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Persistence of bacterial pathogens, fecal bacterial indicators, and microbial source tracking markers in manure-amended soils

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Abstract:

The application of animal manures onto agricultural fields as a fertilizer is a common practice. The USEPA recommends that the rate of manure application be controlled by crop nutrient requirements for nitrogen or phosphorous, thus limiting their movement to nearby waters where they can negatively impact water quality. The presence of microbial pathogens in manure is not a limiting factor for its application, although pathogens are a leading source of impairment in rivers and streams in the US. Therefore, of pressing interest is the persistence of bacterial pathogens introduced to the soil environment through manure application at an agronomic (nutrient-limited) rate and at different seasonal temperatures. Comparing the survival of bacterial pathogens to commonly-used and emerging molecular fecal indicators may provide insight into the potential for these indicators to describe pathogen fate and transport in runoff events.

In this study, the persistence of bacterial pathogens, molecular fecal indicators, and microbial source tracking markers in manure-amended soils of laboratory-scale microcosms were determined. Microcosms were designed using soils from farms in North Carolina, Indiana, and Ohio, and amended with manure according to the agronomic rates used on the respective fields. Known concentrations of transformed green fluorescent protein (GFP) labeled Escherichia coli 0157:H7 and transformed red fluorescent protein (RFP) labeled Salmonella typhimurium were added to microcosms of 60% and 80% water content and incubated at temperatures of -7ÂºC, 10ÂºC, and 25ÂºC. Survival of the transformed pathogens was determined by colony counting on selective media under UV exposure as well as real-time quantitative polymerase chain reaction (real time qPCR). Survival of Campylobacter sp., the fecal bacterial indicators Enterococcus faecalis and Bacteroides fragilis, and host-specific PCR biomarkers indigenous to the applied manures were also determined through real time qPCR and conventional PCR.

Impact Statement:

This project is intended to identify the relationships between the survival of common agriculture bacterial pathogens with classical bacterial indicators and emerging molecular fecal indicators in manure-amended soils. Data collected in this study, along with data collected at the field-scale in manure-fertilized crop fields, will be used to improve models of the fate and transport of the bacterial pathogens and associated fecal indicators near large animal feeding operations.

Category: Other Water Resource Topics
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