

Impacts of Biogenic Nanoparticle on the Biological Control of Plant Pathogens



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Abstract

Nanotechnology has been reported as an additional technology which could help in meeting the global demands for sustainable agriculture and prevention of crop losses. Several scientists have concentrated their efforts on the development of non-target, biodegradable and eco-friendly nano-formulations showing strong biological activities against plant pathogens. This mini review highlights some of the nanomaterial-based agents that have been used in the management of plant pathogens affecting several crops of interest.

Introduction

It has been observed that global pesticide consumption constitutes about millions of tonnes per year [1]. The drawbacks that have been established from using pesticides include development of resistance to these pesticides, unwanted side effects on beneficial organisms, pesticide residues in food, animal feed and ecosystem disruption [2]. The hazardous consequences of pesticides have been a major bottleneck in achieving sustainable agriculture, food safety and prolonged human health. Therefore, there is an urgent need for biological control agents that would help in getting rid of pathogens without any adverse effects on the environment [3].

What is nanotechnology and its significance in pest management?

Nanotechnology offers potential uses in pest management. Formulations of nanomaterial can enhance the resistance of plants to pathogens and pests by modulating the genetical material available in plants [4]. The small size of the nanoparticles makes them an important carrier, enhancing their attachment to plant surfaces. Also, the controlled and slow-release nature help to minimize the amount of spillage into the surroundings [5]. Nanoparticles have been synthesized from various metals including silver, zinc, copper, gold and iron, most of which have been used in the management of plant diseases. Their antimicrobial activities could be linked to the fact they can

deactivate the cell wall of plant pathogens, thereby affecting the normal metabolism of the cell and leading to cell lysis [6].

Significance of plant pathogens

A huge amount of loss has been recorded in crop production due to plant pathogens. They are one of the major biological factors responsible for plant diseases, and the crop loss reported is approximately 2,000 billion dollars per year [7]. Among the plant pathogens, phytopathogenic fungi alone are responsible for \$45 billion loss globally. The main reason is the ability of pathogens to establish and damage any parts of the plant they are in contact with [8].

Recent trends in the application of nanoparticles in controlling plants pathogens

Mishra et al. [9] synthesised silver nanoparticles with the cultural filtrate from *Serratia sp.* BHU-S4. These were used in controlling spot blotch disease in wheat [9]. Abdelmalek and Salaheldin, synthesised silver nanoparticles that served as fungicides against Citrusphytopathogenic fungi which include, *Penicillium digitatum*, *Alternariacitri*, and *Alternaria alternata* [10]. Patra et al. [11] were able to synthesize a nano-based antifungal compounds from zinc oxide, which was used in the effective management of plant pathogenic fungus including *Fusarium oxysporum* and *Aspergillus niger*. Kanhed et al. [12] &

Bramhanwade et al. [13] also synthesized copper nanoparticles which exhibited strong antifungicide activities against tested plant pathogenic fungi responsible for crop diseases [12,13].

Conclusion

The biogenic nanoparticles because of their unique properties have proven to be effective nanomaterial based fungicides in the management of some plant fungal diseases responsible for major crop loss. On the whole, they are potential candidates for extensive use in agriculture as plant protecting agents. The fact that they are from biological source facilitates supports their utilization for promoting sustainable agriculture.

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