Silver Nanoparticles Synthesized Using Green Chemistry: A Study of Environmental Impacts on Brassica oleracea in a Hydroponic System

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Silver nanoparticles (AgNPs) are found in over 200 common products, including paints and toothpastes. These particles can be flushed into wastewater, and agricultural fertilizer is formed from this sewage. Using this stimulant results in exposure of AgNPs to food supplies and the environment. The effects of these particles have not been thoroughly inspected, which raises concerns regarding the safety of both our food and the environment. In this investigation, plant health was measured following exposure to varying concentrations of AgNPs in a hydroponic system. It was hypothesized that as silver nanoparticle concentration increased, negative effects on plant health would also increase. AgNPs were produced using green synthesis with an extract of Allium sativum. The products were spectrophotometrically analyzed, and reducing agents in garlic were evaluated with an oscillating chemical system. Brassica oleracea was grown in a hydroponic system to determine AgNP effects on roots, shoots, biomass, and germination rate. AgNPs had significant negative effects on the plants in all categories according to ANOVA tests. Root length was affected more than shoot height, as shown by a decrease in the average root/shoot ratio among the control and experimental groups. The hypothesis was not supported; AgNPs have significant effects on B. oleracea, yet not necessarily proportional to concentration. These impacts may be due to antimicrobial properties of Ag+ released from AgNP surfaces, which disturbed nitrogen-fixating bacteria in roots, or excess production of potentially-cytotoxic reactive oxygen species. Industries using AgNPs should be aware of these conclusions about effects of AgNPs on the environment.