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Original Research Article

Application of nanoparticles in management of fusarium spp

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Abstract

Nanotechnology is an interdisciplinary science which holds great potential to revolutionize the field of agriculture and plant science. Although Nano technological applications have been widely in use in electronics, cosmetics, textiles and medicine, the field of plant nanotechnology is still in the nascent stage. Nanotechnology in plant pathology is a new frontier among the various Nano technological applications in plant biology. Control of plant diseases by site-targeted delivery of Nano formulated agrochemicals, development of disease resistant plant varieties by nanomaterial-mediated genetic transformation and early detection of plant diseases and pathogens are some of the possible key applications in plant pathology. Pests, including insects, mites, nematodes and pathogens, are the major limiting factor in profitable crop production. Frequent application of pesticides has resulted in development of pest and disease resistance, accumulating residues in produce and environmental pollution. So there is a need for alternative approach as to control pests and pathogens. Application of nanotechnology in crop protection holds a significant promise in management of insects and pathogens, by controlled and targeted delivery of agrochemicals and also by providing diagnostic tools for early detection. The biological agents such as plants and microbes have emerged as cost effective and efficient candidates for the synthesis of nanoparticles by green synthesis approaches. They have advantages over conventional chemical methods which associated with eco toxicity. This review is focused on potential applications of nanomaterials in crop protection for a cleaner and greener agriculture.

Key Words: Crop protection, nanoparticles, nanotechnology, pathogens.

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INTRODUCTION

Nanotec hnology is the understanding and control of matter at dimensions between approximately 1 to 100 nanometers (nm) where unique phenomena involved novel applications. A nanomaterial is one billionth of a meter. Nanoscale ranges from 1 and 100 nanometers (http://www.nano.gov/node/241). Nanosc ale materials show unusual phys ic al, c hemic al and biologic al properties, which are completely distinct from their bulk materials and individual molecules (Li *et al*., 2001). These unique properties find its novel applications in all the fields. Nanoparticles have large surface to volume ratio, chemically alterable physic al proper ties, and possess strong affinity to targets such as proteins (Kumar *et al*., 2010). Through the ever growing global food demand due to changing climate, urbanization and environmental issues such as run-of f and accumulation of agrochemicals, there is an increasing need to feed an estimated population growth from the 6 billion to 9 billion by 2050 (Chen and Yada, 2011). With the limited natural resources such as land, water and soil fertility, demand for food has increased tremendously. The cost of chemical fertilizers, pesticides and other production inputs has been drastically increased due to limited reserves of natural gas and petroleum (Agrios, 2005; Ditta, 2012). There are various applications of nanotechnology in agriculture it not only protect the crop from pathogens but also improve the quality parameters of the crop. In view of the potential influence of nanoscale zinc oxide (ZnO) particles on growth and development of peanut, Prasad *et al.* (2012) reported the effects of zinc oxide nanoparticles (25 nm) at 1000 ppm concentration promoted the seed germination, seedling vigor and growth of peanut plant. Their study also focused on determination of early establishment of flowering, higher leaf chlorophyll content, increasing stem and root growth in treated plants. Particles were very effective in increasing pod yield and root growth of peanut. (Agrawal, and Rathore, 2014) Field experiment on foliar application of ZnO nanoparticles showed determinable effect on pod yield at 15 times lower dose compared to control. Nanomaterials can be effectively employed in growth and germination of plant when used in controlled conditions. Investigation of the adverse effect of nanomaterial's on the seed and plant proper ties increases the effective applicability of nanomaterials in crop production (Norman and Hongda, 2013).

The present research was designed to find out the different types of nanoparticles used in crop protection for ecofriendly nature.

MATERIAL AND METHODS

Procedure of copper nanoparticle synthesis: The copper nanoparticle were synthesized using standard protocol of by Lanje *et al*. 2010 with modification. The nanoparticles dimensions were studied using scanning electron microscopy (MODEL NO.-S4800) and attachment of EDXS (MODEL NO. XFLASH 5030 DETECTOR). These particles are used for the management of fusarium fungi. Antifungal activity of copper nanoparticles were checked against fungus *Fusarium oxysporum f. sp. ciceri* by using different concentrations viz. 100 µl, 50 µl, 25 µl and 10 µl (Stock of 10mg/ml). Copper acetate and Copper sulphate were used as control. And the positive control was bavistin.

RESULT AND DISCUSSION

The synthesized nanoparticles were confirmed with microscopy. In case of copper nanoparticles against the fungus *Fusarium oxysporum f. sp. ciceri* the average zone of inhibition was observed as 13 mm and 12 mm at 100 µl and 25 µl respectively. Maximum zone of inhibition was obseverd in 100µl concentration. Control showed least zone of inhibition. Test of significance was found positive for zone of inhibition. Similar observation were recorded by Ramyadevi *et al* (2011), (Singh, S. 2012) by synthesizing copper nanoparticles using modified polyol method when used for antimicrobial activity. The antimicrobial activity was observed against fungus like *Aspergillus flavus*, *Aspergillus niger* and *Candida albicans*. *In these experiments copper nanoparticles showed inhibitory activity against C. albicans and produced 23 mm zone of inhibition.*

CONCLUSION

Nanotechnology holds the promise of controlled delivery of agrochemicals to improve disease resistance, plant growth enhancement and nutrient utilization. Nano encapsulation shows the benefit of more efficient and targeted use of pesticides, herbicides and insecticides in environment friendly greener way. Research and development in post-harvest nanotechnology can help in preservation of the freshness and quality and prevent diseases in a relatively safer way. With the advancement of nanotechnology, application of green chemistry in synthesis of nanomaterial's by using plant extracts and living cells has reduced the use of toxic solvents and guarantees ecoprotection (Kim *et al.*, 2012). Nanotechnology in conjunction with biotechnology has significantly extended the applicability of nanomaterials in crop protection and production. Even though the toxicity of nanomaterials has not yet clearly understood, it plays a significant role in crop protection because of its unique physical and chemical properties. The application of nanomaterials irrelatively new in the field of agriculture and it needs further research investigations. Barring the miniscule limitations, nanomaterials have a tremendous potential in making crop protection methodologies cost effective and environmental friendly.

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