IMPLEMENTING SILT SOCKS IN TILE RISERS TO REDUCE SEDIMENT AND NUTRIENT TRANSPORT

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Abstract

Given the growing environmental problems associated with eutrophication in surface waters receiving agricultural runoff, there is a need for low-cost and high impact management practice solutions. This study evaluates remediation agents in silt socks to remove sediment, phosphorus, and nitrogen from surface runoff. Tile risers located in closed depressions within agricultural fields act as direct pathways for sediment and nutrient transport to surface waters. This study tested the effects of various configurations for tile risers by collecting runoff from a 9.75 m X 3.66 m soil box placed under a rainfall simulator. While previous findings have demonstrated silt socks to be effective at removing sediments in runoff, preliminary results of this study suggest that flow rate is significantly reduced with the silt sock alone compared to adding a treatment material and that, of the tested agents, charcoal is the most effective. Flow rate through silt socks is an important consideration. If flow rate is reduced too much, excessive ponding may occur; if flow rate is too high, insufficient contact time reduces treatment effectiveness. Adding remediation agents, by contrast, could serve to mitigate nutrient pollution and further improve water quality.

Introduction

Drainage of closed depressions for the purpose of increased crop production is possible through the use of surface inlets, which are placed at the lowest elevation of the depression, and are **directly connected** to a subsurface tile drainage line (Smith and Livingston, 2013). Hence, sediment and nutrient losses in surface runoff are **directly transported** to surface waters. It is estimated that there are about 75,000 surface inlets (tile risers) in Western Lake Erie.

Objective

The purpose of this study is to determine a cost effective way of removing sediment, phosphorus and nitrogen from surface runoff by using remediation agents in silt socks placed on tile risers.

Methodology

Control: Tile Riser (high density polyethylene) without silk sock (TWS)

Fabric: Tile Riser with silk sock only (TSO)

Charcoal w/fabric: Tile Riser with silk sock and charcoal (TSC)

Steel Slag w/fabric : Tile Riser with an industrial by-product containing Ca, Fe, Al, Si, Mn, and Mg oxides (TSS).

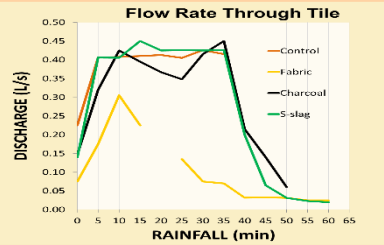
Soils for each of the treatment were exposed to four runoff events lasting 30 minutes each at an intensity of 50 mm h^{-1}. Sediment discharge, Total Nutrient Analysis (TNA) and Soluble Nutrient Analysis (SNA) were collected both at the tile and the box.

Although isotherm adsorption/desorption were previously tested for each treatment, the results were inconclusive.

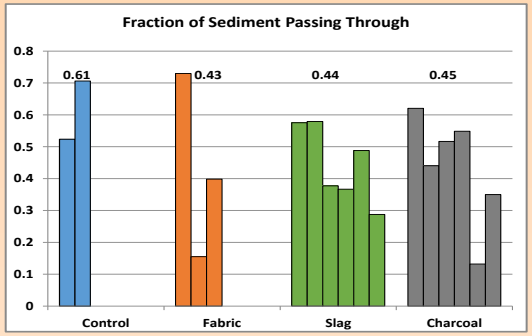
Rainfall Simulations: Soil Box and Tile Data Collection

Preliminary Results/Discussion

The silk sock textile clogged the opening of the tile risers, which may be the reason that they are not commonly used by farmers. However, it takes longer for the nutrients to enter the drainage system resulting in infiltration through the soil profile. The average flow reduction by treatments over control (tile alone) was 50% for the fabric (0.18L s^{-1}), 1% for the S-slag (0.01L s^{-1}) and 13% for the charcoal (0.05L s^{-1}). By reducing the flow, the ponding effect increased allowing more time for nutrient adsorption.



Greater ponding with the fabric



Preliminary Conclusions

All of the fabric treatments (fabric alone or fabric with absorbing materials) were effective at retaining sediments compared to the control. Charcoal was the most effective in reducing sediment outflow (15% reduction from 60 -45%). Nutrient load reductions were observed in the charcoal and slag treatments, however additional analysis is pending.

Future Research

The volume and fraction size of the amendments could be modified to control flow, hence nutrient loss.

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