

Nanotechnology: An Emerging Agro-productivity Tool

Kiran¹, Deepak Kumar² and Ganesh Kumar Koli¹

¹Ph.D scholar, Department of Genetics and Plant Breeding, CCSHAU, Hisar, Haryana

²Ph.D Scholar, Department of Agronomy, ICAR-NDRI, Karnal, Haryana

SUMMARY

Nano-technology is an emerging agro-productive tool which enhances the crop productivity, meet the food security demands and cope up with the current problematic situations in agriculture. It plays a crucial role in every part of agricultural systems from enhancing the crop growth when seed and roots of plant are treated with nano-particles to decrease the level of hidden hunger by biofortification of crops. Nano-particles can be used as fertilizers such as zeolites, pesticides like nano-structured alumina and also increases the shelf life of fruit and vegetables with the use of Cu-chitosen nano-particles.

INTRODUCTION

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. Physicist Richard Feynman (father of nanotechnology) talked about it in his lecture "There's Plenty of Room at the Bottom: An Invitation to Enter a New Field of Physics". Feynman considered the possibility of direct manipulation of individual atoms as a more powerful form of synthetic chemistry than those used at the time. Keeping in mind, the current Covid-19 situations, lockdown resulted in large losses to agriculture production. It is because of less availability of seeds, fertilizers and labour during the growing season and leads to missed windows for planting and harvest. To overcome such problem in near future, nano-engineering particles can be used to treat seeds and roots of plants for smart agriculture. This can boost the crop production and assure sustainability.

Nano-Material Vs Conventional Material:

Conventionally, bulk fertilizers are applied directly to soil or sprayed over the leaves of plants, which surpass the nutritional requirement of plant and due drainage of fertilizers could pollute the ground water but, nano-technology increases the efficiency of input like fertilizers, pesticides and micro-nutrients and minimizes the relevant losses by site directed controlled delivery of these inputs. The unique properties of nano-particles such as high surface area/volume size ratio and enhanced opto-electronic and physio-chemical properties make them more desirable as compared to conventional fertilizers. Nanotechnology could make pesticides more effective by reducing particle size to nano-scale, these particles are more reactive and has more catalytic action than large particles of same chemical substance.

Application of Nanotechnology in Agriculture:

Nano-particle such as iron-pyrite (iron-sulfur nano-bio-stimulant) increases the metabolism of seed and root in crops like wheat, chickpea, cabbage, tomato, mustard and sesamum. In case of spinach, seeds are soaked in aqueous solution of iron-pyrite for 14 hrs and sown directly in the field exhibited significantly broader leaf morphology, larger leaf numbers, increased biomass; along with higher concentration of calcium, manganese and zinc in the leaves when compared to the control plants (Das *et al.*, 2016). Urea-Hydroxyapatite Nanohybrids are used for the slow release of nitrogen in plant, They can release nitrogen upto 1 week as compared to pure urea which is expended within a minute. This also resulted in better rice crop yield at half the lower concentration of urea (Kottegoda *et al.*, 2017). Considering a natural calamity like draught, facile coating of urea with low dose of Zinc oxide nanoparticles promoted good wheat performance and enhanced zinc uptake under stress conditions (Dimpaka *et al.*, 2020). During this pandemic situation, nanotechnology has also played a very crucial role in minimizing the post harvest losses in fruits and vegetable. Talking about tomato, application of Cu-chitosen nano-particles significantly cutoff the microbial decay, decreases the respiration rate and maintained the fruit tenderness during storage period (Meena *et al.*, 2020). Nano-structured alumina particles has insecticidal properties for stored

grain pests like *Sitophilus oryzae*. These particles bind with insect body and causes dehydration of the insect due to its strong sorptive action (Stadler *et al.*, 2017).

CONCLUSION

Nano-technology is an emerging handy tool for agricultural industry. Nano-fertilisers provides nutrients to the plants upto 40-50 days by slowly releasing them to the biofortification of crop using nano-particles. During the current pandemic situation, when it was difficult to go out to buy fresh fruits and vegetable leading to more post harvest losses, the application of nano-technology in food processing industries increases their shelf life of fruits and vegetables thus minimizing the relevant loses. The small amount of alumina-silver nano-particles provide resistance to biotic and abiotic stresses. In near future, nanotechnology will transform agriculture and food industry to smart-agriculture and advanced food industry.

REFERENCES

- Das, C.K., Srivastava, G., Dubey, A. (2016). Nano-iron pyrite seed dressing: a sustainable intervention to reduce fertilizer consumption in vegetable (beetroot, carrot), spice (fenugreek), fodder (alfalfa), and oilseed (mustard, sesamum) crops. *Nanotechnology for environmental engineering*: **1**(2).
- Dimkpa, C.O., Andrews, J., Fugice, J., Singh, U., Bindraban, P.S., Elmer, W.H., Gardea-Torresdey, J.L. and White, J.C. (2020). Facile Coating of Urea With Low-Dose ZnO Nanoparticles Promotes Wheat Performance and Enhances Zn Uptake Under Drought Stress. *Frontiers in Plant Science*: 11:168.
- Kottegoda, N., Sandaruwan, C., Priyadarshana, G., Siriwardhana, A., Rathnayake, U.A., Madushanka, D., Arachchige, B., Kumarasinghe, A.R., Dahanayake, D., Karunaratne, V and Amaratunga, G.A.J. (2017). *ACS Nano*: **11** (2): 1214-1221
- Meena, M., Pilania, S., Pal, A. Cu-chitosan nano-net improves keeping quality of tomato by modulating physio-biochemical responses (2020). *Scientific reports- Nature*: **10**: 21914
- Stadler, T, Buteler, M., Valdez, S.R. and Gitto, J.G (2017). Particulate Nanoinsecticides: A New Concept in Insect Pest Management, *Insecticides - Agriculture and Toxicology*, Ghousia Begum, IntechOpen