



Agricultural Research Service



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**Soil Resource
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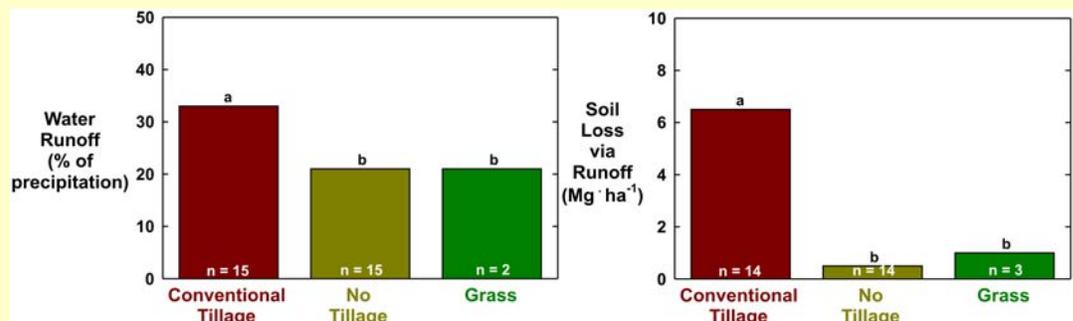
Linking Soil and Water Quality in Conservation Agricultural Systems

Why does it matter?

- Soil and water resources are fundamental components of agriculture.
- Soil quality can be determined by observing the functionality of soil after being subjected to different types of management.
- Some key functions of soil are to:
 - N supply nutrients to plants;
 - N allow rainfall to penetrate soil and provide water to roots;
 - N successfully filter contaminants and nutrients from water passing through soil prior to entry into groundwater;
 - N sequester carbon dioxide from the atmosphere and store C in soil organic matter; and
 - N decompose organic matter and various man-made chemicals to avoid plant and animal toxicities.
- Soil organic matter is a key soil property that drives many of these important soil functions, and therefore, soil organic matter is an essential component of soil quality evaluation.
- Conservation agricultural management (i.e., conservation tillage, cover crops, and perennial pastures) helps to build soil organic matter.

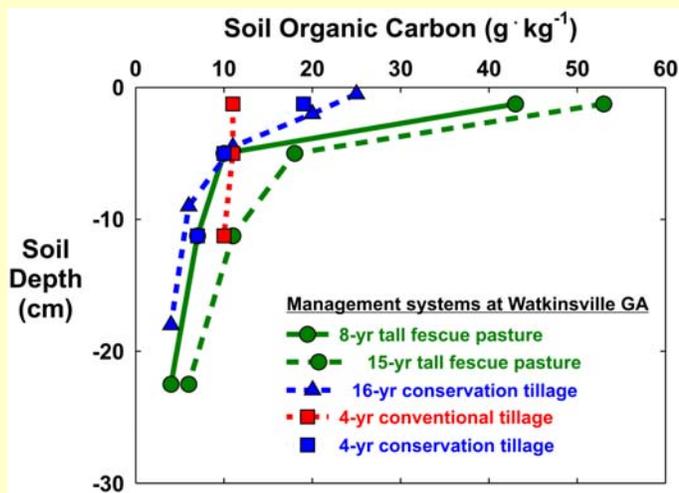
What was done?

- Scientific literature was reviewed and summarized for soil and water quality responses from various conservation agricultural systems.
- This review of the literature draws attention to the important linkage that surface soil organic matter brings to soil and water quality.
- Soil organic matter stratification was determined as the ratio between the concentrations in the surface 2 inches and at about 8-inch soil depth.
- Water runoff and soil loss data were compiled to assess typical responses of conventional and conservation agricultural systems.



What was found?

- Presence of surface residues and high surface soil organic matter are a natural consequence of long-term conservation agricultural management.
- Concentration of surface soil organic matter provided an excellent indication of the capacity of soil to allow rainfall to penetrate soil, as well as to reduce the nutrient content of water running off of the land.
- Soil organic matter stratification with depth provides a buffer to maintain soil and water quality against “normal” perturbations in agricultural systems.
- Perennial pastures often reduce water runoff volume and soil loss even further than with conservation-tillage cropland due to greater accumulations of surface soil organic matter.
- Total loss of nutrients is often lower with conservation tillage than with conventional tillage, because of a reduction in sediment-borne nutrients.
- Issues of concern still remain with unusually high nutrient applications to soil, such as caused by high N input with subsequent leaching of nitrate to groundwater and high P input with subsequent dissolved P in water runoff.
- A direct linkage is suggested between surface soil organic matter accumulation and the potential of conservation agricultural systems to improve water quality.
- Although many detailed water runoff and nutrient transport studies have been conducted, there has been a lack of detailed soil organic matter characterization by depth in these studies.
- A goal in the future should be to more fully characterize the linkages between soil and water quality.



What is the impact?

- Linkages between soil and water quality can be improved with future multidisciplinary approaches that include soil-profile distribution of organic carbon and nitrogen fractions. This more holistic research approach is needed to fairly evaluate the plethora of alternative management systems aimed at conserving soil and water resources.
- The effect of surface soil organic carbon accumulation on improving soil quality and preserving water quality is a concept that can be applied to the >100 million acres currently farmed with conservation tillage and the >100 million acres of pastureland in the USA.

For more information

Full-length article can be accessed at: <http://clt.astate.edu/electronicjournal/Articles.htm>

Franzluebbers AJ. 2008. Linking soil and water quality in conservation agricultural systems. *Electronic Journal of Integrative Biosciences* 6,15-29.