Use of nano-fertilizers in crops-A review

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ABSTRACT

Soil is the major natural medium that supports survival and regeneration and growth of plants. However, exhaustive crop production with high productivity needs supplemental plant nutrition provided by the fertilizers, which may be provided through soil application or foliar application. These supplements have a vital role in development and growth of the plants. Conventional fertilizers are used on a large scale by the farmers for increasing the crop productivity, although their excessive use is causing problems like environmental pollution, water contamination, toxicity in food items so posing a health hazard for human beings and animals. The nanotechnology is playing an imperative part in the productivity with control on nutrients release, target specific, smart delivery system and monitoring irrigation water quality for sustainable development of agriculture.

Key words: Crop yield, Nanofertilizers, Pollution

Nano fertilizers are the nutrients of nanoscale size, nano encapsulations or nano polymer coated nutrients which are applied through smart delivery system to the soil or to plants as per nutrient requirement for enhanced efficiency. Nano-fertilizers have more surface area, absorption capacity and regulated supply to specific sites (Rameshaiah *et al*., 2015; Solanki *et al*., 2015). Fertilizer contribute to the speeding up of plant growth as well as the improvement in soils. Applications of nanotechnology in agriculture, improve crop growth, yield and productivity (Shang *et al*., 2019). Due to minute size, the nano- particles can easily penetrate into the stomata (Eichert *et al*., 2008; Pérez-de-Luque, 2017). Nanocarriers transport the nutrients at appropriate place and time and boost the nutrient use efficiency. Manjunatha *et al*., 2016 stressed upon three times higher nutrient efficiency and increased stress tolerance ability in plants by using nanofertilizers. Nanotechnology may protect the environment by filtering or by catalysts to clean-up pollutants by degradation of toxins or enhancing the ability of microbes to degrade the toxins or waste materials present in the soil.

Undeniably, penetration and translocation of nanofertilizers and their impact on crops in terms of yield, quality and tolerance to abiotic stress and lessening of heavy metal toxicity should be studied. The use efficiency of nitrogen, phosphrous and potassium remained stagnant for the past years. Due to various types of losses caused by runoff, leaching, evaporation, drift, degradation, lack of skill very less amount of nutrients actually reach target sites. As outcomes, the rehashed utilization of abundance measure of fertilizers antagonistically influences the characteristic supplement harmony of the soil. Alongside these, water situations have genuinely been sullied because of draining of lethal materials into streams and water stores, which additionally causes the pollution of drinking water. Nanofertilizers combined in explicit intension to control the arrival of supplements relying upon the necessities of the harvests while limiting differential misfortunes, have enormous probability.

Nanoformulations release the nutrients with the crop's demand, consequently, avert unwanted losses of nutrient via direct absorption by crops. Zeolites, clay and chitosan drastically reduced nitrogen loss and improved the plant uptake (Panpatte *et al*., 2016; Milan *et al*., 2008; Aziz *et al.*2016*)*.Ammonium embeded zeolites augmented availability of phosphorous and its uptake (Dwivedi *et al*., 2016). Graphene oxide nanomaterial, can extend the process of potassium nitrate liberation (Shalaby *et al.* 2016). *Sabir et al.* 2014 demonstrated that nanocalcite application with nano silicon, magnesium and iron oxides improved the uptake of phosphorous, calcium, magnesium, zinc and iron.

Aziz *et al.* 2016 revealed higher wheat yield by using chitosan-NPK fertilizer. Kale *et al.* 2016 observed increased barley yield upto 90% with application of zinc oxide nanoparticles alonwith enhanced use efficiency of other nutrients. Disfani *et al.* 2017 observed remarkable improvement in seed germination in maize and barley crops by applying iron and silica nanoparticles. Higher grain yield in maize and wheat by using titanium and silver nanoparticles was achieved respectively (Jyothi and Hebsur, 2017). Nano-iron particles applied augmented soybean yield was observed by Sheykhbaglou *et al.* (2010). Prasad *et al.* (2012) observed increased growth in plant (root and stem) and pod yield in peanut by application of nano zinc particles.

Increased crop yield and protein content in maize seeds was observed by treatment with selenium nanoparticles (Ampleyeva *et al.*, 2012) and nano-chelate zinc produced higher yield in maize as reported by Farnia and Omidi, 2015. Gold nanoparticles in *Brassica Juncea* accelerated the seedlings growth, oil and sugar content (Arora, *et al.*, 2012), while more shoot and root lengths were observed in *Brassica Juncea* with silver nanoparticles (Sharma *et al.*, 2012). Seeds priming of *Helianthus annuus* with copper nanoparticles led to higher content of proteins and oil in seeds (Polishchuk *et al.,* 2013). Higher dry root mass in *Arachis hypogaea* was observed by the application of ferric oxide nanoparticles (Rui *et al.,* 2016). EL-Metwally *et al.,* 2018 indicated increased growth and yield in peanut with the application of nanoparticles with increased content of N, P, Zn, Fe and Mn in seeds. The application of hydroxyapatite nanoparticles enhanced growth in *Glycine max* (Liu and Lal, 2014). Tarafdar *et al*., 2012a; Tarafdar *et al*., 2012b found significant yield increase by to foliar application of nano fertilizers. They also observed that equivalent yield of clusterbean and pearl millet crops by the application of 640 mg ha-1 of nanophosphorus than 80kg P per hectare.

Increased productivity and improved quality of fruits in almonds was observed with application of nanofertilizers as reported by Kamiab *et al*., 2016. NanoCa sprayed on blue berries led to higher vegetative growth (Sabir *et al*., 2014). Haider *et al*., 2019 observed the higher mango yield and improved quality of fruits by nano boron application, however, nano zinc application on mango tree caused increased fruit number, weight and carotene content in fruits (Zagzog and Gad,2017). Hussein and Abd-Elall, 2018 showed a positive effect of nano boron fertilizer in olive trees with increased fruit yield and oil content. Davarpanah *et al*., 2016 studied the response of pomegranate tree to the application of nano-zinc and nano-boron and they found enhanced quality and quantity of fruits.

Conclusion

In agriculture, nanotechnology has been used for enhancing crop production as well as for quality improvement. The appearance of man-made nano materials revolutionized farming by newness, escalation in growth and sufficiency to meet global demand of food. Nano fertilizers assure enhanced management, conservation of resources and reduction of environmental pollution. More knowledge and research is needed to widen its prospective in agricultural crops.

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