4-23-2007

Residue removal and potential environmental consequences

Mahdi Al-Kaisi
Iowa State University, malkaisi@iastate.edu

José Guzman
Iowa State University

Residue removal and potential environmental consequences

Abstract
Post-harvest residues provide a critical source of soil carbon, protection to the soil surface against water and wind erosion, and assist in improvement of soil quality. Corn stover harvested for ethanol production reduces the amount of residue returned to the soil. The removal of corn residue from both tilled and no-till soils can lead to surface water runoff and sediment loss. Sustainable stover removal rates depend on several factors that include soil erodibility, surface slope, cultural practices, and climate conditions. Recent studies suggest that only 20 to 30 percent of the total stover production could be removed for biofuel, based on ground cover requirements to control soil erosion.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

Current Newsletter

You are viewing archives for the newsletter from 1993-2007. For current news, see Integrated Crop Management News.

Archives 1993-2007

Announcements

Crop Production

Insects and Mites

Pesticide Education

Plant Diseases

Soils

Weed Management

Image Gallery

Printable Version

Printable version of this page

Related Articles

Conservation systems: Challenges and benefits
October 1, 2007

Nutrient removal when harvesting corn stover
August 6, 2007

How residue removal affects nutrient cycling
May 21, 2007

Disease management in corn-following-corn

Residue removal and potential environmental consequences

by Mahdi Al-Kaisi and J. Guzman, Department of Agronomy

Post-harvest residues provide a critical source of soil carbon, protection to the soil surface against water and wind erosion, and assist in improvement of soil quality. Corn stover harvested for ethanol production reduces the amount of residue returned to the soil.

The removal of corn residue from both tilled and no-till soils can lead to surface water runoff and sediment loss. Sustainable stover removal rates depend on several factors that include soil erodibility, surface slope, cultural practices, and climate conditions. Recent studies suggest that only 20 to 30 percent of the total stover production could be removed for biofuel, based on ground cover requirements to control soil erosion. The methods or guidelines for residue removal from any given field is not clear or well documented. It also is not clear whether current management practices for soil erosion control are appropriate for maintaining soil organic matter level and soil quality in general.

Residue removal impact on soil productivity and environmental quality is not a short-term outcome, particularly in the Midwest where high organic matter, high soil productivity, and good agricultural production conditions minimize such effects in the short term. However, it will have a devastating impact on soil sustainability and environmental quality in the long term as documented by many studies in the Midwest and elsewhere. The continuous removal of corn residue, coupled with intensive tillage, is well documented in long-term studies where soil quality, crop productivity, and air quality are compromised.

In a long-term study established in 1888, and which continues at the present time in Missouri and Illinois, different crop rotations, manure, tillage treatments, and continuous corn production, coupled with intensive tillage, decreased soil organic matter by almost 64 percent (Figure 1). The loss of original soil organic matter due to tillage practices exceeds any potential additional carbon from crop residue because the majority (70-80%) of crop residue carbon after decomposition will be lost as CO_2 to the atmosphere as it decomposes. Therefore, the loss of residues due to removal for any use can accelerate soil organic matter loss and carbon and nutrient source to the soil. It also is well documented that intensive tillage and mono-cropping systems, along with residue removal, can have asignificant impact on degrading soil organic matter and increase CO_2 release and potential water quality problems. A long-term study found that corn stover removed vs. stover returned had reduced the total source of carbon (SC) by 20 percent and corn derived soil organic carbon by 35 percent in a 13-year period.

fields
February 12, 2007

Allelopathy: A cause for yield penalties in corn following corn?
February 12, 2007

Tillage challenges in managing continuous corn
February 12, 2007

Equipment considerations for producing corn after corn
February 12, 2007

Can residue be managed successfully with no-till?
May 15, 2006

Why conservation systems are the right choice this fall
October 10, 2005

Residue management and manure application
October 21, 2002

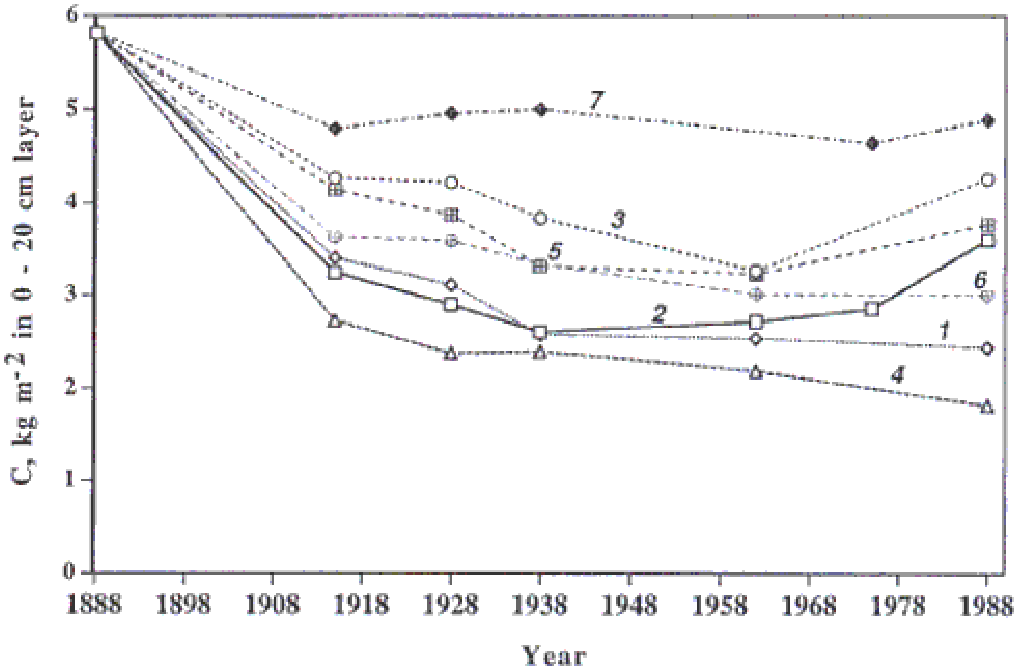

Figure 1. Soil organic matter carbon dynamics in some Sanborn Field plots, Missouri, with common monocrops: (1) wheat with no treatment; (2) wheat full fertilizer application; (3) wheat with 6 ton/acre manure; (4) continuous corn with no treatment; (5) continuous corn with 6 ton/acre manure; (6) timothy grass; and (7) timothy grass with 6 ton/acre manure. Source: G. Buyanovsky and G. Wagner, 1998. "Carbon cycling in cultivated land and its global significance." Global Change Biology 4:131–141.

Possible short-term impacts of corn stover removal may include an increase in application of nitrogen, phosphorus, potassium, calcium, and magnesium nutrients to replace these nutrients due to residue removal and potential deficiencies in the soil nutrients' pool in the long term. In one study, it was estimated that these macro-nutrients' replacement cost due to residue removal was approximately $10/ton of harvested residue. These nutrients will be permanently lost from the soil system nutrients' pool due to lack of replenishment from crop residue; they have to be added to keep soil productivity.

The implementation of conservation systems to sustain soil and improve environmental quality has to be considered in the current trend toward the increase of continuous corn acreage and future thinking of corn residue removal for cellulosic ethanol production. There is a high possibility that continuous corn production may increase the use of conventional tillage.

The increase in conventional tillage, coupled with high use of nitrogen fertilizer, will present a significant soil and water quality challenge. Corn acreage in Iowa is predicted to increase by 10 percent over the 2006 season. This trend will present economic and environmental challenges that we need to consider. The use of corn stover for celluosic ethanol production or any other purposes should be weighed against the potential impact on soil productivity, environmental consequences, and food availability.

Mahdi Al-Kaisi is an associate professor of agronomy with research and extension responsibilities in soil management and environmental soil science. J. Guzman is a research assistant in soil management.

This article originally appeared on pages 122-123 of the IC-498 (7) -- April 23, 2007 issue.

Updated 04/27/2007 - 9:04am