MARUMEGH

Kisaan E- Patrika

Available online at www.marumegh.com

 ISSN: 2456-2904

IMPORTANCE OF NANO FERTILIZERS IN SUSTAINABLE AGRICULTURE

[1]Dharmendra Singh, [2]Bajrang Bali, [3]Kuldeep Singh Rajawat, [4]Jitendra Kumar Sharma

[1,2&4]Ph.D. scholars, Soil Science & [3&4] Ph.D. scholars, Horticulture, MPUAT, Udaipur

In agriculture the main reason to use fertilizer is to give full-fledged macro and micro nutrients which usually soil lacks. Crop productivity depends upon fertilizers up to 35-40 percent, but some of the fertilizers affect the plant growth directly. In spite of this, it is known that yields of many crops have begun to decline as a result of imbalanced fertilization and decrease in soil organic matter. Moreover, excessive applications of nitrogen and phosphorus fertilizers affect the groundwater and also lead to eutrophication in aquatic ecosystems. Such cases along with the fact that the fertilizer use efficiency is about 20-50 percent for nitrogen and 10-25 percent for phosphorus fertilizers implies that food production will have to be much more efficient than ever before (Shaviv, 2000 and Chinnamuthu and Boopathi, 2009). To overcome all these drawbacks a smarter way i.e., nanotechnology can be one of the source.

The application of nanotechnology techniques to agricultural crop inputs is one of the proposed tools for “sustainable intensification”. The potential uses and benefits of nanotechnology are enormous. Since fertilizers are the main concern, developing nano based fertilizer would be a new technology in this field. Fertilizers are sprayed in many ways either to soil or leaves, even to aquatic environments; these inorganic fertilizers are supplied in order to provide three main nutrients; nitrogen, phosphorous and potassium in equal ratios. It increases the nutrient use efficiency (NUE) by 3 times and it also provides stress tolerating ability. Irrespective of the type of crop it can be used on, it will be the complete bio source increasing the eco friendly nature, builds carbon in soil, improves soil aggregation. Since these nano fertilizers contain nutrients, growth promoters encapsulated in nano scale polymers, they will also have a slow and a targeted efficient release. When comparing to chemical fertilizers requirement and cost, nano fertilizers are economically cheap and are required in lesser amount.

Role of nano fertilizers:

Fertilizers have an axial role in enhancing the food production in developing countries especially after the introduction of high yielding and fertilizer responsive crop varieties. According to Royal Society, "Nanotechnologies are the design, characterization, production and application of structures, devices and systems by controlling shape and size at nanometer scale”. Nowadays, nanotechnology is progressively moved away from the experimental into the practical areas. For example, the development of slow/controlled release fertilizers, conditional release of pesticides and herbicides, on the basis of nanotechnology has become critically important for promoting the development of environment friendly and sustainable agriculture. Indeed, nanotechnology has provided the feasibility of exploiting nanoscale or nanostructured materials as fertilizer carriers or

controlled-release vectors for building of so-called "smart fertilizer" as new facilities to enhance nutrient use efficiency and reduce costs of environmental protection.

Encapsulation of fertilizers within a nanoparticle is one of these new facilities which are done in three ways: a) the nutrient can be encapsulated inside nanoporous materials, b) coated with thin polymer film, or c) delivered as particle or emulsions of nanoscales dimensions. In addition, nanofertilizers will combine nanodevices in order to synchronize the release of fertilizer-N and -P with their uptake by crops, so preventing undesirable nutrient losses to soil, water and air via direct internalization by crops, and avoiding the interaction of nutrients with soil, microorganisms, water and air.

Smart fertilizers might become reality through transformed formulation of conventional products using nanotechnology. The nanostructured formulation might permit fertilizer to intelligently control the release speed of nutrients to match the uptake pattern of crop. Solubility and dispersion for mineral micronutrients cause controlled release formulation. Nanosized formulation of mineral micronutrients may improve solubility and dispersion of insoluble nutrients in soil, reduce soil adsorption and fixation and increase the bioavailability leading to increased nutrient uptake efficiency. Nanostructure formulation might increase fertilizer efficiency and uptake ratio of the soil nutrients in crop production and saves fertilizer resource. Controlled release modes have properties of both release rate and release pattern of nutrients for water-soluble fertilizers might be precisely controlled through encapsulation in envelope forms of semi-permeable membranes coated by resin-polymer, waxes and sulphur. Effective duration of nutrient release has desirable property of nanostructured formulation; it can extend effective duration of nutrient supply of fertilizers into soil. Nano structured formulation can reduce loss rate of fertilizer nutrients into soil by leaching and/or leaking.

Conclusions

Since fertilizers, particularly synthetic fertilizers have a major potential to pollute soil, water and air; in recent years, many efforts were done to minimize these problems by agricultural practices and the design of the new improved fertilizers. The appearances of nanotechnology open up potential nobel applications in different fields of agriculture and biotechnology. Nanostructured formulation through mechanisms such as targeted delivery or slow/controlled release mechanisms, conditional release, could release their active ingredients in responding to environmental triggers and biological demands more precisely. There is the possibility of using these mechanisms to design and construction of nanofertilizers. The use of these nanofertilizers causes an increase in their efficiency, reduces soil toxicity, minimizes the potential negative effects associated with over dosage and reduces the frequency of the application. Nanofertilizers mainly delay the release of the nutrients and extends the fertilizer effect period. Obviously, there is an opportunity for nanotechnology to have a significant influence on energy, the economy and the environment by improving fertilizers. Hence, nanotechnology has a high potential for achieving sustainable agriculture, especially in developing countries.

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