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Extended Abstract

Nanotechnology and Horticultural Sector

Abobatta W F

Horticulture Research Institute- Agriculture Research Center, Egypt

Abstract:

Additive Manufacturing (3D Printing) is a process that used to synthesize a 3D object under computer control with successive material layers. 3D printing witnessing a huge potential market with a new business modules, by establishing its own prominent position in the Medical (Clinical, Dental, Orthopedic and many), Architecture, Engineering (Aerospace, Automobile, Bio-material, Material and many) etc.

3D printing 2017 created a platform for 3D printers, researchers, bio printers, Surgeons, Material Engineers, 3D printing Industries & who all are the part of the 3D printing, to pool the knowledge on the current trends, innovations and methodology in 3D printing. It came up with the theme of the "Innovations in Medicine through 3D Printing". There is more attention to use the Nanotechnology applications in various fields from the last few decades, whereas, in the agricultural sector, Nanotechnology has precious characters in the delivery of the various agrochemicals for enhancing plant resistance, plant growth, and nutrient use. From one hand, there is increasingly interesting to use different nano applications like Nanofertilizers, Nanocides, Nano-coating materials, Nanocarrier, and Nano-biosensors in improving horticultural production, from another hand, using nano applications in postharvest processing improving freshness, enhancing quality, and extended shelf life of horticultural products particularly perishable products and control disease activity during storage, also, Bio-Nanotechnology could protect soil and water by using designed Nanosensors linked to the global position system, which is more sensitive and show earlier response to environmental changes.

Nanoparticles formulated by two basic types as follow, firstly 'Top-down' systems whereas tiny manipulations of slight numbers of atoms or molecules produce smallest possible patterns in nanoscale, While in 'Bottom-up' constructions, many molecules self-assemble in parallel steps, as a function of their molecular recognition properties (Royal Society and Royal Academy of Engineering, 2004).

Nanotechnology is the potential technologies that study the materials at nanometer dimensions (1–100 nm), it is a novel scientific branch that could be counted as a key solution to numerous problems in agriculture production, by providing the opportunity to address complex technical issues of various crop production, particularly, under climate change conditions and increasing global demands for food production, nanotechnology applications could improve agricultural productivity through better management of different inputs such as enhancing fertilizers efficacy and improving soil fertility to maximizing crop yield and improve the quality of agricultural commodities and produce safe foods.

The horticultural sector has different challenges that require a strategic solution to improve productivity such as climate change, malnutrition, excessive use of different agrochemicals, spreading pathogens, and increasing post-harvest losses particularly in perishable products, and protect the environment from contamination by various agrochemicals like pesticides and fertilizers.

Nowadays, numerous applications of nanotechnology have been used in horticultural production to maximizing production and increase commodity shelf life and increase food safety e.g. reducing pathogens activity, produce a new generation of packaging materials, controlling internal atmosphere, reduce the damage of different rays particularly Ultra Violet, increasing food safety by using Nano biosensor. There are different impacts of nanotechnology applications in the horticultural sector include controlled released nanofertilizers to improve tree growth, increase yield, and enhancing fruit quality. Nano-based target delivery approach is used for vegetable crop improvement and generates a new variety tolerant for biotic and abiotic stress conditions. Nanocides used for increasing the efficiency of crop protection, while, nanosensors and computerized controls greatly contribute to precision farming, Nanomaterials also used to enhance soil characters and protect the environment. Nanomaterials for horticultural applications must have determined properties like effective concentration and controlled release of nutrients or pesticides in response to positive stimulation, improving targeted activity, and smart and safe delivery with minimal Ecotoxicity.

Currently, Nano-fertilizers represent an alternative to bulk fertilizers and reducing accumulation of different nutrients which may affect negatively on soil characters, and reduce contamination of water may be eliminated. Nanofertilizers supply slow and steady nutrients for the plant in determine time as per plant requirement through smart delivery systems,

thereby increase the efficiency of the using fertilizers and minimize nutrients loss and leaching in drainage water.

There are different paths to adsorb Nanofertilizers in plant tissue and adsorb rates determined by characters of nanoparticles like size and surface properties. Nanoparticles must cross the cell wall before entering the intact plant cell protoplast, therefore, smallest nanoparticles with diameter lesser than (5–20 nm) passing directly through the cell wall pores, meanwhile, the larger ones could penetrate through cuticle-free areas.

Nanofertilizers providing a good potential to deliver nutrients to specific target sites in plant cells, there are different approaches to synthesis Nanofertilizers like formulate composite of nanoparticles of the nutrient itself, absorption nutrients on nanoparticles, and encapsulation nutrients with a Nano particulate polymeric shell.

Soil application of Nanofertilizers increased the adsorption of nutrients from soil solution due to noticeably minor particle dimensions and larger specific surface areas.

Nanomaterial's have more efficient and able to site-specific use due to their distinctive physical and chemical characteristics like wide surface area, Nanomaterial's offer new insights toward crop protection and play a significant role as an alternative for bulk pesticides of different pesticides, insecticides, and herbicides in an eco-friendly greener way, also, the composition of Nanocides enhancing solubility of low soluble active ingredients, and assist in gradual releasing of the active compound, also, Nanomaterial's attain two vital aspects in pathogen and pests control represented in their higher efficiency with tiny ecological influence and minimizing toxicity for mankind health, Nanocides are highly reactive comparing to the bulk pesticides, so, it used at lower doses to spray a wide area of crops, also, it could use as soil application in the form of encapsulated pesticides with controlled-release against pests and soil pathogens depending on the need, therefore, less amount of nanocides show improved effect in crop protection.

There are different forms of nanoparticles used in the agricultural sector like silver nanoparticles, Zinc oxide nanoparticles, Carbon nanotubes, Nano magnetite, Urea nanoparticles, Cu, K, Mn, Mo, Si, Ti, and their oxides, also, Nanocoating materials like chitosan nanoparticles, and zeolite nanoparticles used to coating various conventional agrochemicals such as phosphorus, sulfur, while, active ingredients like validamycin, tebuconazole and azadirachtin have been converted into nanopestecides.

This work concentrates on nanotechnology as a key tool for improving horticultural production by using various applications including Nanofertilizers, Nanopestecides, Nano-coating materials, nano-packaging materials, and Nano biosensors, also, it protects the environment and reduces soil and water contamination. More researches are required with respect to synthesis, toxicology, mode of action, and its effective application at the farm level.