"From Phytoremediation to Implications and Applications of Nanotechnology in Agriculture: Effects of Copper Nanoparticles on Sugarcane"

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Abstract

The extensive work of my research group at the University of Texas El Paso (UTEP) in the field phytoremediation led us to discover, for the first time, that plants could form gold nanoparticles (NPs) from the absorbed gold ions. This discovery allowed us to be part of the NSF/EPA UC Center for the Environmental Implications of Nanotechnology (UC CEIN), and several other key nanotechnology centers, where we have been studying, for over ten years, the effects of metal NPs (nano-CeO_2, nano-TiO_2, nano-ZnO, and nano-CuO) on terrestrial plants. The widespread use of NPs, more specifically, of copper based NPs has been accompanied by an increasing interest in understanding their potential risks. It is essential to understand the effects of these nanoparticles on edible crops by performing long-term experiments at relevant exposure concentrations. Sugarcane is the source of 70% of the world's sugar supply and the widespread use of refined sugar and the consumption of raw sugarcane can provide a route for nanoparticles to enter the food supply. In order to evaluate the biochemical and physiological effects of copper nanoparticle exposure, sugarcane was grown for about one year in soil amended with 20, 40, and 60 mg/kg of Kocide 3000 (a copper based fungicide), copper metal nanoparticles, micro-sized CuO, and $CuCl_2$. The results show that stress indicators such as catalase and ascorbic peroxidase enzymatic activity in the sugarcane plant were activated by all the copper based materials at different concentrations. Sugarcane plants exposed to nearly all copper treatments showed dosage dependent increases in copper concentrations in root tissues. Translocation of copper to aerial tissues was low. My presentation will also include information, which we published in Nature nanotechnology, on our thoughts of future implications and applications of nanotechnology in agriculture.