Mechanistic understanding on environmental behavior, bioavailability and persistence in chronic wasting disease prions

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Prion diseases are neurodegenerative diseases that can affect a multitude of species. Some examples of prion diseases are Scrapie in sheep, Bovine Spongiform Encephalopathy (BSE) in cattle, chronic wasting disease (CWD) in cervids (e.g., deer, elk, and moose), or Kuru in humans. Prion diseases present significant health challenges as these prion diseases are generally fatal. Currently, there isn't a clear understanding of how prion exposure leads to infection.

Some prion diseases are more frightening than others. Many prion diseases are spread through the ingestion of infectious animal tissue. CWD however, is not only transmitted through consumption of tissue, but also through contact with feces, urine, or other bodily fluids, and even through exposure to contaminated soil and water, or perhaps foraging on plants grown in contaminated soil. These other avenues of infection mean that CWD could have devastating impacts on the deer population.

No one knows how long prions that have been spread across the landscape remain infectious in soil, though evidence shows it may be years! Understanding how to decontaminate CWD contaminated sites is very important and understanding soil chemistry is a key piece of information needed to develop effective decontamination regimes.

MSU soil scientist Wei Zhang and colleagues at Michigan State and Creighton University (Wen Li, Hui Li, Kurt Steinke, Jason Bartz, and Qi Yuan) were awarded funding under PA 207 of 2018 to collect this information. This interdisciplinary team is focusing on the role of metal ions (such as manganese and copper) on the environmental behavior, bioavailability, and persistence of prions. These metal ions are key to controlling how fast and how well organic materials in soil are degraded. They have developed specialized electrochemical sensors to measure manganese and copper concentrations. Already, in laboratory experiments, the research has shown that copper is more effective than manganese in breaking down prions.

Next, these laboratory results will be applied to more 'real world' settings. The researchers will test whether different levels of manganese and copper affect prion decay in soil systems. They will also evaluate whether various soil amendments, for example, the addition of activated carbon or biochar, can 'capture' prions and make them less harmful to animals. The team will also recruit and train graduate students in CWD science and management.

As CWD spreads across the landscape, the development of practical decontamination methods will become essential. Understanding strategies that could be implemented to possibly deactivate CWD prion (e.g., prescribed fires for grasslands management produce biochars that could capture prions) is critical information as managers learn how to lessen the presence of CWD.

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