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# APPLICATION OF NANOMATERIALS IN THE FIELD OF AGRICULTURE

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## ABSTRACT

Now a day's agriculture is facing a wide range of challenges all across the world. The important challenges are crop yield stagnation, decrease in arable land due to land degradation and urbanization, low nutrient use efficiency, deficiencies of more than one nutrients in soil, declining soil organic and water availability etc. It would be difficult to produce enough food to feed the ever increasing populations. Fertilizers play a vital role in increasing agricultural production, but excessive use of chemical fertilizers irreversibly damages the chemical ecology of soil and reduces the available area for crop production. Nanomaterials in fertilizers improves the productivity of crops. In this article we are discussing about the use of Nanofertilizers in agriculture and their extensive uses compared to conventional bulk fertilizers.

**Keywords:** Nanofertilizers, Conventional Bulk Fertilizers, Nanostructured Formulations, Agriculture, Efficiency.

## I. INTRODUCTION

The Nanofertilizers are also nutrient fertilizers composed, in whole or part, of nanostructured formulations that can be delivered to the plants, allowing for efficient uptake or slow release of active ingredients. Nanomaterials improve the productivity of crops and efficiently regulate the delivery of nutrients to plants and targeted sites, guaranteeing the minimal usage of agrochemicals. In conventional agriculture, an excess of fertilizer is applied directly into the soil or sprayed on the leaves, which surpass the nutritional need of the plant. This is because a very low percentage of fertilizer reaches its target site, due to leaching of chemicals, evaporation, drift, hydrolysis, run-off, and photolytic or microbial degradation. This excess of chemical fertilizer negatively affects the nutrient equilibrium of the soil, and causes contamination of local water supplies, due to the leaching of toxic materials into water bodies.

## II. NANOFERTILIZERS IN AGRICULTURE

The main ambition of nonmaterial in agriculture is to reduce the amount of spread chemicals, minimize nutrient losses in fertilization and increased yield through pest and nutrient management. Nanomaterials can increase crop yield by increasing fertilizer nutrient availability in soil and nutrient uptake by plants. These materials can suppress crop diseases by acting directly on phytopathogens through a variety of mechanisms, including the production of reactive oxygen species. These materials also enhance crop production indirectly by improving crop nutrition and boosting plant defense pathways. The efficient use of nanomaterials may reduce the negative environmental impact of conventional agricultural practices. In recent laboratory analyses, it has been reported that nano fertilizers can improve crop productivity by enhancing the rate of seed germination, seedling growth and photosynthetic activity.

Nanomaterials incite the plant root and leaf surface, which are the main nutrient gateways of plant systems and highly porous at the nanoscale. The application of nano fertilizers can enhance the nutrient uptake of the plant through these pores, or the process can facilitate complexation with molecular transporters or root exudates through the creation of new pores, or by the exploitation of endocytosis or ion channels.

Additionally, several researchers have reported that a decrease in the size of nanomaterials facilitates an increase in the surface mass ratio of particles. This enables the absorption of abundant nutrient ions that is later desorbed slowly and steadily for an extended period. Therefore, formulations of nano fertilizers can provide balanced nutrition for crops throughout the growth cycle, which in turn improves agricultural production.

Nanobiosensors that react with specific root exudates are also being explored. These techniques are relatively new and have numerous ethical and safety issues that must be carefully studied before implementation. The global agricultural landscape has radically changed since the revolution of green nanotechnology. Nano fertilizers are now being used in specific concentrations, in accordance with the nutritional requirements of the crops, ensuring minimal differential losses.

## IV. CLASSIFICATION OF NANOFERTILIZERS

There are three types of nano fertilizers: nanoscale fertilizers, nanoscale additive fertilizers, and nanoscale coating fertilizers. Nanoscale fertilizers are made of nanoparticles that contain nutrients. Nanoscale additive fertilizers are traditional fertilizers with nanoscale additives. Nanoscale coating fertilizers are traditional fertilizers coated or loaded with nanoparticles.

The encapsulation of nutrients most commonly produces nano fertilizers with nanomaterials. Preliminary nanomaterials are produced by using both physical and chemical approaches.

More recently, the targeted nutrients are either encapsulated inside nanoporous materials, coated with a thin polymer film particle, or coated with emulsions of nanoscale dimension.

Encapsulation of beneficial microorganisms, such as bacteria or fungi, has shown promise as it can enhance the availability of nitrogen, phosphorus, and potassium in the root zone, thereby improving plant growth.

Nanofertilizers can also be classified based on their actions: control or slow-release fertilizers; control loss fertilizers; magnetic fertilizers or nanocomposite fertilizers (which use a nanodevice to supply a wide range of macronutrient and micronutrients in desirable concentration).

Porous nanomaterials significantly reduce nitrogen loss by regulating demand-based release, and by enhancing the plant uptake process. Examples of porous nanomaterials include:

- Ammonium charged zeolites, which can enhance the solubility of phosphate minerals, showing an improvement in phosphorus availability and uptake by crops.
- Graphene oxide films, a carbon-based nanomaterial, can prolong potassium nitrate release, extending the time of function and minimizing losses by leaching.
- Nanocalcite ($CaCO_3$-40%) with nano $SiO_2$ (4%), MgO (1%), and $Fe_2O_3$ (1%) which not only improve the uptake of calcium, magnesium and iron, but also notably enhance the intake of phosphorous with micronutrients zinc and manganese.

## V. CONVENTIONAL BULK FERTILIZERS VS NANOFERTILIZERS

Farmers or growers mainly apply convention fertilizers through the soil by either surface broadcasting, subsurface placement, or as fertigation or with irrigation water. However, the fate of large portion of applied fertilizers is lost to the atmosphere or enters to water bodies, finally polluting our ecosystems. For example, the 75% N of urea after application in field lost through volatilization (as NH3 or emission as N2O or NO) or through NO3 leaching or runoff to water bodies.

The current N fertilizers, therefore, face the problem of low nitrogen utilization efficiency (<20%), whereby loss of N in the environment causes eutrophication and greenhouse gas increase. it has been reported that key macronutrient elements, including N, P, and K, applied to the soil are lost by 40–70 %, 80–90 % and 50–90%, respectively, causing a considerable loss of resources. the excess phosphorus becomes "fixed" in soil, where it forms chemical bonds with other nutrients and becomes unavailable for uptake by the plants. Important benefits of nanofertilizers over conventional chemical fertilizers rely on their (a) nutrient delivery system as they regulate the availability of nutrients in crops through slow/control release mechanisms. Such a slow delivery of nutrients is associated with the covering or cementing of nutrients with nanomaterials . By taking advantage of this slow nutrient delivery, growers can increase their crop growth because of consistently long-term delivery of nutrients to plants. For example, nutrients can be released over 40–50 days in a slow release fashion rather than the 4–10 days by the conventional fertilizers (b) In addition, nanofertilizers required in small amount which reduce the cost of transportation and field application (c) An additional major advantage is over accumulation of salt in soil can be minimized as it required in small amount (d) Another advantage for using nanofertilizers is that they can be synthesized according to the nutrient requirements of planned crops. In this regard, biosensors can be attached to a new innovative fertilizer that controls the delivery of the nutrients according to soil nutrient status, growth period of a crop or environmental conditions (e) The miniature size, high specific surface area and high reactivity of nanofertilzers increase the bioavailability of nutrients (f) Providing balanced nutrition, nanofertilizers facilitate the crop plants to fight various biotic and abiotic stresses.

It is reported in several crops, that use of nanofertlizers and nanomaterials enhanced the growth and yield in several crops relative to plant treated with conventional fertilizers. However, the extensive use of nanofertilizers in agriculture may have some important limitations, which must also be considered and it is crucial to determine the toxicity /biocompatibility of nanofertilizers.

## VI. CONCLUSION

The exceptional properties of nanoparticles, such as high surface area/volume size ratio and enhanced optoelectronic and physicochemical properties, compared to their bulk counterparts, is now emerging as a promising strategy to promote plant growth and productivity. As a result of their unique properties, nanoparticles may influence metabolic activities of the plant to different degrees compared to conventional materials and have the potential to mobilize native nutrients, such as phosphorus, in the rhizosphere.

Sustainable agriculture demands minimal use of agrochemicals. Advanced nanoengineering techniques are being used to overcome an agricultural crisis by developing an improved crop production system that assures sustainability. For instance, it noted that controlled use of nano-fertilisers can significantly increase the nutrient use efficiency and provide stress tolerating ability to crops as well as reduce environmental pollution by reducing fertiliser nutrient run-off into ground and surface water.

## VII. REFERENCES


1) Shang, Y., Hasan, K., Ahammed, G.J., Li, M., Yin H., and Zhou, J. (2019). Applications of Nanotechnology in Plant Growth and Crop Protection: A Review. Molecules, 24, 2558.
2) Adisa, I. O., Reddy, V. L., Peralta-Videa, J. R. et al., (2019). Recent advances in nano-enabled fertilizers and pesticides: a critical review of mechanisms of action. Environmental Science: Nano, vol. 6, no. 7, pp. 2002–2030.
3) https://www.azonano.com/article.aspx?ArticleID=5446.
4) Raliya, R., Saharan, V., Dimkpa, C. and Biswas, P., 2017. Nanofertilizer for precision and sustainable agriculture: current state and future perspectives. *Journal of agricultural and food chemistry*, *66*(26), 6487-6503.
5) Zulfiqar, F., Navarro, M., Ashraf, M., Akram, N.A. and Munné-Bosch, S., 2019. Nanofertilizer use for sustainable agriculture: advantages and limitations. *Plant Science*, 110270.
6) https://krishijagran.com/featured/use-of-nanofertilizers-in-agriculture-advantages-and-safety-concerns/
7) https://www.technologytimes.pk/2018/04/02/nanotechnology-sustainable-agriculture-2/