



Stockpiling manure and soluble salts: Site remediation for crop production – 3

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Discovery Farms has investigated the potential for nutrients to move from headland-stacked manure into waters of the state (surface or groundwater). A headland stack is a pile of manure stored on bare soil at the edge of a crop field until the field is ready for manure application. Headland stacks remain in place for weeks or months, and at times 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. Many livestock producers that have temporarily stacked manure on the edge of fields ask the same question, "Why is it difficult to establish crops on soil immediately beneath where a pile of manure has been in place for a period of time?"

This brief contains information on the observed inhibition of plant growth, which is of concern to producers and to the regulatory community. A "typical" headland stack of poultry litter (6 feet high X 12 feet wide X 100 feet long) was placed on the site. The stack remained in place for one year, which is longer than most stacks remain in a field. The soil had a high water holding capacity and moderate permeability. Soil samples prior to stacking indicated a pH of 7.4, 3.3 percent organic matter, 30 ppm P_2O_5 , and 114 ppm K_2O . Figure 1 shows the construction of the manure stack.

Methods

Soil samples were taken before manure was stacked and again after the manure was spread. Samples were taken in the center of the site where the pile depth was the greatest and at the edge of the stack, around the entire perimeter. Soil samples were analyzed for a range of constituents, including total nitrogen, nitrate, ammonium, phosphorus, potassium, manganese and other soluble salts. These data were collected to address grower concern about the challenges encountered in establishing crops on stacking sites after the manure is removed. After one year the manure stack was deconstructed, and the manure was applied to the surrounding cropland.

Results and discussion

Post-stacking soil analysis results revealed high levels of soluble salts, primarily ammonium, potassium and manganese, in the upper soil profile (Figures 2-5, page 2). Salts at these elevated levels can lead to toxic conditions for germinating seeds and would largely account for the lack of plant growth beneath stacking sites. Because of the solubility of these salts, a number of rain events over a period of time can flush them from the soil, returning productivity. The high level of ammonium in the center of the stack in the upper 12 inches of the soil probably occurs because of the lack of oxygen and the interaction between the soil and manure as moisture moves between the stack and the soil. There are concerns that this ammonium could present a potential groundwater threat if it converts to nitrate and moves through the soil. The potential affect on groundwater is the subject of another phase of this study, reported in another paper.

While manure stack sites have not been extensively researched, plant growth inhibition associated with heavy/repeated manure applications has been well documented and is not necessarily linked to animal species. Papers have described lower germination and plant growth after exposure to dairy manure and concluded that high salt levels and ammonium toxicity were the cause. Other studies found large increases in soil sodium and potassium following high applications of beef manure, which resulted in corn silage yield reductions, attributed to high salt levels and ammonium toxicity. Additional studies also confirm reduced crop yields associated with heavy beef manure application.

Though salt build up and ammonium toxicity are often cited as reasons for reduced plant growth, other factors may



Figure 1. Piling poultry manure

also play a role. Research on fresh beef manure found that certain organic acids may reduce germination and seedling growth. Heavy applications of poultry litter have also been shown to produce soil salinity levels that reduce crop yields.

Soil pH was also tested during this study. Surprisingly, there was little variation in pH levels before the pile versus after the stack was removed. The consistency of these results suggests that changes in soil pH are not a factor in the lack of plant growth after a manure stack has been removed.

Remediation recommendations

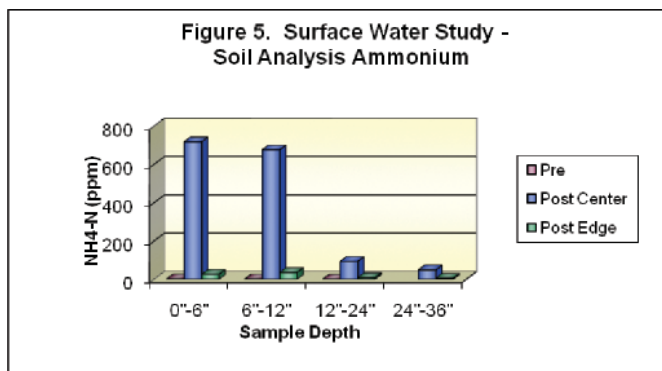
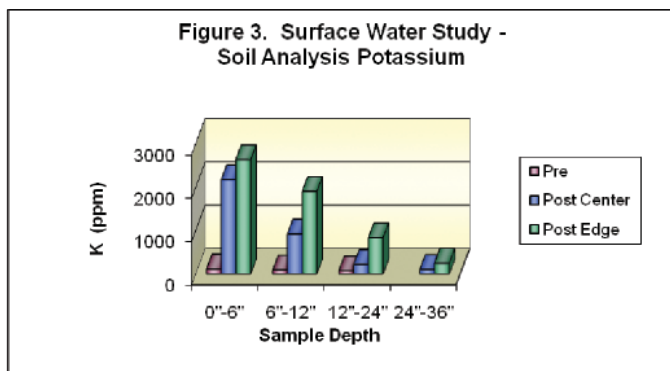
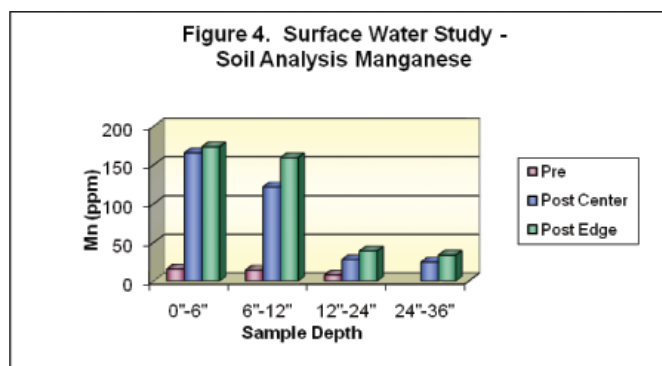
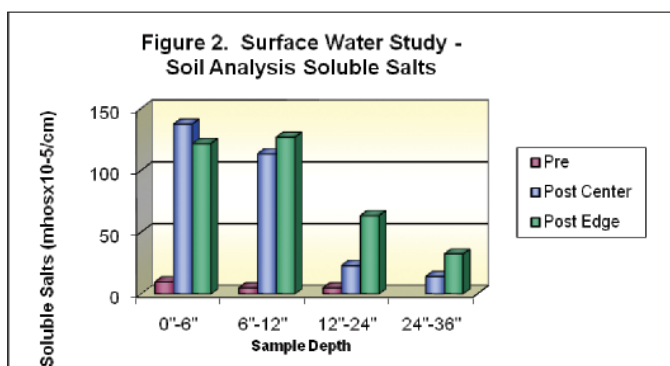
Time is the ultimate solution to re-establishing soil productivity once a manure stack is removed, but other techniques can be used. Aggressive tillage to mix the soil and release some of the nitrogen may speed the process. Packing lime screenings or paper mill sludge on the site prior to manure stacking establishes a break between the manure and soil surface. This barrier can minimize the movement of soil moisture into and out

of the bottom layer of stacked manure. Minimizing the moisture cycle at the manure/soil interface can reduce extreme accumulations of ammonium and soluble salts in the soil.

The goal should be to establish vegetation on the manure stack site as quickly as possible, utilizing accumulated nutrients and removing mobile nutrients from the soil. A Discovery Farms factsheet lists agronomic plants and their salt tolerance. Producers should plant tolerant or moderately tolerant crops over the top of former stacking sites. One possible approach is to spread manure in early fall and establish a salt tolerant wheat or rye crop on the site yet that fall.

Conclusion

Stockpiling can be a useful method to store manure for short to moderate periods of time. The recommendations listed above may be useful in the remediation of past manure stacking sites. However, the disadvantage is that salt tolerant plants may likely not be a desirable crop for the whole field.



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>.