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A Small Overview of Nanofertilizers in Agriculture

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Introduction

Agriculture is the backbone and the bedrock of our Indian economic sector and related to the production and provision of a wide range of crops for food, feed, and ornamental purposes. Currently it's a Multitrillion dollar industry worldwide. [1]. Limited resources and the rapidly-increasing human population is pushing the sector forward demanding the development of a very efficient agriculture and facilitating the reduction of worldwide poverty and hunger [2]. With the boom of production the use of Chemical fertilizers have increased which provides plants with nutrients for optimal growth and productivity; however, current production practices cannot keep pace with the growing demand of food without relying on the extensive use of fertilizers.Limited nutrient use efficiency associated with the use of chemical fertilizers is posing a major problem and a huge chunk of hindrance to the sustainability in agriculture. In addition to that the cost increases resulting from over-application of chemicalfertilizers also reduce the profit margins for growers.Around 50% of the applied nitrogen is estimated to be lost to the environment which is resulting in additional cost of production as well as contamination of river, other water-bodies and groundwater. Therefore we have to keep an eye on optimized and judicious use of these chemical fertilizer in a sustainable manner. In the context of sustainable agriculture, application of nanotechnology for the fertilizer development is one of the potentially promising step for boosting the production to meet up the growing food demand of the huge population as well checking the environmental pollution.

What is Nanofertilizers?

Nanofertilizers are nutrients consists of a carrier matrix of a mineral elements in the form of a nanomaterial for controlled and slow delivery of nutrients in order to meet up the imperative nutrient requirements of agricultural crops [3]. These new technology fertilisers are currently being regarded as a viable alternative to the conventional one [4].Nanofertilizers

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can be absorbed through both the plant roots and leaves and as a result of this, the application of it significantly influence the behaviour, bioavailability, and uptake of nanofertilizers in crops [5].

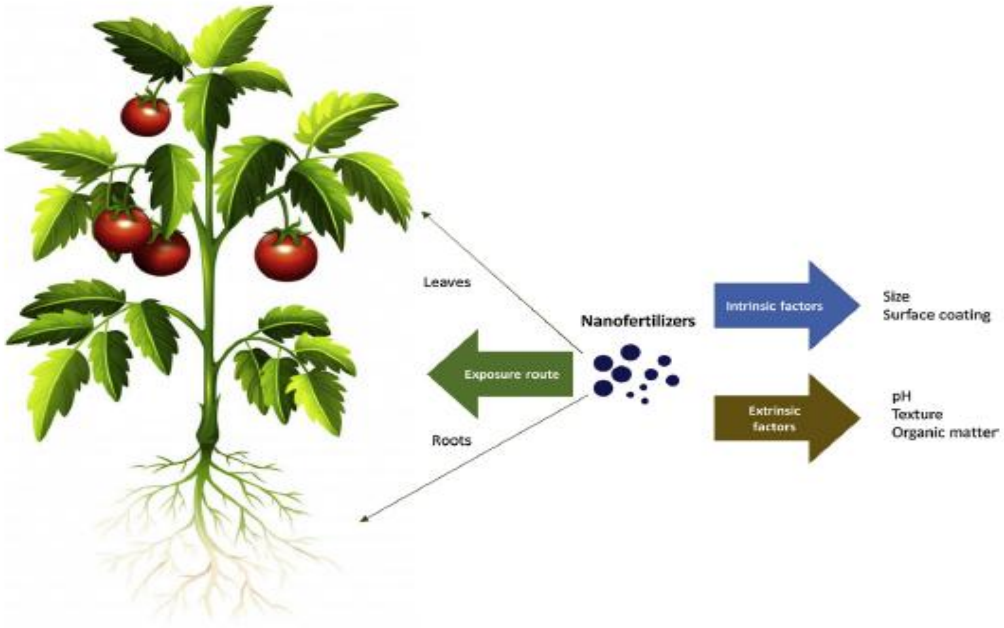

Fig 1. Factors that influence uptake, distribution and accumulation of nanofertilizers in crops. Intrinsic factors (nanofertilizers), extrinsic factors (soil) and exposure route.

Advantages of nanofertilisers in Agriculture

Researches showed that key macronutrient elements as in N, P, and K, applied to the soil are usually lost by 40–70 %, 80–90 %and 50–90%, respectively resulting a considerable loss of resourcesand ultimately becomes unavailable to the plants. Benefits of nanofertilizers over conventional chemical fertilizers mainly relies on the nutrient delivery which regulates the availability of nutrients in crops as they are slow-releasing in nature. The slow delivery mechanism of nutrients is related to the cementing of nutrients with nanoparticles. Bytaking advantage of this slow nutrient delivery mechanism farmers can increase the crop growth because of the consistency of nutrient delivery for long terms which makes nanofertilisers more viable than the conventional fertilisers. For example, nutrients can be released up to 40–50 days or more than that in a slowrelease mechanism rather than the 4-10 days by the conventional fertilizers [6]. In conventional fertiliser application system, half of the appliedfertilizer is lost in leaching or becomes bio-unavailable to the plant because the excessive availability restricts the roots to uptake or sometimescausing toxic effects on the

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plant. Moreover, nanofertilizersreduce the transportation and application costs. Plants are indeed sensitive towards micronutrient availability during crop growth period and the unavailability of it imparts and negative production in the form of poor quality of fruits and vegetables. In conventional nutrient management system, it is very difficult to controlthe micronutrient application to a specific crop, but nanofertilizers gives the opportunity to the farmers for applying an adequate amounts of nutrients with an aim to increase the nutrient use efficiency, leading to precision agriculture. In this discussion, nanofertilizer application technology is to take us a step ahead to make the agriculture sector sustainable and environment-friendly. These new smart fertilizers can be aviable alternative for the conventionalfertilizers which are required in bulk amount, and can save the soil and water from nutrient pollution.

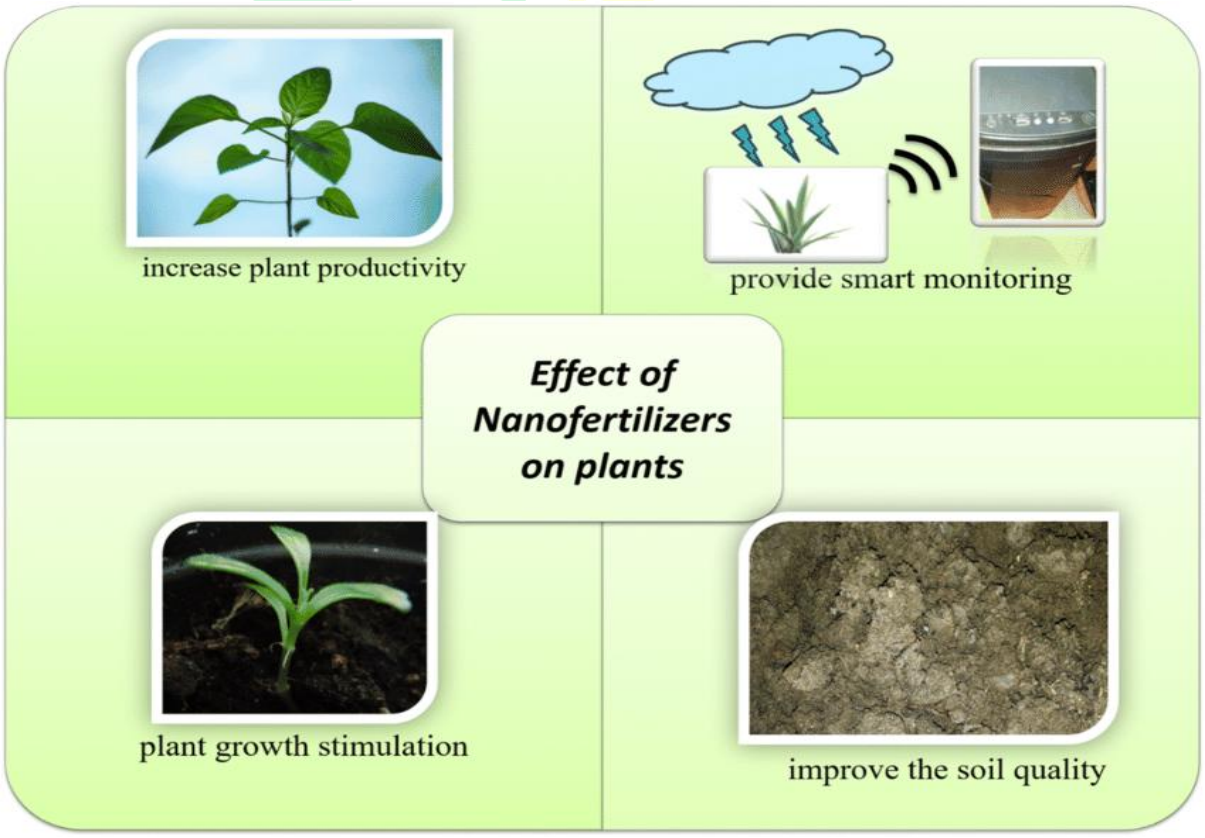

Fig 2. Effects of nanofertilisers on plants: A schematic overview

Benefits and challenges of using nanofertilizers

Although the benefits of application of nanofetilisers are way too effective than conventional fertilisation but there's always some disadvantages to any emerging technology. Even if the slow nutrient release mechanism can be breathtakingly revolutionary but still

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there is a need of studying the life cycle of the fertilisers in case of long term benefits which could be a case of concern under multiple stress condition for a plant. Until now no issues have been found regarding the bad impact of using nanofertliser we can hope for a better and sustainable use of nanofertilisers which can be a great ally for our changing climatic condition and booming population.

Conclusions

Nanofertilizers which is an essential source of fertilizers improving the crop production, as compared to traditional chemical fertilizers. It has many advantages, which includes their slow-delivery of mechanism, abilities to reduce the loss of nutrientsincreasing the bioavailability of nutrients, increasing the nutrient uptake and increasing the nutrient use efficiency. But on the other side the nanofertilizers have some problems because they are high reactive in nature and may lead to the phytotoxicity ofplants. But as of now we must look forward to the positive role of nanofertilizers on crop production as well as the simplicity of execution and no need for sophisticated equipment helps to show us the brighter side of it.As the majority of the research works shows a promising future in using nanofertilizers for plant nutrition and crop-production, there are still some active and encouraging area unexplored.

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