

Smart Nanomaterials Technology

Azamal Husen *Editor*

# Plant Response to Silver Nanoparticles

Plant Growth, Development,  
Production, and Protection

 Springer

*Editor*

Azamal Husen  
Wolaita Sodo University  
Wolaita, Ethiopia

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# Mitigation of Metal Toxicity in Plants Using Silver Nanoparticles



Kulsum Hashmi, Tahmeena Khan, Saman Raza, and Seema Joshi

**Abstract** Certain metals like Ca, Mg, Cu, and Fe are essential for plant growth while several others, like As, Cd, and Pb are not; the presence of these metals in soil above a certain threshold concentration is toxic to plants. They lead to several cellular and structural changes in the plants by increasing oxidative stress and modifications in certain metabolic pathways. The plant in turn responds to this stress by several methods like increasing the production of antioxidants and other enzymes. Metal toxicity hampers water uptake, nutrient assimilation and consequently plant growth. As a result, there is a decrease in plant productivity as well as quality, leading to financial loss for the farmers and health problems for the consumers. Several methods are used for the remediation of this toxicity in the soil and the plants, including leaching, use of chelators, phytoremediation, etc. However, most of these techniques have drawbacks like being expensive, hazardous to the environment, unsuitable for varied use and not being target-specific. In recent years, nanotechnology has emerged as a safe and effective tool with many desirable outcomes. Its use is being explored in agriculture as well, with nanoparticles being employed in soil fertilizers, disease management and removal of toxins. This chapter describes in detail, the effect of metal toxicity in plants and the use of nanoparticles, for its remediation. AgNPs are of particular interest here, owing to their beneficial effects on plants which have been widely investigated.

**Keywords** Heavy metals · Nanotechnology · AgNPs · Synthetic routes · Toxicity · Mechanistic insight

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K. Hashmi · S. Raza · S. Joshi  
Department of Chemistry, Isabella Thoburn College, Lucknow, UP 226007, India

T. Khan (✉)  
Department of Chemistry, Integral University, Lucknow, UP 226026, India  
e-mail: [tahminakhan30@yahoo.com](mailto:tahminakhan30@yahoo.com)

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