System seems to reduce harmful field runoff

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A system to reduce harmful components of agriculture runoff, without impacting crop yields, is gaining support from Minnesota scientists.

Research involving the University of Minnesota, Minnesota Department of Agriculture and other cooperators is seeking to learn more about wood chip bioreactors. In the past, studies on these systems focused on their ability to convert nitrate-nitrogen in agriculture drainage water to a nitrogen gas found naturally in the air.

Reducing the amount of nitrate-nitrogen entering a watershed should result in higher quality drinking water and positive environmental impacts.

This study is the first in the state to examine how bioreactors affect other runoff elements, such as sediment, phosphorus and E. Coli. The group hopes to receive funding to also study affects on agriculture chemicals like atrazine.

The researchers are trying to learn more about bioreactors in general and how to maximize their efficiency. This includes looking into what it would cost to use them; the best combination between number of draining acres and size of bioreactors; the best length of time to leave water in the trench; how bioreactors work in different seasons; how temperature, aeration and pH levels affect the bacteria; how much excess water doesn't fit into the bioreactors and bypass the system; and what happens when nitrate-nitrogen isn't fully converted to the harmless nitrogen gas.

A wood chip bioreactor is a trench filled with wood chips that contain microorganisms. It's covered with soil. As water drains from a field and fills the trench, bacteria survive by combining dissolved oxygen with their energy source, carbon. Once the oxygen is gone, the bacteria use nitrate-nitrogen instead.

Research in other states has shown bioreactors have the potential to completely convert nitrate-nitrogen to the harmless gas.

Unlike other nutrient management methods, bioreactors don't impact crop yield because they work with water after it leaves a field and requires no change from a farmer's production habits.

John Moncrief, a university professor involved with the study, was skeptical about bioreactors in Minnesota at first. He thought the cold climate would negatively impact the bacteria but the data has changed his mind. The hypothesis now is that bioreactors work here because heat is created inside the trench, similar to a compost pile.

"They work in Minnesota" he said. "Now we're trying to find out why and gather date on the specific conditions within them that affect their efficiency. This will allow us to accurately estimate their longevity under Minnesota conditions and, subsequently, implementation costs."

The study is examining two bioreactors, each paired with a controlled drainage system. This type of drainage can hold water in tile lines under a field based on the time of year, risk of contaminant loss and crop production needs.

Water from 26 acres drains into a bioreactor on Ed smith's land in West Concord that is approximately 240 feet long, three feet wide and six feet deep. The other bioreactor is on Eric Schrader's farm in Dundas and receives drainage water from eight acres. It is approximately 80 feet long two and a half feet wide and five feet deep.

Data collected at Dundas in 2008 shows the bioreactor reduced total suspended solids, such as sediment, by 74 percent; total phosphorus by 78 percent; nitrate-nitrogen by 38 percent; and E. Coli by 52 percent. The combination of controlled drainage and a bioreactor reduced nitrogen and phosphorus in the drainage water by 88 percent.

Data is not fully prepared yet from Smith's farm, but Moncrief said nitrate-nitrogen going into the bioreactor there averages approximately 18 parts per million, much higher than the Environmental Protection Agency's maximum contaminant level for drinking water, which is 10 ppm.

However, water leaving the bioreactor is averaging a concentration of about 5 ppm. These averages are over the entire year.

"That is significant," said Moncrief.