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Nano Fertilizer

A Modern Concept of Fertilizer Application

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Abstract

As a novel approach to resolving legal difficulties or falling nutrient usage efficiency, nanotechnology has emerged with nanoscale inputs for manufacturing. Crop production has become more sustainable because to nano fertilisers. In order to increase crop output, improve nutrients, and decrease chemical fertiliser waste, nano fertilisers are becoming more and more important in sustainable

agriculture. When compared to the traditional method of fertiliser administration, nano fertilisers offer a larger surface area, increasing plant metabolism and speeding up photosynthesis, which enhances crop production and dry matter. It has a specific delivery method and is more reactive in nature.

Introduction

Any particle with dimensions of 100 nm or fewer is often referred to as a nano particle. Due to their unusual size they exibit unique physical and chemical features such as cation exchange capacity, increased diffusion, ion adsorption, when operated at nanoscale. The efficient supply of ions to the plant is the product of recent advancements in the agricultural sector. Nanotechnology is also assisting in the development of transgenic plants with desired genes, such as those that exhibit accelerated growth, insect pest resistance, and drought resistance. According to studies, more than 50% of fertiliser applied to soil is often lost to the environment. However, nano fertilisers are able to address the problem because of their high absorption efficiency. The high surface area to volume ratio of nano fertiliser accounts for its remarkable efficacy. The absorption efficiency of phosphorus was attained up to 90%, according to a recent study on phosphorus nano fertiliser. The capacity of nanofertilizer to offer delayed release nutrients to plants over a 40–50-day target period rather to 4–10 days in conventional fertiliser administration methods is another crucial component of employing nanofertilizer. The first liquid fertiliser containing nano-urea was just released by Iffco. Ramesh Raliya, whose team has been working on creating nano urea since 2015, is the brain behind this accomplishment. Iffco has been assisting farmers for the past 50 years with the goal of increasing agricultural productivity and improving social and economic conditions.

Effect of Nano Fertilizer on Sustainable Crop Development

Due to their application, nano fertilisers have increased crop biological system functionality and supported plant growth and development under biotic and abiotic conditions (drought, salinity, alkalinity, temeperature, metal toxicity etc.). The efficiency with which water is used; photosynthesis, transpiration, and other physio-chemical aspects of plants and soil are all improved by nanoparticles. In the same way as SiO_2 has demonstrated plant defence mechanisms, nano fertiliser does the same. It was discovered with the aid of more study and findings that TiO_2 changed the photoreduction activity and prevented the synthesis of linolenic acid in the electron transport chain. Additionally, nanoparticles aid in soil aggregation, dispersion, bioavailability, and have an impact on a variety of physical and chemical characteristics. Nano fertiliser can be directly sprayed on the crop's soil or leaves. The application of the foliage is made first, then the root entrance. Absorption of fertiliser applied to foliage occurs mostly through stomata, cuticles, and hydathodes, whereas access to fertiliser applied to roots is gained by root hairs, rhizodermis, lateral roots, etc. The nutrients in nanofertilizers are sufficient to boost antioxidant activity in plant cells and have an impact on the control of plant hormones.

Fertilizer and Formulations

Nanotechnology has great promise for addressing issues in agriculture such declining nutrient availability, leaching losses, and productivity. The industry offers a variety of nano fertiliser formulations, including nonogels, nanoemulsions, inclusion complexes, dendrimers, polymeric micelles, and liposomes. These 3D materials have a great capacity to store water without actually dissolving into an

aqueous media because they are made of crosslinked swelling polymer networks.

Urea molecules are combined with trisodium citrate under optimum conditions to create nano urea. It is a procedure in which 0.30 gram of urea and 0.86 gram of trisodium citrate are combined and heated to 90 degrees Celsius for one hour. Trisodium citrate served as a nitrification inhibitor in this situation. The solution begins to look like ash when the heating process is finished, which indicates the presence of nanourea. In the case of biological nanoparticle manufacturing, certain microbial proteins are employed to convert salts into the corresponding nanoforms. Salts are converted into nanoforms using a variety of bacteria, fungus, plants, biomolecules, and herbs.

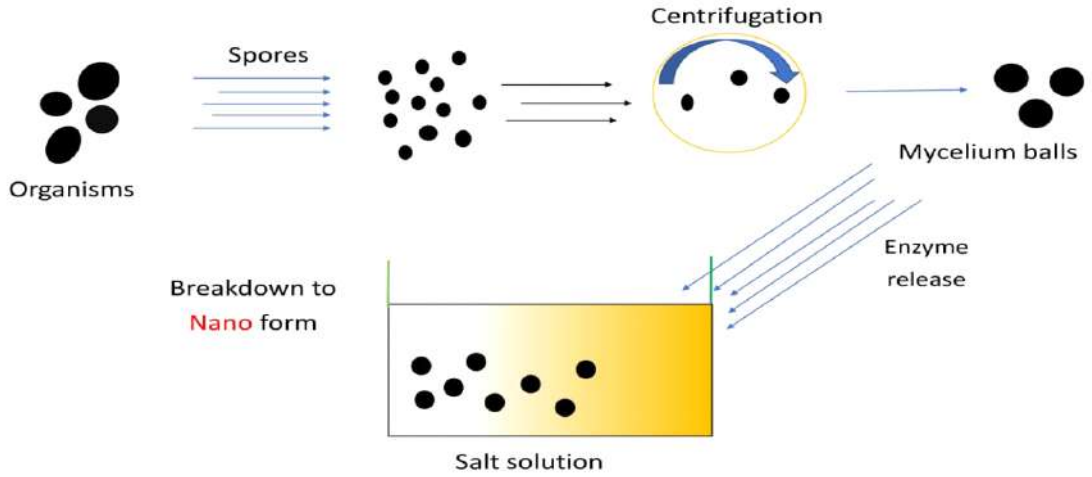

Fig: Biosynthesis of nanoparticles from fungal protein

Application of Nano Technology

After the discovery of semiconductors, nanotechnology has the potential to lead the way for new agricultural uses in a variety of industries, including information technology, medical science, food safety, and transportation. It was demonstrated that 80kg P/ha equivalent yields of cluster beans and pearl millet were produced by foliar treatments of nanophosphorus at 640 mg/ha in a dry environment. In the process of creating the biosensors, nanotechnology is crucial. The application of nanotechnology is enhancing the sensitivity and performance of biosensors. Biosensors are tools for figuring out the make-up of soil. Nano herbicides offer greater soil penetration while inflicting the least amount of environmental harm.

Conclusion

Nanotechnology's impact has demonstrated that it is a doorway to new applications in agriculture and other industries. In many chemical reactions, it works great as a catalyst. Due to their tiny size, nanoparticles are more readily available to plants and may rapidly permeate the soil. Along with all of its benefits, it also has some drawbacks. These nanoparticles generate some harmful waste that contaminates the environment. Other than these, there are a variety of factors that have restricted the use of nanotechnology. If these drawbacks are overcome, nanotechnology will advance into the 21st and 22nd centuries as a revolutionary technology.