Nanoparticle Contamination of Agricultural Crop Species

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Project Objectives- Nanomaterials (NM), substances with dimensions less than 100 nm, possess unique properties as a function of small size. Over 1300 nanomaterial-containing products are now commercially available, including pesticide and fertilizer formulations. The current magnitude of exposure and the unique nature of engineered particulates warrant caution, especially given the regulatory framework that generally assumes that nanomaterials possess equivalent toxicity and risk to corresponding bulk materials. As a consequence of this assumption, until recently little research has focused on nanomaterial impacts on agricultural plants. This lack of understanding is disconcerting given that food crop contamination is a primary pathway of human exposure. This five year project has the following objectives:

Obj.1- Determine the uptake, translocation, and toxicity of nanomaterials to crops.
Obj.2- Determine the impact of environmental conditions on nanomaterial uptake, translocation, and toxicity to crops.
Obj.3- Determine the potential trophic transfer of nanomaterials.
Obj.4- Quantify the facilitated uptake of pesticides through NM-chemical interactions.

NANO HIGHLIGHT-

Under objective 4, we have published several papers demonstrating that engineered nanomaterials can significantly alter the accumulation of co-existing pesticides into food crops [3-6]. In two studies published in 2012 and 2013 [3,4], we noted that nanoparticle co-exposure (fullerenes, silver) significantly altered the uptake of DDE (DDT metabolite) by several crops grown in vermiculite. However, a soil-based study was published in 2013 and showed far less impact of fullerene co-exposure on DDE uptake than observed in vermiculite [5]. A fourth study using a second soil was recently published and addresses the impact of multiwalled carbon nanotube (MWCNT) or fullerene co-exposure on the uptake of field weathered chlordane and DDx (DDT plus metabolites) by four crop species [6]. Carbon nanotube co-exposure consistently decreased pesticide uptake in a concentration dependent fashion. Notably, fullerene effects were far more variable, ranging from decreased uptake to no measurable effect to actual increases in pesticide accumulation into the food crop. This discovery of potentially altered pesticide uptake in plants upon nanomaterial co-exposure may have significant implications for food safety, as well as for the movement of pesticides and other organic contaminants through the environment.

References

[1] For further information about this project, contact Jason.White@ct.gov
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