



Manure Applications on Frozen and/or Snow Covered Ground – 7

Dennis Frame, Tim Radatz, and Amber Radatz
UW - Extension / UW - Discovery Farms

Introduction

Managing manure applications during the frozen ground period is essential to reducing the loss of nutrients. As a state annual average, we lose about 8% of precipitation or 2.55 inches of water as surface runoff each year. Water-quality data collected through the Discovery Farms Program show that at least 50% of runoff occurs on frozen ground, even though precipitation is much greater during the non-frozen period. Monthly runoff was highest during 2 time periods: February - March, and May - June. This paper provides background on the issues, challenges and potential opportunities involved with manure application during frozen or snow covered ground periods.

Riechers and other Discovery Farms sites clearly show that runoff volumes at the end of the winter months contribute an important amount of runoff. At this farm, runoff from frozen ground/snowmelt conditions contributed 80% of the total annual surface runoff (Figure 2), though only 10% of the annual precipitation occurred during this time. Frozen ground runoff was observed every year, but the contribution and timing was extremely unpredictable and varied from year to year depending on snowpack depth, rate of snowpack melt, frost depth, and rainfall amount on frozen or snow covered ground. On average, there were 11 runoff events/site/year and runoff was recorded on 7% of the days monitored (25.5 days each year).

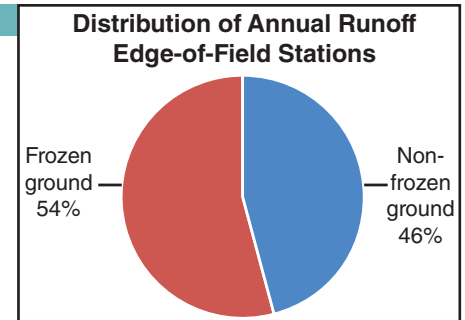


Figure 1. Runoff distribution 2003-08

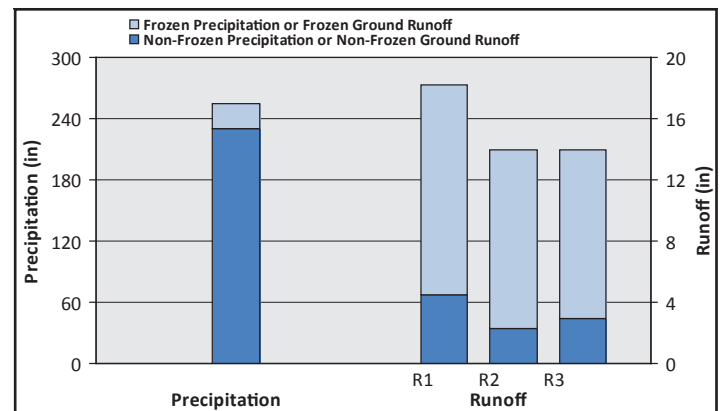


Figure 2. Study period precipitation and runoff

Manure on frozen ground

Wisconsin livestock operations apply manure in the winter months for a variety of reasons. One of the main reasons is animal health and welfare. Animals can handle most cold weather as long as they are dry and clean. Keeping animals dry, clean and providing them some sort of wind protection is crucial in northern climates. Manure applications also happen when farmers have time. The period after harvest and before spring planting is often when farmers have the most time available to properly apply manure that has been stored through the growing season. Another advantage to applying manure while the ground is frozen is that it reduces the chance of soil compaction. Soil compaction can result from heavy machinery or intense animal hoof traffic compressing wet soil. It can reduce yields and increase runoff.

Manure application and handling has changed and improved over the last several decades. When it was necessary to haul manure every day, inclement weather forced operators to spread most of the winter manure on fields close to the barn, as extremely cold weather caused

issues like frozen manure in the spreader. It is important to understand critical risk periods and take care to avoid applying manure during high risk periods. Spreading a load of manure every day did not provide options to spreading in high risk conditions, but the areas applied were small. Today, with larger volumes of manure applied at once, it is critical for farmers to avoid and manage for high risk time periods. Factors that increase the risk for frozen ground runoff include the amount of snowpack present, the speed at which it melts, and the amount and type of frost present in the soil. Managers should look for a rapid and dramatic temperature increase, clear sunny skies or a layer of ice over the soil as conditions that could lead to high runoff volumes during the winter months. Rain events cause snow to rapidly melt, leaving little chance for infiltration into the soil. Establishing a time period allowing or disallowing manure spreading based on the variable nature of weather, and therefore, runoff will not eliminate risk of nutrient loss.

Runoff and winter manure applications

For information on losses at Riechers Beef, please review fact sheets 4 (sediment) & 5 (nutrients) in the report series. On this farm, 80% of the phosphorus loss occurred in February and March (Figure 3). There are two reasons for this:

- The farming system improved soil infiltration so that very little runoff occurred during non-frozen soil months,
- Losses were influenced by manure applications done either immediately preceding or during the snow melt period.

Winter manure applications occurred each year of the 7 year study period. Annual phosphorus losses ranged from 0.0 to 5.3 lb/ac (Figure 4). Phosphorus losses were higher in FY04, FY05 and FY09 and lower in FY06 and FY07. During the years with higher losses, a manure application was made during or shortly preceding runoff events in the winter.

In FY04, liquid dairy manure was surface applied in November at R3 and in September and February at R1 and R2. The manure application (February) at R1 and R2 occurred only five days before a significant runoff event. Phosphorus losses were five times greater at R1 and R2 compared to R3 for the entire year. The majority of the FY04 phosphorus loss difference between R1/R2 and R3 can be attributed to the February runoff time period. In FY05, solid beef manure was surface applied in September and October at R1 and R2 and September, October, January, and February at R3. The February manure application at R3 occurred during a snowmelt runoff event. Phosphorus losses for FY05 were two to three times greater at R3 compared to R1 and R2 and

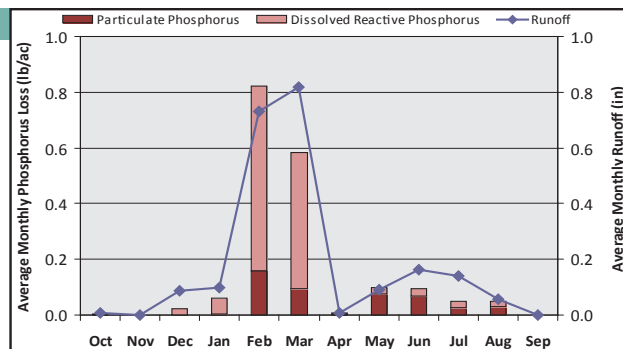


Figure 3. Average monthly phosphorus loss

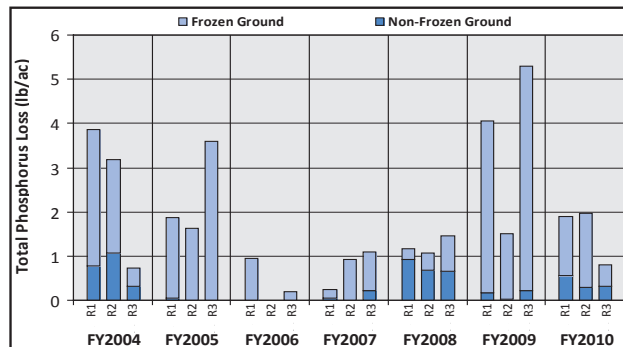


Figure 4. Annual phosphorus losses

most of this disparity can be attributed to the February runoff events. In FY09, solid beef manure was applied shortly before runoff in February at R1 and R3, but not at R2. Phosphorus and nitrogen loss at R1 and R3 were two to four times greater than at R2 for FY09, again because of the February runoff events.

Conclusions

In Wisconsin and surrounding states, frozen soil and snow cover can be a challenge for completing field operations such as manure application. The option to spread manure while the soil is frozen but runoff is not imminent can improve farm management and animal health. Managers must understand the conditions that lead to increased nutrient loss and avoid application or find areas with the lowest risk. Manure applied on or immediately preceding snow melt can have a negative effect on the water quality. The type of manure (liquid dairy or solid beef) did not affect nutrient losses and the rate of application was well within (or below) the recommended rates. The key factor in these runoff events was the timing of the applications.

When winter manure was applied and no runoff occurred until several months/weeks after the application, the impact

on nutrient losses was reduced. When applications are made during early winter or when low risk conditions exist, there is less risk of nutrient loss than applications made during spring (saturated soil/intense storm conditions). Those considering rules and regulations on manure applications on frozen and/or snow covered ground need to evaluate the risks associated with winter spreading, and the risks associated with manure applications in the spring. Manure is a valuable source of organic matter and nutrients, and the proper use and applications can assist in improving overall farm sustainability. Manure application is a necessary practice and it has many benefits. However, over applications of manure and applications of manure at improper times can pose an unacceptable environmental risk.

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This brief is part 7 of 9 that can be found along with the rest of the information on Riechers Beef at: www.uwdiscoveryfarms.org or by calling the UW-Discovery Farms Office at 715-983-5668.