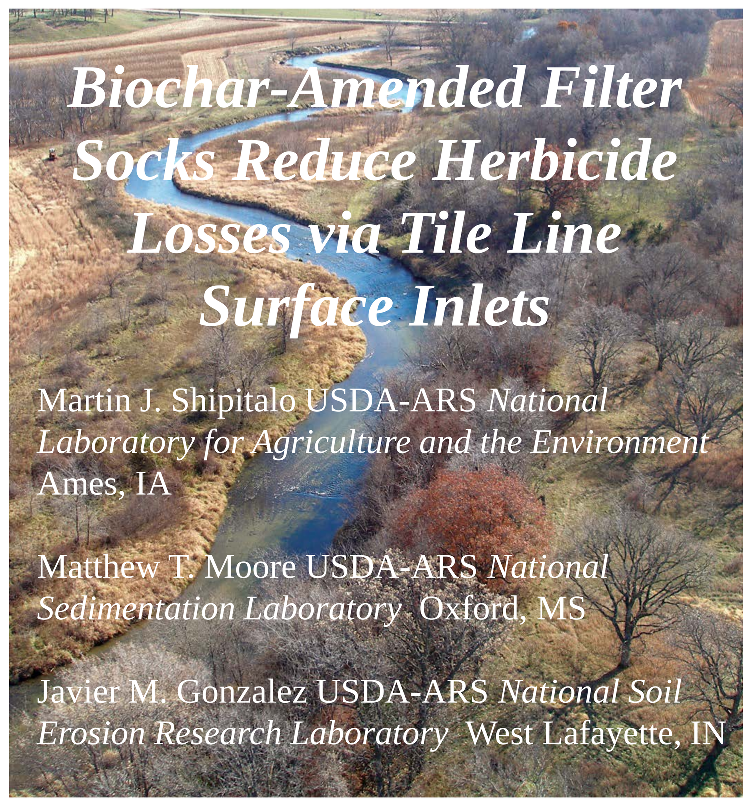

Biochar-Amended Filter Socks Reduce Herbicide Losses via Tile Line Surface Inlets

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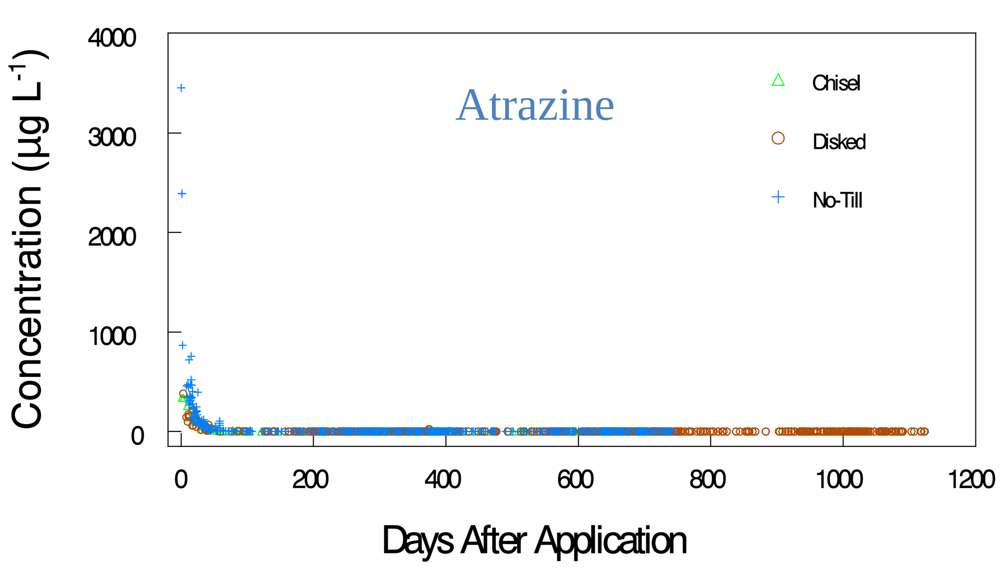
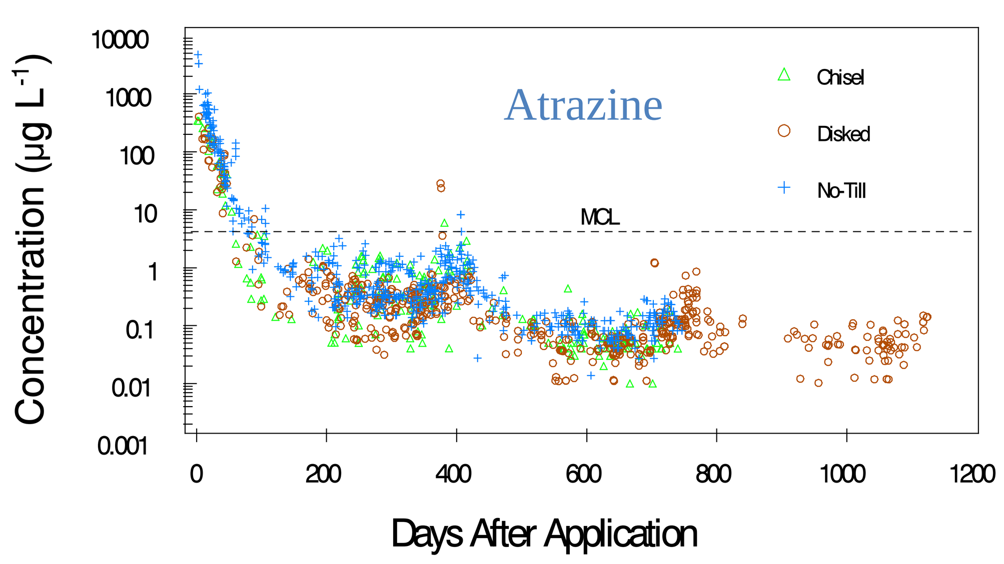
Introduction & Objective

- Subsurface drainage can degrade water quality by accelerating water, nutrient, and pesticide transport to streams and lakes.
- Surface inlets are often included in drainage systems to reduce ponding or surface runoff. They can exacerbate water quality concerns by allowing water to bypass the soil with its ability to sorb nutrients and pesticides and filter out sediment.
- Recognizing the negative impact that surface inlets can have on water quality, the Iowa NRCS recently added them to the list of water quality sensitive areas. Currently, there are few options available to address this concern. Within the South Fork of the Iowa River, where this study was conducted, ~ 9% of the agricultural land is in closed depressions that are likely to have surface inlets.

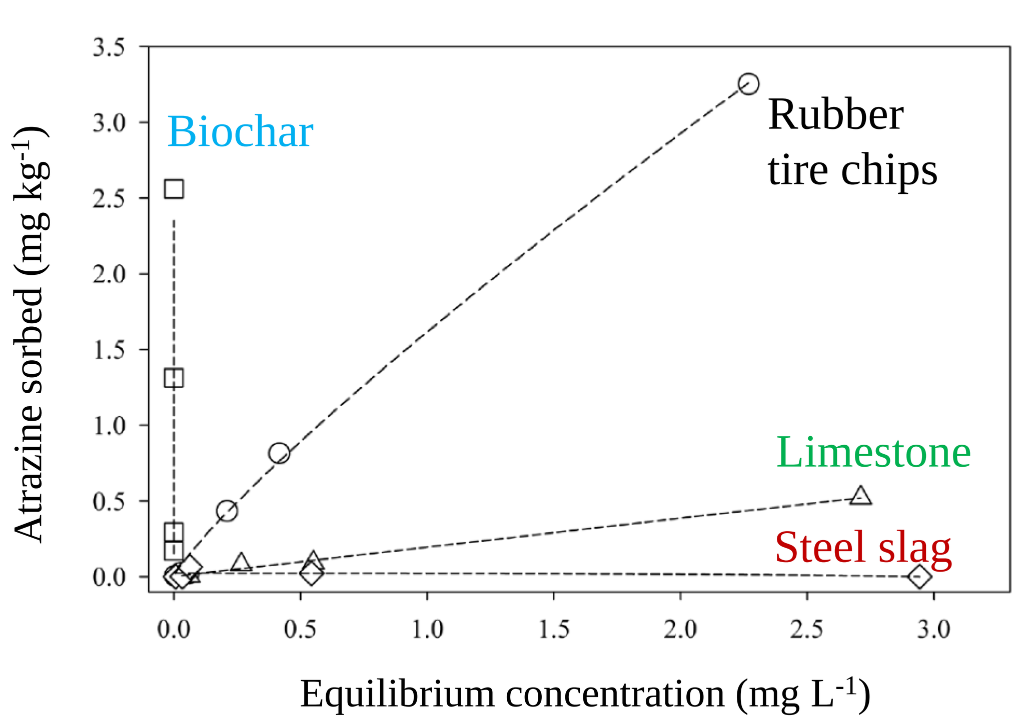
- Long-term watershed research (Shipitalo and Owens, *JEQ* 2006) has shown that the highest herbicide concentrations and most of the transport occurs in the first few surface runoff events after application. In a 9-yr period 60-99% of the losses of four herbicides occurred in the 5 largest transport events out of a total of ~1800 storms.

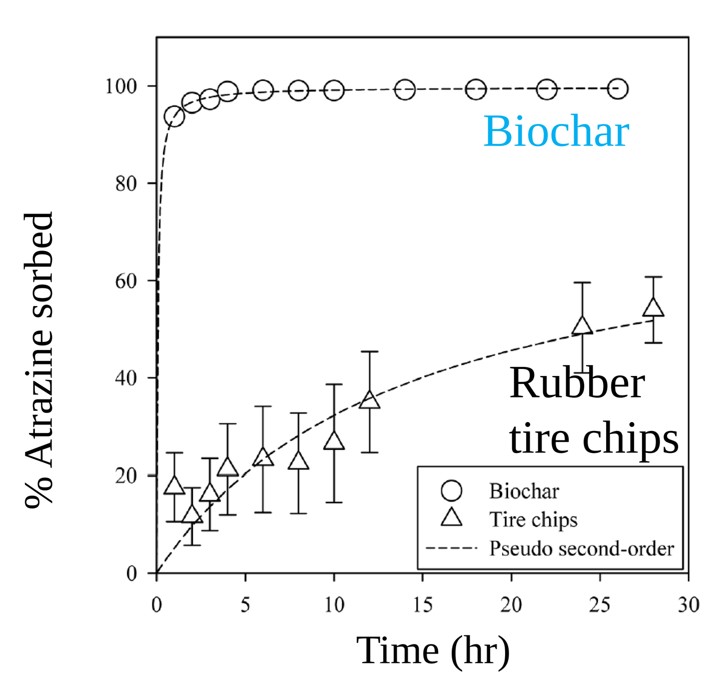




Concentration of atrazine (natural and log scales) in surface runoff as a function of days after application as observed for seven watersheds for a 9-yr period

- Thus, edge-of-field concentrations in the first few events after application need to be controlled in order to reduce the impact of herbicides on water quality. Laboratory sorption studies have shown that biochar can more rapidly and completely remove atrazine and other herbicides from solution than other sorbent materials.

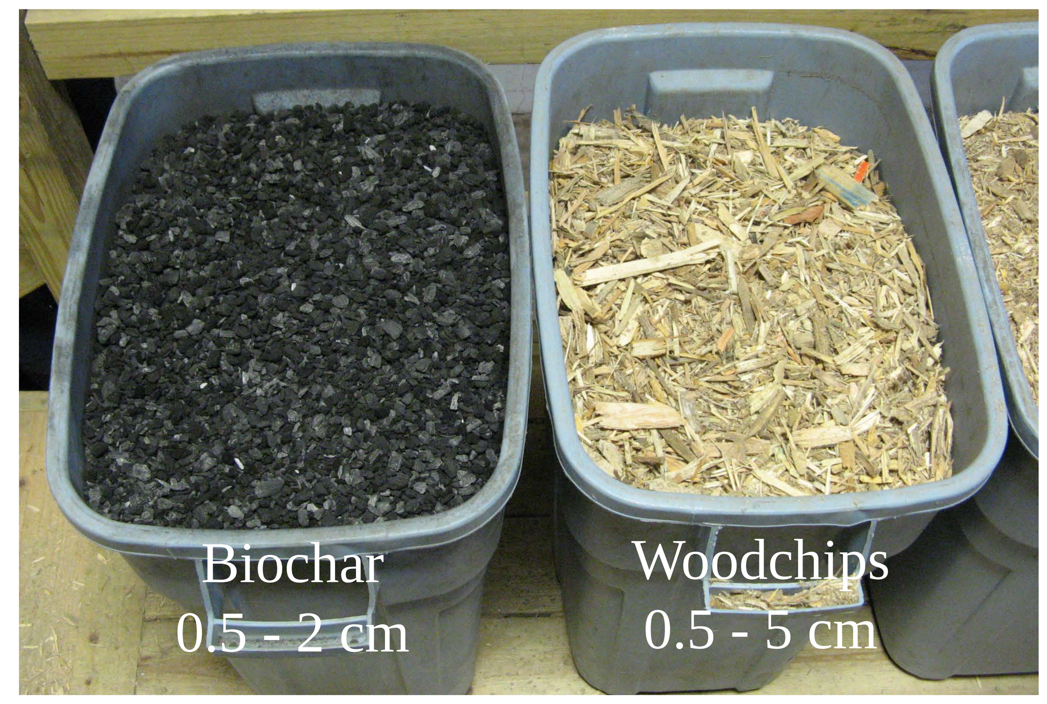




Equilibrium and kinetic sorption of atrazine on biochar and other materials

- Filter socks (mesh cloth tubes filled with woodchips or other materials) have been shown to reduce sediment and nutrient losses when placed around surface inlets.
- ***Our objective*** was to determine if adding biochar to filter socks could increase their ability to reduce herbicide concentrations transmitted to subsurface drainage systems via surface inlets.

Methodology

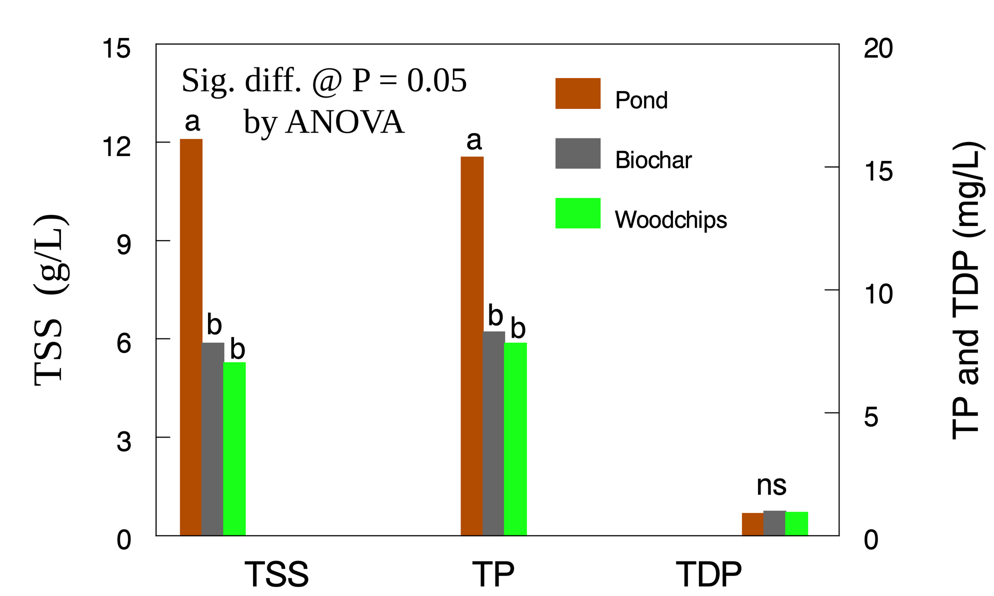


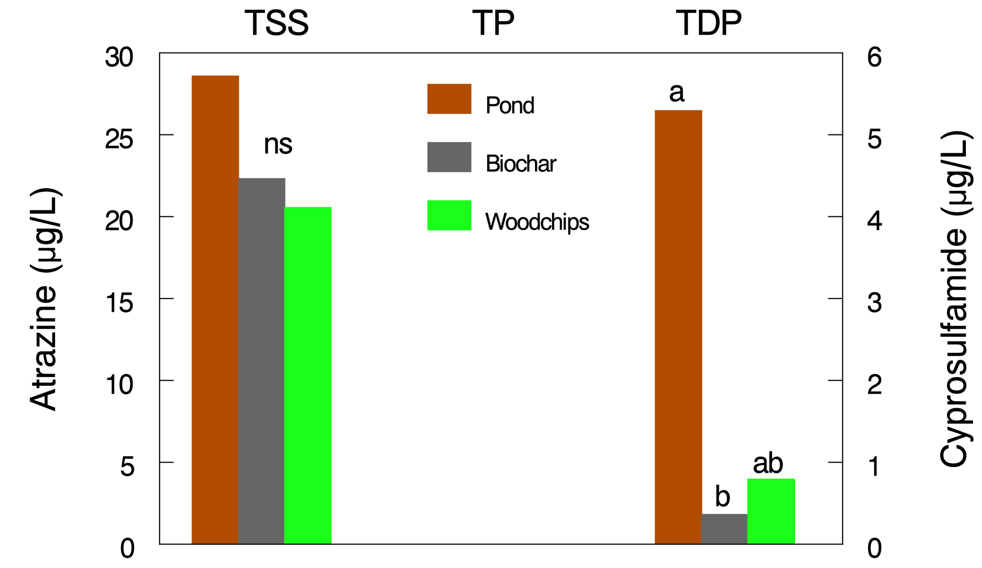
- 20-cm diameter filter socks were filled with woodchips or a 50:50 mixture by volume of woodchips and a commercially available oak biochar pyrolyzed at 425°C.

- Existing inlets in front of three terraces in the same field were removed and replaced with two inlets at the same elevation. Woodchip-filled socks were placed around one inlet in each pair and biochar-amended socks were placed around the companion inlet.
- ISCO samplers were used to collect water every 30 minutes as it entered the inlets and storm water samplers were placed outside the filter socks to collect water at ponding depths of 5 and 15 cm. Depth of ponding was measured using bubble flow meters. Samples were analyzed for atrazine, three of its metabolites, isoxaflutole, thiencarbazone-methyl, cyprosulfamide, sediment, and nutrient concentrations.

Results

- Due to limited rainfall there were only 4 small runoff events during the 2017 growing season, with only one in May, presented below, yielding full sample sets at all sites.





- Both sock types reduced Total Suspended Solids (TSS) and Total P (TP) by ~1/2 compared to samples collected in the ponded area outside the socks, but had no effect on Total Dissolved P (TDP).
- Similar reductions in atrazine concentration were noted for both sock types, whereas the biochar-amended socks reduced cyprosulfamide concentration to a greater extent than the woodchip-filled socks. No trends were detected for the other analytes.
- The driest June and July on record was a less than ideal time to conduct a natural runoff experiment.