AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 04 Issue: 01 January 2023 Article No: 02

Nanofertilizers – Role in Modern Agriculture

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SUMMARY

Nanofertilizers is a sustainable option for the problems of pollutions, toxicity, damages to soil environment, low fertility and deteriorative soil health conditions created by traditional fertilizer application in blind mode. In addition to this, Nanotechnology is playing important role in agriculture sector, as use of Nanofertilizers can help to decrease the amount of fertilizers through the smart delivery of active ingredients; increased nutrient uptake and nutrient use efficiency, and decrease fertilizer losses through volatilization, leaching and runoff. Therefore, research is required to study the effects of Nano fertilizers under different climatic and soil conditions for their judicious use before marketing or distribution at the commercial scale.

INTRODUCTION

Nanoparticles are particulate matter having size dimension of 1 and 100 nm in size in at least one dimension. Nanofertilizers are the nano material coated fertilizer having the size range of nearly 1-100nm derived or made from traditional fertilizers, extracted from different plant parts, bulky materials. These fertilizers have advantages over the other traditional fertilizers as the loss of nutrients i.e. volatilization, leaching, denitrification and other losses can be controlled with prolonged supply to the crops, thus increasing the efficiency of fertilizer and ensuring better crop production. Different types of Nanofertilizers can be produced by using different carrier materials e.g., hydroxyapatite nanoparticles, zeolite, mesoporous silica nanoparticles, nitrogen, copper, zinc, silica, carbon, and polymeric nanoparticles.

Factors affecting effectiveness of Nanofertilizers:

Mode of Uptake or transportation: The mode of application like foliar application or soil application that determines the fate of the nano fertilizer. Mostly the Nanofertilizers show more efficiency when applied in foliar mode as absorption by the foliage of the plants have more active absorption rather than absorption by roots.

Materials associated with Nanofertilizers: Different nano formulations, its preparations, coating on fertilizer materials also affects the efficiency of fertilizers. The suitable formulation with compatible coating materials increase the fertilizer longevity and efficiency.

Properties related factors: Soil associated factors like pH, organic matter, depth, structure; moisture, texture etc affect the efficiency of nano fertilizer.

Types and characterization of nano fertilizer

Solid or powder nanofertilizer: The solid nanofertilizer is in solid form and it can be characterized by using a scanning electron microscope (SEM).

Liquid nanofertilizer: Liquid nanofertilizer are in either solution or suspension form in nature and the nanoparticles are estimated by transmission electron microscope (TEM) and highly efficient absorption than solid nanofertilizer.

Mechanism of nanofertilizer entry

Nano particles in the fertilizer are in nano range i.e. 10-9 meter so these minute particles can enter through foliage parts specially through leaf parts and also through stomata. It can be transported inside the plant cell effective even can pass through plasmodesmata.

Factors affecting Nanofertilizers absorption through plant tissues

- Plant variety or species
- Growth stages of plants
- Environmental factors
- Size range of nano fertilizer particles
- Stability and efficiency of nano fertilizer

- The Physical and chemical properties of nano particles

Advantages

- Nanofertilizers reduces the nutrient losses through leaching and volatilization as they allow selective release linked with time and environmental conditions and may synchronize the release of nutrients with the uptake by crop. Their by reduces environment pollution and toxicity, other hazards caused by fertilizers
- Nanofertilizers fertilizers exhibit high sorption capacity, surface area and control release of nutrients to targeted sites, hence these can be considered as smart nutrient delivery system ensuring slow and control release of nutrients.
- It increases the efficiency of nutrients in soil and its use efficiency in plants.
- Reduces the loss of nutrients and increase its use by plants.
- Reduces the frequent fertilizer application in soil thus helps in improving soil health.
- Minimizes the cost of operation.
- Higher crop yield.

Disadvantages

- Human exposure to Nanofertilizers can lead to serious health risk due to associated cyto- and genotoxicity aspects. Nanoparticles can trespass the cell membrane(s) to reach cytoplasm, organelles and even cell nucleus can alter the gene expression in animals because of their size.
- Nanoparticles can enter the food chain and their increased dispersal in non-targeted species can induce adverse environmental impacts. These form of matter may affect the living organisms in many ways, particularly carbon-based nanoparticles can modify the DNA structure and the gene expression in plant tissues
- Zinc oxide nanoparticles have been observed to disturb the symbiotic relationship of rhizobia-legumes thereby affecting the nitrogen fixation process
- Iron based Nanofertilizers can alter the hydraulic conductivity of roots due to the accumulation of the applied nanoparticles on the root surface, which leads to lowering of water and nutrient (such as K, Ca , Mg and S) uptake

REFERENCES

Chaitra P, Kalia A, Ahuja R, SPK Sidhu and Sikka R. 2021. Importance of Nano Fertilizers in Sustainable Agriculture. Environ Sci Ecol: Curr Res 2: 1029 Volume 1 Issue 5.

Debashis Dutta1 and Anurag Bera. 2021. Nano Fertilizer on Sustainable Agriculture- A Review. International Journal of Environment and Climate Change. 11(8): 1-5.

Kumar Chiranjeeb and Rajani. (2021). Nano Fertilizer: Recent Trends and Advantages in Agriculture. Agrospheres:e-Newsletter, 2(12), 5-6

Lakshman K, Chandrakala M, Siva Prasad P N, Prasad Babu G, Srinivas T, Ramesh Naik TN and Arjun Korah. 2022. Liquid Nano-Urea: An Emerging Nano Fertilizer Substitute for Conventional Urea. Chronicle of Bioresource Management, 6(2):054-059