Application of nan fertilizers in cereals and oilseed crops – A review

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ABSTRACT

Soil is the major natural source of plant nutrients and support survival and regeneration and growth of flora. However, intensive crop production that aims at high levels of productivity needs supplemental plant nutrition which may be given through soil application and or foliar application. Nutrient supplements assume a significant job in development and advancement of the plants, and when present in inadequate amounts can decrease development and yields. Soil application of nutrients is the most common practice, but it has many limitations with respect to availability of nutrients to the plants. Foliar application overcomes these limitations. The nanotechnology has an imperative role in the productivity by controlling nutrients and monitoring irrigation water quality for sustainable development of agriculture.

Key words: Agriculture; crops; nanoparticles, yield

Notwithstanding that, foliar taking care of has end up being the quickest method for remedying supplement inadequacies and expanding yield and nature of harvest items (Roemheld and El-Fouly, 1999) and it additionally limits ecological contamination and improves supplement usage by diminishing the measures of fertilizers applied into the soil (El-nour, 2002). Even though leaves allow gas exchange, but cuticle present in the leaves restricts the penetration of substances (Schwab *et al.*, 2015; Pérez-de-Luque, 2017).

The nano coated substances enhance the penetration via stomata with a size exclusion limit above 10 nm (Eichert *et al*., 2008; Pérez-de-Luque, 2017). In addition to this, nanocarriers deliver the nutrients in the right place and at right time so reduce the extra amount of active chemicals deposited into the plant system and increase the nutrient use efficiency. Nano-fertilizers have more surface area , absorption ability, and controlled-release to targeted sites, thus having smart delivery system (Rameshaiah *et al.*, 2015; Solanki *et al.*, 2015).

Indeed, it is necessary to study about the penetration and translocation of nanofertilizers through foliage and its effect on crops with respect of growth, development, yield, quality, tolerance to abiotic stress and alleviation of heavy metal toxicity. The use efficiency of nitrogen, phosphrous and potassium remained stagnant for the past years, moreover, the use efficiency of these fertilizers depends upon the net amount to the target loci when these are applied in soil or foliage. 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. The application of zeolites, clay or chitosan significantly reduced the losses of nitrogen and enhanced the plant uptake (Panpatte *et al*., 2016; Milan *et al*., 2008; Abdel-Aziz *et al*.2016). Zeolites charged by ammonium increased phosphorous availability and uptake in plants (Dwivedi *et al*., 2016). Graphene oxide nanomaterial, can extend the process of potassium nitrate liberation so minimized losses (Shalaby *et al.* 2016). *Sabir et al.* 2014 demonstrated that nanocalcite application with nano SiO_2 , MgO and Fe_2O_3 enhanced the uptake of P, Ca, Mg, Zn, Fe.

Nanofertlizers have ability to increase yield in rice, maize, soybean, wheat up-to 10,11, 17 and 29% respectively (Liu *et al*., 2009). Abdel-Aziz *et al.* 2016 revealed increased wheat yield attributes along with higher harvest index by using chitosan-NPK fertilizer. Kale *et al*. 2016 showed 91% increase in barley yield by the application of zinc oxide nanoparticles and enhanced use efficiency of nutrients.

Disfani *et al*. 2017 observed that iron and silica nanoparticles have noteworthy prospective for improvement in seed germination of maize and barley crops. Zinc nanoparticles caused increasing root and shoot lengths and dry matter in rice crop. Similarly higher grain yield in maize by using titanium nanoparticles and silver nanoparticles in wheat crops was achieved as reported by Jyothi and Hebsur, 2017. Sheykhbaglou *et al.* (2010) observed that application of nano-iron particles augmented soybean yield. Prasad *et al.* (2012) showed increased root and stem growth as well as pod yield in peanut with application of nano zinc.

Seeds of maize when treated with selenium nanoparticles , crop yield,starch and protein content increased in seeds as reported by Ampleyeva *et al.*, 2012. Application of nano-chelate zinc produced higher yield in maize (Farnia and Omidi, 2015). Application of gold nanoparticles in *Brassica Juncea* accelerated the seedlings growth and increased secondary branches in plants, oil content and sugar content in seeds (Arora, *et al.*, 2012), however higher shoot and root lengths were observed in Brassica Juncea by applying silver nanoparticles (Sharma *et al*., 2012).

Seeds of *Helianthus annuus* primed with copper nanoparticles produced more number of seeds with higher amounts of proteins and oil (Polishchuk *et al*., 2013). Ferric oxide nanoparticle produced higher dry root mass in *Arachis hypogaea (*Rui *et al*., 2016). EL-Metwally *et al., 2018* indicated that the highest plant height, branches per plant, pod number, pods weight seeds per pod in peanut plant was with the application of 30 ppm nanoparticles. They further added that N, P, Zn, Fe and Mn contents increased in seeds. The application of hydroxyapatite nanoparticles enhanced growth in *Glycine max* (Liu and Lal, 2014).

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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