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Fate and Transport of Algal Toxins in Agriculture Environments

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Abstract: Global presence of cyanotoxins has brought attention to risks associated with toxin contaminated water used for irrigation and the potential to introduce new exposure pathways. Studies into accumulation and morphological effects of cyanotoxin exposure on agricultural crops have indicated a potential exposure pathway that needs to be considered. Identification of degradation pathways within the soil matrix allows the availability and transport of toxins through the agricultural environment to be identified. Determination of toxin fate in the soil will elucidate the risk to groundwater and agricultural crops. Initially, alfalfa and spinach plants were exposed to cylindrospermopsin and microcystin-LR in a greenhouse environment to determine effects on germination, bioaccumulation and morphology at various stages of the life cycle. Measurements for biomass and morphological differences indicate the plants' ability to adapt to the presence of toxins in the environment. Germination rates between treatment and control for alfalfa and spinach showed no significant differences; however, primary root development for seedlings exposed to toxins was significantly higher than control seedlings. Total biomass of plants exposed to toxins compared to control plants further indicate the plants ability to adapt to toxins in the environment. Plant tissue will be extracted to determine the bioaccumulation of toxins. Soil testing will be conducted to identify sorption and microbial degradation of cyanotoxins to calculate the amount of toxins available for plant uptake. Using chemical transport computer models the fate of cyanotoxins in the environment can be illustrated to better understand the risks associated with cyanotoxins in irrigation water.

Keywords: HABs; agriculture; algal toxins; cylindrospermopsin; microcystin