EFFECTS OF BUFFER STRIP INSTALLATION ON RUNOFF, DISSOLVED ORGANIC MATTER AND SOIL ORGANIC MATTER

Kristen Veum
Graduate Student

Keith Goyne
Assistant Professor

Peter Motavalli
Associate Professor

Ranjith Udawatta
Research Assistant Professor

Harold E. Garrett
Professor

Introduction:

Organic matter plays several important roles in the biogeochemistry of soil and impacts the sustainability and profitability of agroecosystems (Doran et al., 1994). Retention and transformation of soil organic matter (SOM) is affected by agronomic and conservation management practices (Bertol et al., 2007; Christopher et al., 2009) including the installation of vegetated buffer strips (Liu et al., 2008; Tate et al., 2004). The primary objectives of this study are to evaluate the effect of grass and agroforestry buffer strips on 1) dissolved organic carbon (DOC) in runoff and 2) SOM quantity and quality.

Methods and Materials:

The Greenley Memorial Research Center is located in the central claypan region of Missouri, USA (Figure 1). The study site consists of three watersheds no-till planted to a corn-soybean rotation. Grass and agroforestry contour buffer strips were installed in 1997 in the west and center watersheds, respectively. The east watershed serves as a control watershed without buffer strips. Flumes and autosamplers are located at the outflow of each watershed for collection of runoff samples. Runoff samples were collected from 1991 (pre-buffer installation in 1997) through 2006. Soil samples were collected in 2007 from all three watersheds in four landscape positions. Three subsamples were collected from each management (crop, grass and agroforestry) and landscape position (summit, shoulder, backslope and toeslope) combination for a total of 36 sample locations. At each location, soils were sampled at two depths, 0-2 inches and 2-5 inches.

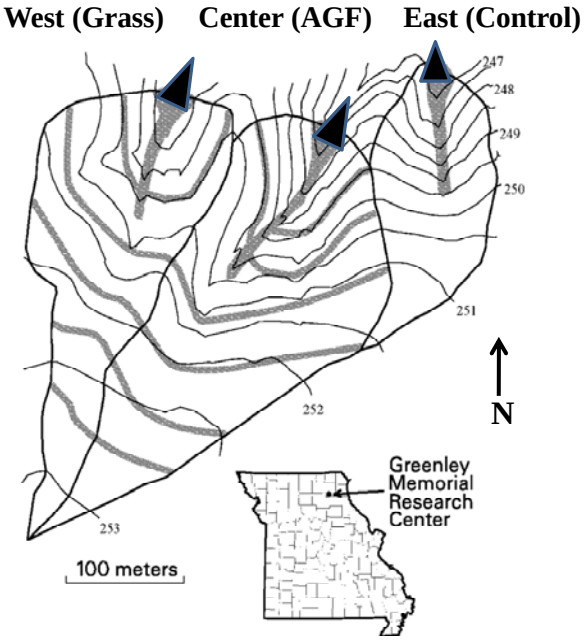

Figure 1. Location of the Greenley Memorial Research Center in Missouri, USA and layout of the study watersheds. Location of flumes and autosamplers (triangles), elevation contour lines (meters above sea level; black lines), grass waterways and buffer strips (grey lines).

Runoff Study:

Runoff was collected from all three watersheds for a six-year calibration period (1991 – 1997) and for a nine-year treatment period (1997 – 2006) after the buffer strips were installed. Data from these two periods were compared using a paired-watershed approach to evaluate the effects of buffer installation on runoff and DOC loss. The grass buffers significantly reduced runoff by 8.4% (Figure 2a). No significant difference was found in DOC loss for either type of buffer (grass and agroforestry), indicating that vegetative buffer strips do not contribute to DOC contamination of surface waters (Figure 2b). These results were published in Agriculture, Ecosystems and the Environment (Veum et al., 2009).

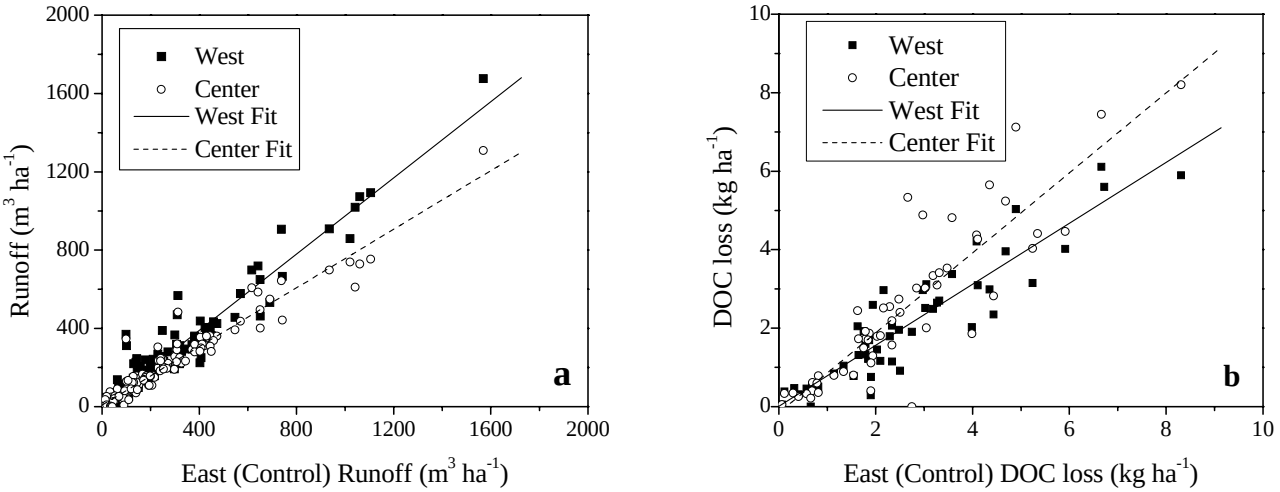

Figure 2. Paired watershed relationships between control and treated watersheds for (a) runoff and (b) DOC loss for all years.

Current and Future Work:

Current and future work at the Greenley Memorial Research Center includes investigating the effects of buffer strip installation on SOM and other soil quality indicators. Soil quality indicators will be evaluated for each buffer treatment and a control: grass, agroforestry and row-cropped soil. In addition, four landscape positions will be evaluated by comparing soils from summit, shoulder, backslope and toeslope landscape positions. The soil quality indicators in this study include bulk density, soil organic carbon (SOC), total nitrogen (TN), water-extractable organic carbon (WEOC), particulate organic matter (POM), enzyme activity and aggregate stability (AS). In addition, spectroscopic methods such as Fourier-transform Infrared (FTIR), visible-near infrared (VNIR) and nuclear magnetic resonance (NMR) will be used to compare the chemical structures of SOM under different management practices.

Preliminary results indicate significantly lower AS, SOC and TN in the row-cropped soil versus the grass and agroforestry buffers, while no significant differences are observed between the grass and agroforestry buffer systems. We hypothesize that WEOC, POM and enzyme activity will follow the same pattern. Overall, this study has the potential to elucidate changes in both the quantity and quality of SOM as the result of buffer-strip conservation management practices and landscape position.

References:

Bertol, I., Engel, F. L., Mafra, A. L., Bertol, O. J., and Ritter, S. R. (2007). Phosphorus, potassium and organic carbon concentrations in runoff water and sediments under different soil tillage systems during soybean growth. *Soil and Tillage Research* **94**, 142-150.

Christopher, S. F., Lal, R., and Mishra, U. (2009). Regional Study of No-Till Effects on Carbon Sequestration in the Midwestern United States. *Soil Sci Soc Am J* **73**, 207-216.

Doran, J. W., Coleman, D. C., Bezdicek, D. F., and Stewart, B. A. (1994). "Defining Soil Quality for a Sustainable Environment. SSSA Spec. Publ. No. 35," Madison, WI.

Liu, X., Zhang, X., and Zhang, M. (2008). Major factors influencing the efficacy of vegetated buffers on sediment trapping: a review and analysis. *Journal of Environmental Quality* **37**, 1667-1674.

Tate, K. W., van Kessel, C., Atwill, E. R., and Dahlgren, R. A. (2004). "Evaluating the effectiveness of vegetated buffers to remove nutrients, pathogens, and sediment transported in runoff from grazed, irrigated pastures." University of California Water Resources Center.

Veum, K. S., Goyne, K. W., Motavalli, P. P., Udawatta, R. P., and Garrett, H. E. (2009). Runoff and dissolved organic carbon loss from a paired-watershed study of three adjacent agricultural watersheds. *Agriculture, Ecosystems, and Environment* **130**, 115-122.