Changes in Soil Aggregate Size and Stability Over Time Under Riparian Vegetation

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Introduction
Grass filters are a conservation practice designed to protect water quality and prevent soil erosion by improving soil quality, including soil aggregation, in the riparian zone.

USDA Conservation Reserve Program (CRP) grass filter contracts span 10-15 years. It is known that some soil quality parameters improve under perennial vegetation within a short time span (5-7) years.

Depending on management, some CRP grass filters may not contain the original mixture of species.

Objective
This study was conducted to (1) establish whether aggregation and carbon storage continues to improve after typical CRP contracts expire and (2) to follow up on previous soil quality work done within the watershed in the late 1990’s (Marquez et al., 2004) and mid 2000’s (Kim et al., 2010).

Materials and Methods

Location
The Bear Creek watershed (Figure 1) in central Iowa contains a number of CRP riparian forest buffers and grass filters established from 1990-2010.

Fig. 1. Areal view of a portion of the Bear Creek watershed and multispecies riparian buffer systems. Inset: Approximate location of the Bear Creek watershed in central Iowa.

Results

• Samples were collected from the surface 15 cm in two grass filters established in 1990 and previously sampled in 1997 (Marquez et al. 1998, 2004) and 2006-2007 (Kim et al., 2008).
• One grass filter was planted to, and still contains, smooth brome (Bromus inermis).
• The other grass filter originally contained switchgrass (Panicum virgatum L. ‘Cave-in-Rock’), but has since been invaded by smooth brome (Figs. 2a-c).
• An adjacent row crop field (corn-soybean rotation, conservation tillage) was also sampled.
• Major soils types present:
  - Clarion loam (fine-loamy, mixed, superactive, mesic Typic Hapludoll), Coland clay loam (fine-loamy, mixed, superactive, mesic Cumulic Endoaquoll).

Methods

• Five soil samples were collected from triplicate plots within each vegetation type and composited; plots were sampled 4 times between Nov. 2010 and Nov. 2011.
• Soil samples were wet sieved for slaked aggregate stability distribution (Fig. 3). Aggregate fraction samples were corrected for sand content.
• Aggregate mean weight diameter (MWD) and percent water-stable aggregates (>0.25 mm (%WSA)) were calculated.
• An unslaked subsample was used to determine total soil texture, carbon and nitrogen, and particulate organic matter (POM).

Fig. 3. Slaked aggregate distribution method. Each aggregate fraction was dried at 65°C. A subsample of each fraction was dispersed with 50 mL 5 g L⁻¹ sodium hexametaphosphate and rinsed through a 0.053 mm sieve to determine sand content.

Conclusions
These results suggest:

• Grass filter soil quality still improves even after CRP contracts would typically expire.
• Switchgrass may take longer to increase aggregation, however it is unclear whether gains in aggregation are as a result of time, or as a result of a plant community shift.
• Characterization of the intra-aggregate particulate organic matter (iPOM) may detect changes in POM inputs between C₄ grasses (switchgrass) and C₃ grasses (smooth brome).
• Smooth brome increases aggregation in short time periods, but lacks other attributes such as stiff stems to slow water runoff that make switchgrass attractive in a grass filter.
• Annually tilled row crop soils continue to lose aggregate stability and total soil carbon.

References: