomenon for the abolition of poverty and hunger, which must be eradicated from the current situation. As a result, we should take one bold step toward agricultural development. In this world, the majority of people live in poverty, and they are concentrated in rural areas where agricultural expansion is ineffective.

Natural agricultural production is an open system in which energy and matter are freely exchanged, with interactions involving the geosphere (particularly the pedosphere), biosphere, and atmosphere. Agriculture produces crops for food and industry, as well as fibre, fuel, automobile fuel, and drugs. On the one hand, it is confronted with ever-increasing food prices and farmer suicides, while on the other hand, input use efficiency is low. Harvests are now toxic, mother's milk is poisonous, and breathing-air venomous as a result of current agricultural practises. In this context, nanotechnology offers new hope.

Nanotechnology is an interdisciplinary venture-field that combines science, engineering, agriculture, and food systems. The Environmental Protection Agency of the United States defines nanotechnology as the understanding and control of matter at dimensions ranging from 1 to 100 nanometres, where unique physical properties allow for novel applications. Agriculture's triple problems – over-reliance on supplementary irrigation, vulnerability to climate change, and poor input and energy conversion to products – can be solved by using nanotechnology, if agricultural scientists seek an opportunity to try and collaborate with scientists from other disciplines.

Nanotechnology is a relatively new field in agriculture, having been developed in less than a decade. However, success has already been achieved in the production of Nano-pesticides and Nano-fertilizers, disease elimination in poultry, food packaging, agricultural waste use, Nano sensors, precision agricultural practises, and livestock and fisheries.

Nanotechnology has the potential to revolutionise agriculture and food systems in the areas of Nano-fertilizers, pesticide career, microfluidics, Biomes, nucleic acid bioengineering, smart treatment delivery systems, Nano bioprocessing, bio analytical Nano sensors, nanomaterial's, bio selective surfaces, environmental processing, pathogen detection, plant/animal production, biosecurity, molecular and cellular biology, and environmental protection through the reduction and elimination of pollutants.

Nanotechnology has shown promise in promoting sustainable agriculture. Nanomaterial's play an important role in the fate, mobility, and toxicity of soil pollutants, and are an important component of various biotic and abiotic remediation strategies. The properties and interactions of nanomaterial's with soil constituents strongly influence their efficiency and fate. Investigations into remediation applications and the fate of nanoparticles in soil are still limited to laboratory studies. Nanomaterial's, once introduced into the soil system, may have an impact on soil quality and plant growth.

APPLICATIONS

Excessive use of chemical fertilisers and pesticides has been shown to harm soil health and the environment. Chemical residues devastate the soil ecosystem by affecting non-targeted organisms while also reducing soil fertility. Researchers have used nanotechnology in agriculture to prevent such adversity in soil and the environment. Nanotechnology is a newer technology that has shown promising results in controlling excess agri-inputs and maintaining environmental balance.

In comparison to conventional fertilisers and pesticides, the controlled release capacity and targeted delivery of Nano fertilizer

***Correspondence to:** Jiayi Li, Beijing Key Laboratory of Bioprocess, Department of Agriculture research, East Road, ChaoYang District, Beijing, 100029, People's Republic of China, E-mail: Jiayi_li@yahoo.com

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and Nano pesticide demonstrated high activity. Silver, zinc, iron, titanium, phosphorus, molybdenum, and polymer nanoparticles have demonstrated significant potential as plant growth and pest control agents. Agri tools based on nanomaterial's, Nano formulations, Nano composite, Nano emulsion, and Nano encapsulation have been used to provide nutrition to plants and toxins to pests in a controlled manner. Nano sensors have also demonstrated effective applications in smart agriculture systems and food safety.

Nanomaterial's used as fertilisers may have properties such as crop improvement and lower environmental toxicity. Plants can provide an important route for bioaccumulation into the food chain. Recent agricultural developments include the use of nanoparticles (NPs) to improve the efficacy and safety of plant-based chemicals. Several researchers have reported on the effects of different NPs on plant growth and phytotoxicity, including magnetite (Fe_3O_4) nanoparticles and plant growth, alumina, zinc, and zinc oxide on seed germination and root growth of five higher plant species; radish, rape, lettuce, corn, and cucumber, silver nanoparticles and seedling growth in wheat, sulphur nanoparticles on tomato, zinc oxide in moonbeam, and nanoparticles of Silver nanoparticles can increase wheat yield and growth. Soil-applied 25 ppm SNPs had a strong growth-promoting effect on wheat growth and yield.