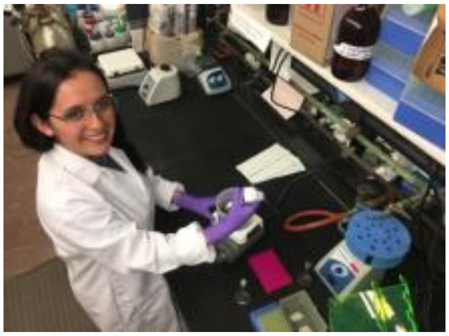

Metal Oxide Engineered Nanomaterials Effect on Soil Function and Microbial Communities

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Helena is from Bogotá, Colombia and earned her Bachelor degree in Industrial Microbiology from Pontificia Universidad Javeriana in Bogotá. Before graduation, Helena did her internship in the biggest brewery in Colombia where she was tasked with the care of beer yeast, and quality control for alcoholic and non-alcoholic beverages. During her undergrad thesis project in microbial ecology she discovered her passion for research. After graduation, she pursued her master degree, also at Javeriana, to study biodegradation of explosives (TNT and PETN). In 2012, Helena came to Purdue to pursue her Ph.D. through the Colombian government fellowship under the Colombia-Purdue Initiative.

Helena has worked collaboratively with guidance from her co-advisors, Dr. Ron Turco and Dr. Loring Nies.

Helena is intrigued by microbes and how environmental perturbations and anthropogenic contaminants affect the micro world.

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Engineered nanomaterials enter the environment through direct (e.g., nanoagrochemicals) or indirect (released during all life cycle phases) processes, soil being the main sink for them. Soils are the foundation of life as they harbor billions of microorganisms. Soil health is ultimately necessary to our collective success providing for essential human needs.

The main objective of this dissertation was to investigate effects of metal oxide engineered nanomaterials on broad function and the microbial communities that inhabit soils. We investigated the effect of nano molybdenum oxide (nanoMoO_3), nano nickel oxide (nanoNiO) and nano lithium oxide (nanoLi_2O) over increasing concentrations on soil function and microbial community structure. Using a fingerprinting technique, we found that nano metal oxide effect on microbial community structure followed a dose-effect response, except for archaeal communities under nanoLi_2O. Further, soil under nanoLi_2O released more CO_2 with respect to the control, increased urease production, while also decreased BG activity. NanoMoO_3 and nanoNiO temporarily suppressed BG.

Based on these findings, we investigated if the observed effect was a result of the material size, by comparing the toxicity of nanoMoO_3, nanoNiO and nanoLi_2O with the bulk form. The work explored how these compounds affect microbial biomass, diversity and composition. Zinc oxide (ZnO) was included due to reported and recognized toxicity in soils. NanoLi_2O, ZnO, and MoO_3 induced distinctive perturbations on diversity and composition of soil microbial communities. In terms of soil toxicity and changes in microbial communities, nanoLi_2O > bulkZnO|nanoZnO > bulkMoO_3|nanoMoO_3. NiO did not have an effect on soil function nor microbial community metrics. This study provides evidence that soil microbial diversity and composition were influenced by the presence of nanoLi_2O, nanoMoO_3, and nanoZnO. However, through the assessment of toxicity provided here, there is no evidence that the toxicity was caused by nano-effects. These are the first reports in literature that analyze the effect of Li_2O, MoO_3, and NiO in soil function and microbial communities.