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NANO FERTILIZERS: A REVOLUTION IN FERTILIZER INDUSTRY

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Background: A nano-fertilizer refers to a product in nanometer regime that delivers nutrients to crops. For example, encapsulation inside nanomaterials coated with a thin protective polymer film or in the form of particles or emulsions of nanoscale dimensions (DeRosa *et al*. 2010). Surface coatings of nanomaterials on fertilizer particles hold the material more strongly due to higher surface tension than the conventional surfaces and thus help in controlled release (Brady and Weil 1999). The rapid growth in the world population has increased the demand from the agricultural sector, making researchers wary of the overuse of chemical fertilizers by farmers. Nanoparticles have potential applications in agriculture system, viz., detection of pollutants, plant diseases, pests, and pathogens; controlled delivery of pesticide, fertilizers, nutrients, and genetic material; and can act as nanoarchitects in formation and binding of soil structure (Ghormade*et al*. 2011). Nano-fertilizers have emerged as a promising alternative that ensures high crop production and soil restoration.

Mode of action:

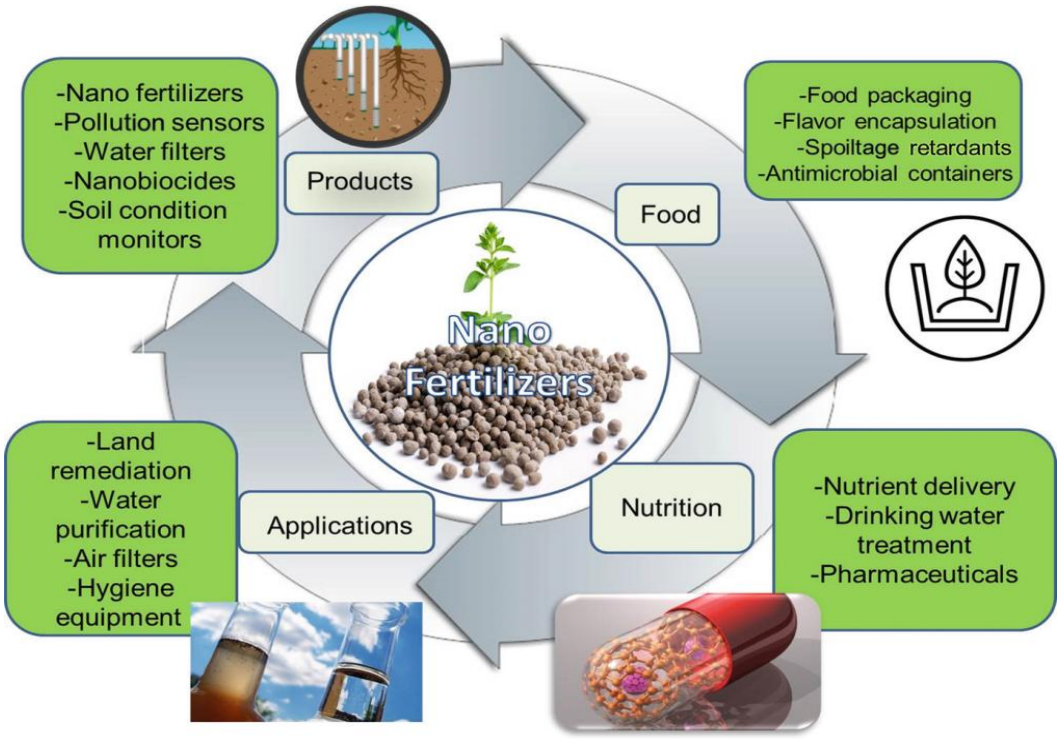
Nano-fertilizers are released very slowly in comparison to conventional fertilizers. This approach improves nutritional management, i.e., increasing the nutrient-use efficiency and decreasing nutrient leaching into groundwater. The unique properties of nanoparticles, such as high sorption capacity, the increased surface to volume ratio, and controlled-release kinetics to targeted sites, make them a potential plant growth enhancer.

Nano-Fertilizers Entry to the Plant System:

Researchers have stated that the plant root system, which is the gateway for the nutrients, is highly porous to nanomaterials (nano-fertilizers) than conventional fertilizers. Stomatal openings in leaves are also reported to favor uptake of nanomaterials and their entry to leaves.

Use of Nano-Fertilizers in Sustainable Crop Development

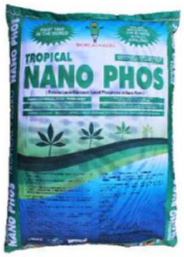
In a previous study, the amendment of zinc nano-fertilizers significantly increased the yield of peanuts. These nano-fertilizers also improve seed production of vegetables. Similarly, carbon nanotubes containing fertilizers were reported to decrease the days to germination. These nano-fertilizers were also found to promote the development of plant root systems in rice seedlings. Nanofertilizers have been projected as a tool to meet sustainable intensification criteria in agricultural activities in the next 30 years due to the feasibility of synchronizing the release mechanism of nutrients (N and phosphorus, P) with an increment in crop yields and forage production while reducing the fertilization inputs (Kalia *et al*., 2019).



Types of Nano fertilizers in Market

Nano phosphorous

Nano Zinc



Nano Nitrogen

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