Geophysical Research Abstracts
Vol. 16, EGU2014-6983, 2014
EGU General Assembly 2014

Effects of citrate-coated silver nanoparticles on interactions between soil bacteria and the major crop plant Zea mays

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The increasing use of silver nanoparticles (AgNPs) in commercial antimicrobial products presents an opportunity for increased environmental exposures. While the behavior of AgNPs in surface waters is becoming increasingly understood, little research has been conducted on the effects of these, or any nanoparticles, on soil-dwelling bacteria and major crop plants. Because of the importance of soil bacteria to the overall health of natural and agricultural soils, it is necessary to better understand how AgNPs interact with common bacterial species such as Bacillus subtilis and Escherichia coli. It is further necessary to quantify the effect of AgNPs on major crop plants, including Zea mays, a staple crop for much of the world. Finally, research is needed on how complex plant-microbe interactions that originate in the rhizosphere may be disrupted by AgNPs. Our preliminary data show highly statistically significant growth inhibition near 30% for both species of bacteria exposed to 1.0 mg L-1 citrate-coated AgNPs (c-AgNPs). Growth curves compiled from absorbance data show a similar dose-response for both species. Treatment with aqueous Ag as $AgNO_3$ slightly inhibits E. coli (90 ± 5 %), but enhances growth of B. subtilis to 127 ± 23% of control. These results indicate that toxicity may be related to specific nano-scale properties of the c-AgNPs. On-going experiments measure potential growth inhibition, root development and morphology of Z. mays exposed to c-AgNPs, and resulting changes in plant-microbe interactions.