Effect of headland stacking of poultry manure on groundwater – 4

Paul Kivlin, Kevan Klingberg, Dennis Frame — UW-Extension/Discovery Farms

Discovery Farms investigated the potential for nutrients to move from headland-stacked poultry manure into waters of the state (surface or groundwater). Headland stacks are manure piles stored on bare soil at the edge of crop fields until the field is ready for application. Stacks are normally applied to fields within three months, but may remain in place for up to one year. Stacking, while not unique to poultry manure, is common in the industry because of this manure's high dry matter content. Stacking is also common on farms that haul daily or clean livestock lots, or on farms with stackable manure.

The goal of this study was to evaluate the potential for nutrients to move from headland stacks to groundwater. Two study sites (MM and RM) were selected, both on Rosholt silt loam soil. Rosholt soils are susceptible to leaching and represent some sites where poultry litter is headland-stacked in Wisconsin. The primary difference between the two sites was the depth to groundwater. The MM site had a groundwater depth of 12 feet; the RM site had a groundwater depth of 24 feet.

Methods

The study design utilized a set of six well nests at each location. Three sets of wells were placed up-gradient of the manure pile to represent water samples not influenced by the stack. Three more sets of wells were placed down-gradient of the pile, representing wells that may be influenced by the manure. Well water was sampled and analyzed on a routine basis.

Precipitation

Monthly rainfall for the MM and RM sites is shown in Figure 1. Note that in October 2005, while the piles were still in place, the MM site received 11.5 inches of rain for the month. Of this rainfall, 10.5 inches came in one 24-hour period, making this an extremely important storm. To put this in context, for the study site location a 25-year/24-hour storm is 4.6 inches, and a 100-year/24-hour storm is 5.8 inches. During the same storm, the RM site received 4.2 inches of rain within 24 hours.

At the study site, 2006 was a relatively dry year with 25 inches of precipitation, which is why sampling continued for two years after the stack was removed. Total rainfall for 2007 was typical (32.88 inches), yet between April and August 30, there were only three events that produced more than 1 inch of rain. In contrast, September 2007 had four events over 1 inch, including a 2-inch storm. The importance of seasonal and daily precipitation events and their impact on groundwater is discussed below.

Results – MM site

Poultry litter is dry by nature and has a tremendous ability to absorb and hold water (37 percent of its weight). In addition, natural composting that occurs in the pile generates heat and drives off moisture between rain events. This ability to absorb and dissipate water is a key factor in keeping poultry manure piles environmentally benign.

During the 10.5-inch storm (October 2005), the pile was unable to absorb the extreme amount of rain water and resulted in portions of the pile becoming saturated. The manure leached and effectively "charged" the soil profile. These nutrients were subsequently detected in the monitoring wells. The October 2005 sampling period detected higher levels of nitrate in the down-gradient wells compared to the up-gradient wells. This

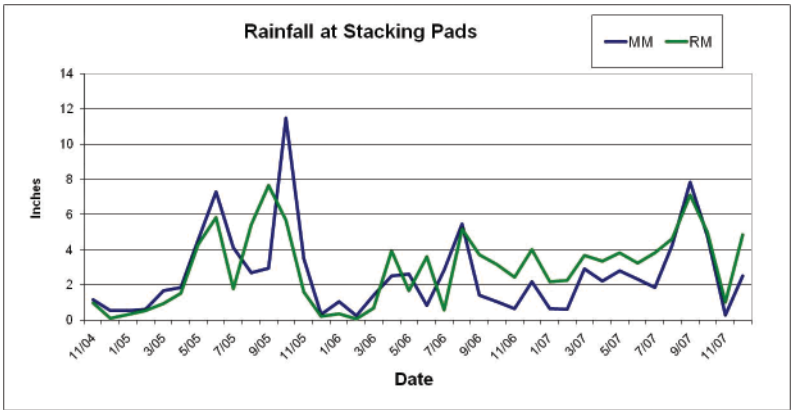

Figure 1. Rainfall at the RM and MM monitoring sites

indicates that the manure stack did affect the groundwater as a direct result of the 10.5-inch storm event.

In April of 2006, another flush of nitrate was observed in the down-gradient wells as the ground thawed and melting snow and rain percolated through the soil. The remainder of 2006 was relatively dry, and nutrients remained in the soil profile until the significant rain events in September of 2007. Rainfall that month contributed 23 percent of the total annual precipitation, causing another spike in groundwater nitrate levels.

Results – RM site

The RM site behaved differently from the MM site. Through three years of monitoring, we saw no significant changes in the concentration of nitrate in the above-gradient wells compared to below-gradient wells. The headland-stacked manure had no influence on the groundwater at the RM site. This site received a 4.2-inch rain event in October 2005, which is close to a 25-year/24-hour storm. This storm had no impact on groundwater nitrate concentrations at the RM site.

Conclusions

The objective of this study was to determine whether headland-stacked poultry manure had the potential to negatively impact groundwater. Normal design criteria for agricultural practices focus on protecting against 25-year/24-hour storm events. For the study site location in Wisconsin, practices would be designed to protect against any storm with less than or equal to 4.6 inches of rain in a 24-hour period. For this site, rain events of greater than 4.6 inches are considered to be above the design criteria, and producers are not held liable for runoff events linked to these storms.

An evaluation of the October 4, 2005, rain event at the RM site provides a good assessment of the potential for headland stacks of poultry manure to negatively impact groundwater. This site received 4.2 inches of precipitation within a 24-hour period (4/10ths of an inch less than a 25-year/24-hour event), and the groundwater samples taken after this event showed no significant increase in nitrate.

In contrast, the MM site received 10.5 inches of rain on October 4, 2005, with the manure stack still in place. The 10.5-inch storm far exceeded the 25-year design parameter, as well as the 100-year storm event. It is evident that the current standard design parameter (25-year/24-hour storm event) appears to be functional. The RM site was pushed close to that parameter with the 4.2-inch rain, but no increased detection of nitrate occurred. In other words, the current rules are effective given the site conditions at RM.

There are a few simple management practices that producers can adopt to reduce the potential impacts of headland stacks of poultry manure on water quality. These practices include:

- ❒ Stacks should be located with the appropriate separation distance from wells, sinkholes, areas of concentrated flow, streams, wetlands and water bodies. (Review NRCS 313 standard.)
- ❒ Site stacks on soils with low leaching potential and as great a distance to bedrock and groundwater as possible.
- ❒ Stack manure as deep as possible to minimize the potential for rain to saturate the pile. Bales or other products could be used to hold the manure.
- ❒ Avoid creating pockets on top of the stack that would collect and hold precipitation.
- ❒ Remove the stack and apply manure as soon as the field is available and the ground is fit.

University of Wisconsin – Extension
DISCOVERY FARMS
University of Wisconsin – Madison

This brief is a summary of a five-year project evaluating the potential impacts of headland-stacked poultry manure. This project resulted in four factsheets, which are summarized in four additional Discovery Farms briefs. The series includes: Characterization of poultry manure – 1; Potential runoff of headland-stacked poultry manure – 2; Stockpiling manure and soluble salts: Site remediation for crop production – 3; and Effect of headland stacking of poultry manure on groundwater – 4. *All briefs, as well as four more detailed factsheets, are available from the UW Discovery Farms office, PO Box 429, Pigeon Falls, WI 54760, and 715-983-5668 or at our website: http://www.uwdiscoveryfarms.org.*