RESEARCH ABSTRACT

ENVIRONMENT

Title: Influence of the Method and Timing of the Land Application of Manure on the Fate and Transport of Manure Constituents in Runoff, **NPB #14-121**

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Scientific Abstract

Swine manure has been used a soil amendment for crop production because it can provide a source of nutrients, increase soil productivity, improve water infiltration, and reduce the potential of soil erosion. It is important to understand how different manure land application strategies may affect the fate and transport of various manure constituents in the environment. The objective of this project was to determine how the method and timing of swine manure application may impact the fate and transport of multiple constituents in surface runoff. The manure constituents included nutrients, antimicrobials, antimicrobial resistant bacteria, and antimicrobial resistance genes.

A series of field rainfall simulation experiments were performed. In these tests, swine manure slurry from a commercial farm was either broadcast on or injected into test plots by a commercial manure applicator. A set of three 30-min simulated rainfall events, 24 hour apart, were initiated on the manure amended plots 1 day, 1 week, 2 weeks, or 3 weeks after the manure application. Runoff samples were collected and analyzed for nutrients using standard methods, for antimicrobials using liquid chromatography tandem mass spectroscopy, for antimicrobial resistant bacteria using culture-based methods, and antimicrobial resistance genes using quantitative polymerase chain reactions.

Results show that manure application methods had no significant impact on the transport of NH_3-N, NO_3-N, or total nitrogen in runoff, but had significant impact on dissolved and total phosphorus in runoff. The levels of three antimicrobials, chlortetracycline, lincomycin, and tiamulin, were higher in runoff from broadcast plots than from injected plots. Broadcast also caused higher *E. coli* level in runoff than did injection; however, the two application methods did not yield significantly different levels of other microbial constituents in runoff, such as the relative abundance of tetracycline resistant bacteria, and the relative abundance of bacteria carrying tetracycline resistance genes *tet*(Q) and *tet*(X).

On the other hand, the timing of land application relative to rainfall events exhibited significant impacts on the levels of nearly all manure constituents in runoff. Longer intervals typically led to less load in runoff. The only noticeable exception was the antimicrobial resistance gene *tet*(X), whose relative abundance in runoff increased with longer interval between application and rainfall. This finding suggests that either manure bacteria carrying *tet*(X) could survive better in amended soil than bacteria that didn't carry this resistance gene, or the *tet*(X) resistance gene proliferated to other bacteria during the test period.

The findings from this project show how the movement of different manure constituents in the environment was affected by the method and timing of manure land application. The differences in the effects highlight the complexity in designing best management practice for manure application.