Article: RT938

Biotica Research Today
Vol 4:3
2022
208
210

How to cite this article?
Chakraborty, 2022. Nano-Fertilizers: An Alternative for Sustainable Crop Production. Biotica Research Today 4(3): 208-210.

Nano-Fertilizers: An Alternative for Sustainable Crop Production

Mandakranta Chakraborty

College of Agriculture, CSK HPKV, Palampur, Himachal Pradesh (176 062), India

Abstract

Nanofertilizers owing to its smaller surface area have the potential to increase nutrient-surface interaction, thereby enhancing nutrient use efficiency (NUE) through higher nutrients uptake. Apart from boosting crops yield sustainably, nanofertilizers hold potential to put a halt to environmental pollution. Plant roots which act as the gateway for nutrients are porous to nanomaterials over conventional ones. Mineral nutrients in the form of nanofertilizers if applied to crops offer numerous benefits for sustainable and eco-friendly crop production. The properties of nanoparticles, *viz*., size, shape, solubility, exposure, dosage concentrations, *etc*., might have potential risk to human health. Although, expert are in the opinions that food products containing nanoparticles are probably safe to eat. However, the future of nanofertilizers for sustainable crop production depends on its effective legislation, production of novel nanofertilizers products and risk management.

Open Access

Corresponding Author
Mandakranta Chakraborty
e-mail: chakrabortymandakranta@gmail.com

Keywords
Eco-friendly, Legislation, Nano-particles, Sustainable

Introduction

Nanotechnology, the term first used by Richard Feynman, is the study, design, creation, synthesis, manipulation and application of nanometric scale materials, having one or more dimensions with sizes smaller than 100 nm. Nanostructured materials due to its altered structure are superior in physical and chemical properties. Nanoparticles have stronger magnetic properties, better conductivity, are highly reactive and greater reflector of light. Modern intensive farming systems have resulted in serious deterioration of ecosystems and environment. Nanofertilizers owing to its smaller surface area have the potential to increase nutrient-surface interaction, thereby enhancing nutrient use efficiency (NUE) through higher nutrients uptake (Kumar *et al*., 2020). Apart from boosting crops yield sustainably, nanofertilizers hold potential to put a halt to environmental pollution. Therefore, nanotechnology in agriculture might be useful to regain the health of agricultural lands, prevent destruction of plants and animals species, and enhance the efficiency of the agriculture to meet the needs of alarmingly growing population.

Nanofertilizers and Its Types

Nanofertilizers are defined as materials in the nanometer scale, usually in the form of nanoparticles, containing macro and micronutrients that are delivered to crops in a controlled mode. They are classified into three categories (Mikkelsen, 2018):

- Nanoscale fertilizer: Conventional fertilizer reduced in size typically in the form of nanoparticles;
- Nanoscale additive fertilizer: Traditional fertilizer containing

Article History
Received on: 24th March 2022
Revised on: 25th March 2022
Accepted on: 26th March 2022

E-mail: *bioticapublications@gmail.com*

a supplement nanomaterial;

• Nanoscale coating fertilizer: Nutrients encapsulated by nanofilms or intercalated into nanoscale pores of a host material.

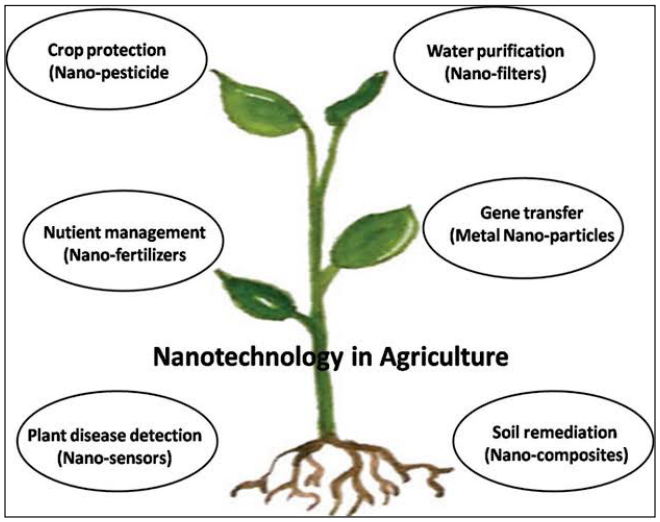

Figure 1: Application of nanotechnology in agriculture

Mechanisms of Action of Nanofertilizers

Nanofertilizers have higher NUE due to small pore sizes (upto 20 nm) of plants cell walls ensuing higher nutrient uptake. Plant roots which act as the gateway for nutrients are porous to nanomaterials over conventional ones. Nano-pores and stomatal openings in leaves also felicitate nanomaterials uptake and their penetration deep inside leaves. Enhanced transport and delivery of nutrients through nano-fertilizers takes place through plasmodesmata, which are nanosized (50-60 nm) channels for transportation of ions between cells (Iqbaal, 2019).

Conventional Bulk Fertilizers vs. Nanofertilizers

Mineral nutrients in the form of nanofertilizers if applied to crops offer numerous benefits for sustainable and eco-friendly crop production. Important benefits of nanofertilizers over conventional chemical fertilizers are:

• Slow nutrient delivery system: Increases crop growth due to long-term delivery of nutrients to plants.

• Efficient: Nanofertilizer lessens losses in the form of leaching and volatilization.

• Profitability: Nanofertilizers are required in small amount lowering the cost of transportation and field application.

• Applicable in saline soils: Lessened dosage prevents salt accumulation in soil.

• Controlled release: They are synthesized according to the nutrient requirements of planned crops.

• Enhanced bioavailability: The miniature size, high specific surface area and high reactivity of nanofertilzers increase the bioavailability of nutrients.

• Balanced nutrition: Nanofertilizers facilitate the crop plants to fight various biotic and abiotic stresses.

• Lowers pollution: Reduction in nutrient losses lower risk of environmental pollution.

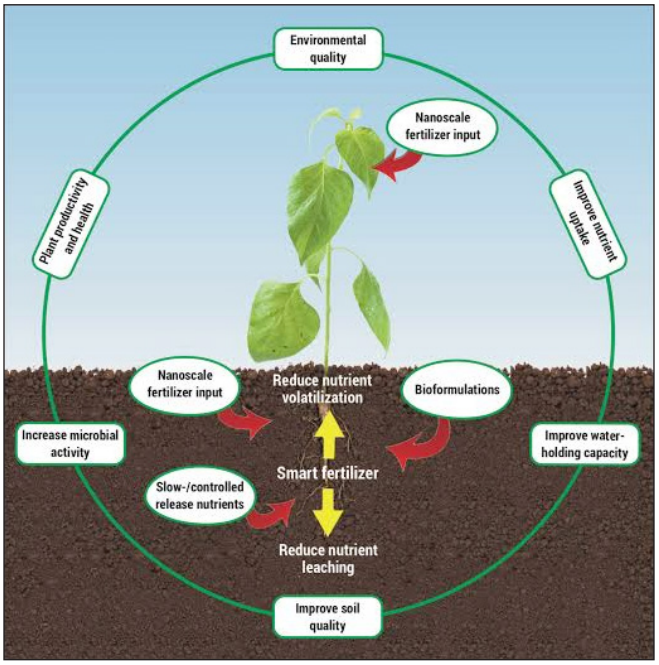

Figure 2: Mechanism of action of nano- fertilizers

Environmental and Health Concern of Nanofertilizers

Despite numerous benefits pertaining to sustainable crop production, nanofertilizers posses certain concern. The properties of nanoparticles, *viz*., size, shape, solubility, exposure, dosage concentrations, *etc*., might have potential risk to human health. Nano fertilizers related legislation and associated risk management continue to remain the prime limitation in advocating and promoting nanofertilizers for sustainable crop production. Although, expert are in the opinions that food products containing nanoparticles are probably safe to eat. Further, development of proper assessment strategies to understand the impact of nanoparticles on biotic and abiotic components of ecosystem is needed. Among the various apprehensions, the accumulation of nanomaterials in environment and in edible part of plants is some of the important issues to be dealt before its use in agriculture.

Conclusion

Nanofertilizers could be a crucial development in the protection of the environment because they can be applied in smaller quantities compared to traditional fertilizers hence reducing leaching, runoff, and gas emissions to the atmosphere. However, the future of nanofertilizers for sustainable crop production depends on its effective legislation, production of novel nanofertilizers products and risk management.

References

Iqbal, M.A., 2019. Nano-Fertilizers for Sustainable Crop Production under Changing Climate: A Global Perspective. In: *Sustainable crop production*. London, United Kingdom, IntechOpen [Online]. DOI: 10.5772/intechopen.89089.

Kumar, Y., Tiwari, K.N., Nayak, R.K., Rai, A., Singh, S.P., Singh, A.N., Kumar, Y., Tomar, H., Singh, T., Raliya, R., 2020. Nanofertilizers for Increasing Nutrient Use Efficiency, Yield and Economic Returns in important Winter Season Crops of Uttar Pradesh. *Indian Journal of Fertilisers* 16(8), 772-786.

Mikkelsen, R., 2018. Nanofertilizer and Nanotechnology: a quick look. *Better Crops* 102, 18-19.