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Developing and Implementing a Composting/ Vegetative Filter Strip Demonstration Site at the ISU Dairy Teaching Farm

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Abstract
Composting is often the preferred technology for solid manure management. Composting reduces odor, stabilizes nutrients, and generates an easily stored product. While the benefits of composting are well documented, little is known about the water quality impacts at composting sites. This project established a demonstration site at the ISU Dairy Farm, Ames, Iowa, to explore these impacts.

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Agricultural Science | Agriculture | Bioresource and Agricultural Engineering

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Introduction

Composting is often the preferred technology for solid manure management. Composting reduces odor, stabilizes nutrients, and generates an easily stored product. While the benefits of composting are well documented, little is known about the water quality impacts at composting sites. This project established a demonstration site at the ISU Dairy Farm, Ames, Iowa, to explore these impacts.

Research Objectives

- Evaluate the effects of a composting/vegetative filter strip (VFS) system on surface runoff of nitrogen (N), phosphorus (P), and sediment after natural rainfall events.
- Determine the levels and trends of N, P, and other factors in compost windrows throughout the composting process.
- Develop a computer modeling approach for simulating nutrient transport through the composting/VFS system.

Research Site

- The research site is located at the ISU Dairy Teaching Farm, Ames, Iowa.
- The site is comprised of nine 6 m × 23-m (20’ × 75’) plots with compost windrows placed upslope from the VFS components.
- The site focuses on the N, P, and sediment concentrations contained in runoff that has passed through compost:VFS area ratios of 1:0 (control), 1:0.5, or 1:1.

Data Collection

- The term “area ratio” represents the ratio of the area of compost windrow draining into a VFS to the area of the VFS. All treatments have three randomized block replications for statistical analysis purposes.
- All of the compost and VFS plot areas are hydrologically isolated from their surroundings using blue vinyl fire hoses and 15-cm-high sheet metal borders, respectively. The fire hoses provide a mobile barrier that can be drained easily and moved for compost turning operations. Figure 1 shows the runoff collection and compost windrow system.
- In addition to collecting grab-samples from the compost windrows, a white perforated PVC collector and “T” pipe delivery system directs runoff to a tipping bucket system for volumetric measurement and sample collection.
- The runoff samples are analyzed for total solids, nitrate-nitrogen (NO_3-N), ammonia (NH_3), ortho-phosphorus (PO_4-P), and total phosphorus at the Water Quality Laboratory of the Swine Manure Research Institute, ISU, Ames, Iowa.

Preliminary Results

- Three compost sampling dates (May 22, June 18, and July 29, 2003) and one rainfall/runoff event (E1, June 25, 2003) are discussed in this presentation. Compost:VFS ratios are 1:0 (control), 1:0.5, and 1:1.
- Figure 1 shows the general trend of nitrogen reduction during the composting process because of NH_3 and NO_X emissions.
- Whereas some phosphorus mass can leach out of the compost windrow over time, phosphorus concentration gradually increases due to the even greater compost mass reduction (Figure 2).

- Figure 3 shows compost stone content increased due to volume reduction. Stone material was removed from compost ash samples using a cyclone aspirator grain separation device to improve analysis results accuracy.
- Figures 4 and 5 show potential VFS benefits resulting from increased average runoff and total solids, and NO_3-N concentration in the 1:0 (control) plots, respectively.

Project Benefits

- This project will benefit Iowa livestock manure management systems and municipalities that generate solid waste streams compatible with composting. The water quality impacts of the outdoor windrow systems that predominate in municipal and agricultural composting applications are largely unknown. Research suggests substantial losses of N and P occur during composting processes through runoff and leaching. Low-cost, effective water protection measures are critical to environmentally sound composting facilities.
- This project also provides an education and demonstration site for managing livestock manure and urban yard waste combinations in a windrow composting facility and the runoff from such a facility. The site is easily accessible to K–12 and college students, research faculty, and environmental professionals who want to learn about composting and managing nutrient runoff.
- Through nutrient transport model development in the compost windrow and VFS during this project, important data and criteria may be generated to improve compost facility design and identify environmentally compatible sites for compost facilities.

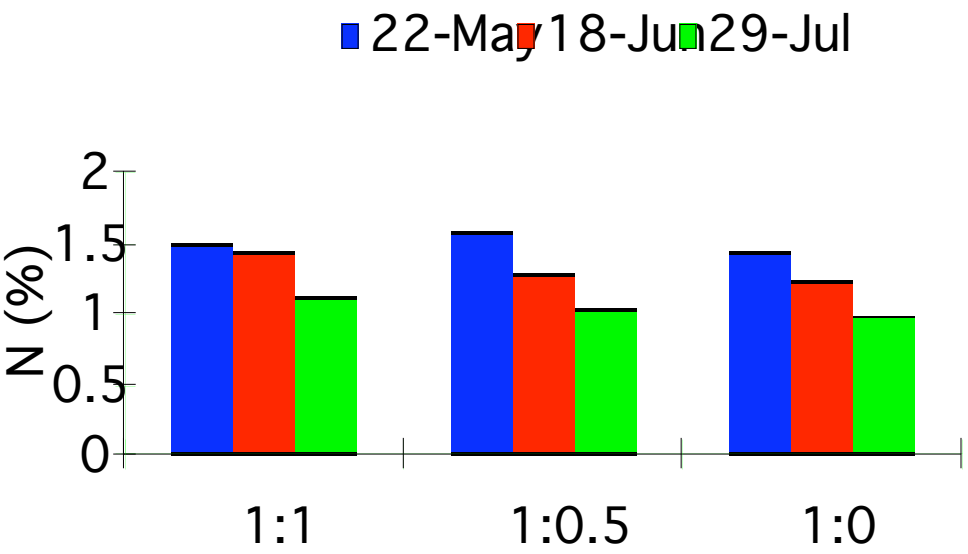

Figure 1. Variation of nitrogen for May 22, June 18, and July 29, 2003 compost sampling dates.

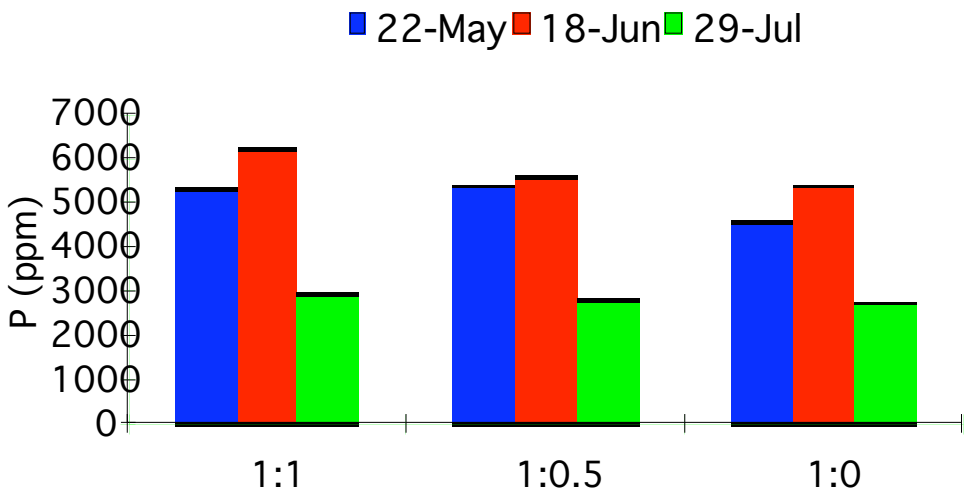

Figure 2. Variation of phosphorus for May 22, June 18, and July 29, 2003 compost sampling dates.

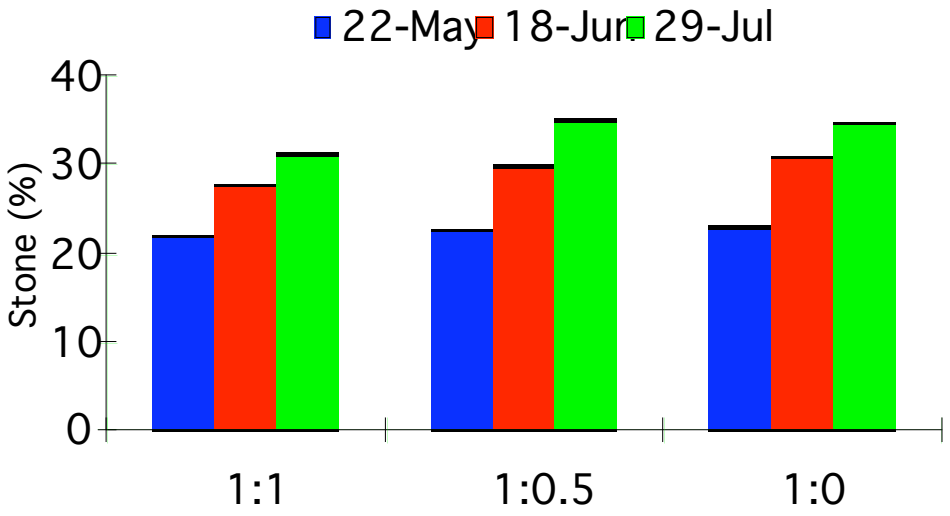

Figure 3. Variation of stone content for May 22, June 18, and July 29, 2003 compost sampling dates.

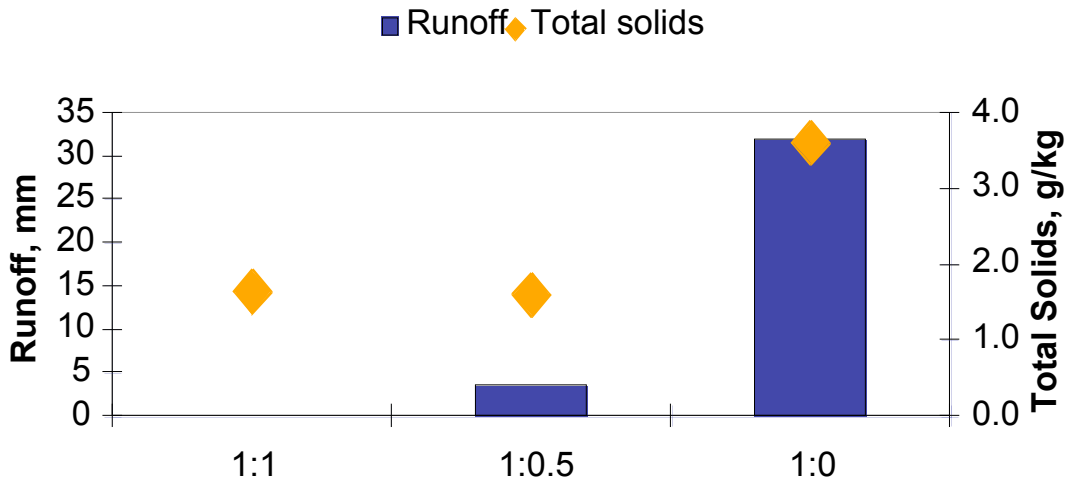

Figure 4. Effect of VFS on average Runoff and Total Solids for E1 (June 25, 2003).

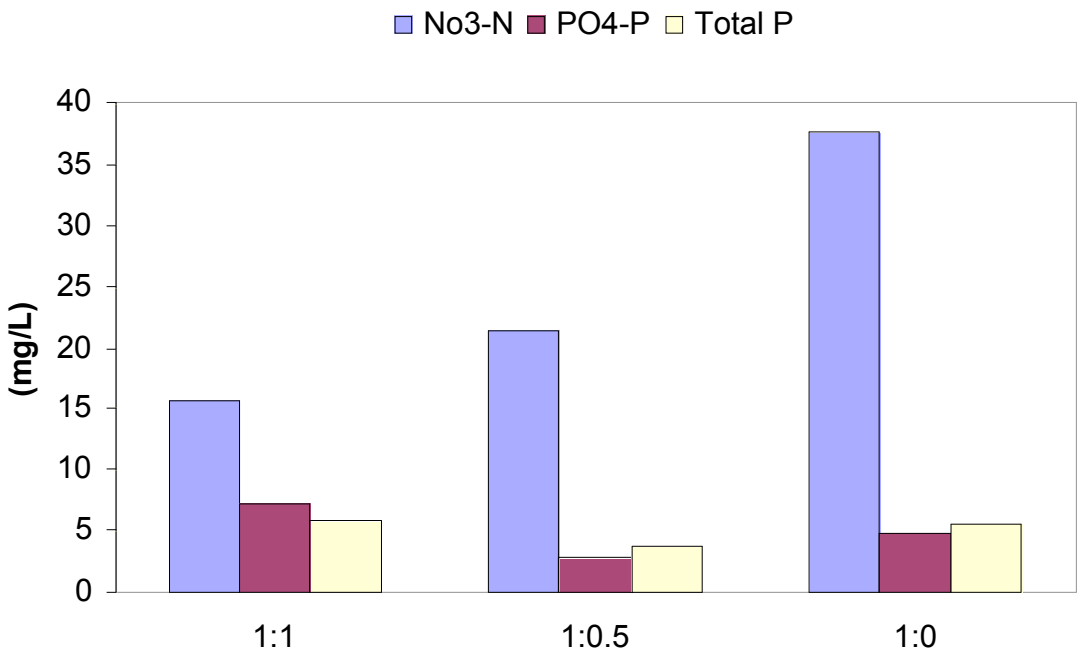

Figure 5. Effect of VFS on average concentration of NO3-N, PO4-P, and Total P in surface runoff for E1 (June 25, 2003).