Managed Riparian Buffer Zones and Cover Crops to Minimize Phosphorus and Nitrogen Runoff Losses from Corn Fields

Final Report for LNE97-087

Project Type: Research and Education
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Matching Non-Federal Funds: $53,600.00
Region: Northeast
State: Vermont
Project Leader:

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Project Information

Summary:

The goal of this project is to evaluate the effectiveness of riparian (streamside) buffer strips of grass-legume hay (25 ft and 50 ft widths) in minimizing runoff losses of phosphorus (P) and nitrogen (N) from corn fields into adjacent streams. Grass-legume buffers offer an economic return to the farmer on land that would be non-productive if converted to a natural forest riparian zone. Using a paired watershed design, we monitored the effect of the buffer strips on P and N runoff losses, crop yields, and soil nutrient levels. Preliminary results show significant reductions in total P and sediment concentrations in runoff with implementation of a 50-ft buffer strip. Field tours to the site held in June of both 1998 and 1999 included legislators, agricultural and environmental agency personnel, and farmers.

Project Objectives:

To evaluate the effectiveness of managed riparian zone at reducing losses of phosphorus and nitrogen in surface runoff from silage corn fields, including an evaluation of the effect of riparian buffer width on pollutant abatement.

To compare the relative importance of surface runoff, erosion/sediment deposition, and plant uptake on loss of nitrogen and phosphorus from corn fields and on retention in managed riparian zones, and seasonal variations of these processes.

To evaluate the economic impact of these management alternatives to the farmer.

To distribute the results of this study, including both environmental and economic implications, to farmers and farm organizations, agricultural educators, agricultural and environmental agency personnel, industry representatives, and the general public via an extension/outreach program.

Research

Materials and methods:

We used a paired watershed design to compare buffer strips of grass-legume hay (25 ft or 50 ft wide) to a control treatment of corn planted to the field edge adjacent to the stream. The basic approach requires two or more similar watersheds, or drainage areas, and two periods of study: calibration and treatment period. In our study, the “watersheds” consist of portions of a field, ranging in size from 2 to 5 acres, each of which has separate surface drainage and an outlet which we have instrumented to monitor surface runoff with an H-flume with a stilling well and Coshocton wheel proportional sampling device.

The study site is a 15-acre silage corn field on the dairy farm of Bob and Peter Smith in Addison County in the Champlain Valley of Vermont. The soil is a Vergennes clay (Glossaquic Hapludalf) with slopes of 2% to 10%, bordered on two sides by a small stream. Erosion and runoff potential are moderate to high. This site is representative of clay soils that make up significant portions of the soils in the Lake Champlain Basin of New York and Vermont.

During the 20-month calibration period (starting in August 1996) all sub-watersheds were treated identically with corn planted all the way to the field edge near the stream. Data were collected on an event basis to develop regression equations for each variable (runoff, sediment, and P and N concentrations) between the control watershed and each of the watersheds to be treated. At the start of the treatment period (late May 1998) buffer strips of mixed grass-legume were established on two of the mini-watersheds while the control watershed remained in corn to the field edge, providing a means to manage effects due to year-to-year weather variability.

Research results and discussion:

Runoff monitoring results were obtained for the three sub-watersheds during the calibration (8/96–5/98) and treatment periods (6/98–5/00). Total phosphorus (TP) concentration during the calibration period shows no consistent pattern. However, beginning in late June 1998, when buffer vegetation had become established, concentration values were clustered by treatment: the 50-ft buffer the lowest, the 25-ft buffer next, and the control (no vegetative buffer) the highest. The total mass of P per runoff event (TP concentration x runoff volume) showed a similar pattern, but three events in summer of 1998 were much greater than all others. Cumulative TP mass over the monitoring period reflects two changes as the treatment period begins: loss of P in runoff increased dramatically, a result of the series of unusually large precipitation and runoff events starting in late June, and an effect of buffer treatment with apparently greater reduction in P loss from the 50-ft buffer strip than the 25-ft buffer strip. Results for total suspended solids show very similar trends, reflecting the association of phosphorus with the sediment fraction of the runoff. Nitrogen content of runoff was also determined, but data analysis has not been completed at this time.

Soil samples and above-ground vegetation (either corn or grass-legume forage) were collected at various distances from the flumes to examine plant uptake and deposition effects, but data analysis has not been completed.

Participation Summary

No milestones

Project Outcomes

Impacts of Results/Outcomes

Field tours to the site held in June of both 1998 and 1999 included legislators, agricultural and environmental agency personnel, and farmers. Results have been used in extension nutrient management programs and have been incorporated into a phosphorus index to assess P runoff potential as part of the nutrient management planning process.

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