WHEN IT HITS THE FAN: PATHOGENS FROM HUMAN AND BOVINE SOURCES IN THE ENVIRONMENT

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Manure from livestock and fecal wastes from humans are economically and environmentally valuable. Applied to agricultural crops, fecal wastes contribute macro and micronutrients, enhance soil tilth, and aid soil carbon sequestration. Manure spreading, and the on-farm nutrient recycling it facilitates, is the quintessential practice of sustainability. However, these benefits can only be fully realized when the wastes are managed to avoid contamination of non-target sites. Best management practices primarily focus on nutrients. Pathogens are also found in fecal wastes, but research and development are limited in identifying those practices that help avoid pathogen contamination issues that can lead to disease transmission.

This presentation will focus on fecal pathogens in the environment: their release, transport, and potential for disease transmission, or in other words, the consequences of "when it hits the fan." These concepts will be illustrated by presenting two research studies. The first will report the rate of acute gastrointestinal illness in Wisconsin communities that drink non-disinfected groundwater contaminated with human viruses. The role of human sanitation in disease transmission is well established, and this study provides a good example of the same research steps that can be applied to investigate and solve problems related to manure-borne pathogens. Such steps include pathogen detection, exposure assessment, and measuring risk. In addition, because the study resulted in changes to Wisconsin's drinking water code that were later rescinded by legislation, it provides an excellent starting point for a discussion on the role government has in fecal sanitation issues.

The second study to be presented is being conducted at the new Institute for Environmentally Integrated Dairy Management. A research unit of the Dairy Forage Research Center of the USDA Agricultural Research Service, the Institute's mission is to conduct research that addresses comprehensive nutrient management, atmospheric emissions, water quality, and pathogen transfer within dairy production systems.

The study is quantifying runoff losses of bovine pathogens from dairy manure applied to corn silage fields under different manure/crop/tillage management systems. The site is in central Wisconsin and is designed as a paired watershed study consisting of four 1.6 hectare adjacent fields, each equipped with H-flumes, flow meters, and automated runoff samplers. During runoff pathogens are sampled continuously, and the samples are analyzed for bovine pathogenic protozoa, bacteria, and viruses. Manure is applied to the fields in autumn (three fields) or spring (one field) at a rate of 56,000 liters/hectare. The practices being investigated include: 1) Control, autumn applied dairy manure with same day chisel plow; 2) Spring manure/chisel plowing with autumn seeded rye cover crop; 3) Autumn surface-applied manure with spring chisel plowing; 4) Autumn manure/chisel plowing with permanent vegetative buffer strips.

So far we have learned the types of pathogens and their concentrations in the field runoff are highly variable. Runoff may contain pathogens many months after manure application. For example, some viruses detected in the manure applied in the fall were still present in the runoff

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the following summer. However, the virus concentrations are low and it appears from preliminary data that fall-applied manure with same day chisel plowing will reduce pathogens exported from the field by 99.9%. The problem is if the manure has high pathogen concentrations to begin with, despite a 99.9 % reduction, the concentration in runoff can remain above the dose that will cause infections. Importantly, we also have learned that measurements of the standard indicator bacteria *E. coli* in runoff are not correlated with pathogen measurements. *E. coli* is easy to measure and is a common parameter in runoff studies. However, microorganisms can differ in their transport behavior, and making runoff measurements on just one could lead to erroneous conclusions.

Understanding the potential for disease transmission from fecal wastes in the environment and finding solutions for minimizing disease risk are important to the economic and environmental value of these materials to agricultural production. In the case of manure, such knowledge will help protect the health of wildlife, livestock, and people.