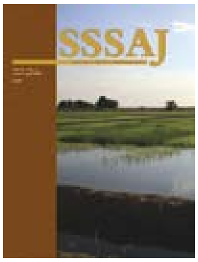

Indiscriminate Corn Stover Removal Reduces Soil Fertility, Soil Organic Carbon, and Crop Yields

Production of cellulosic ethanol is expected to increase substantially in the near future in the quest to reduce both excessive dependence on fossil fuels and net emissions of greenhouse gases. Among the potential cellulosic feedstocks are crop residues such as corn (*Zea mays* L.) stover, perennial warm-season grasses, and short-rotation woody crops. At present, corn stover is being considered the main feedstock source for producing ethanol because other alternative feedstock sources are not yet readily available. Cellulosic ethanol has more potential than grain ethanol in the long term, and it will soon become a reality as technologies for the conversion of cellulose into liquid fuels are being refined and cellulosic ethanol plants are being built.

Producing ethanol from renewable energy sources is a plausible endeavor. The concern, however, is that high rates of corn stover removal as biofuel may adversely impact soil productivity and environmental quality. Experimental data on the impacts of stover removal are needed to establish threshold levels of stover management.

In the March–April 2009 issue of *Soil Science Society of America Journal*, Humberto Blanco and Rattan Lal from the Ohio State University document the four-year impacts of systematic removal of corn stover from long-term no-till systems in Ohio on soil structural stability, soil organic carbon (SOC), soil nutrient concentrations, and grain and stover yields across three contrasting soils (Rayne silt loam with a 10% slope, Celina silt loam with a 2% slope, and Hoytville clay loam with <1% slope). Stover was removed at rates of 0, 25, 50, 75, and 100% after harvest for four years.

Results of the study revealed that stover removal at rates as low as 50% reduced SOC concentration by, on

Crop residue removal increases the soil's susceptibility to cracking, crusting, surface sealing, and compaction.

average, 5.5 Mg ha^{-1} while complete stover removal reduced the total N concentration by nearly 0.82 Mg ha^{-1} in silt loams in the 0- to 10-cm soil depth after four years of stover removal. Complete stover removal also reduced available P, exchangeable Ca^{2+} and Mg^{2+}, and cation exchange capacity on the sloping silt loam. In the nearly level silt loam and clayey soils, stover removal at rates as low as 25% reduced the stability of aggregates. Stover removal at 50% reduced, on average, grain yield by 1.8 Mg ha^{-1} yr^{-1}, and 100% removal reduced it by 3.3 Mg ha^{-1} yr^{-1} in the last three years of stover management in the sloping soil.

The authors conclude that indiscriminate stover removal for expanded uses degrades soil structure and reduces soil fertility, soil organic carbon concentration, and crop yields. Residue return after harvest is essential to elemental recycling, improving soil structure, maintaining favorable soil temperature and moisture regimes, improving biotic activity of soil fauna (e.g., earthworms), and sustaining grain and biomass yields, according to the authors.

The short-term stover removal impacts were soil specific. Stover removal had the most adverse impacts on the sloping and erosion-prone soil. Stover removal did not reduce crop yields in the nearly level silt loam and clayey soils in the short term, but aggregate stability was reduced in both soils with stover removal above 25%.

"Based on these results, only a fraction of stover produced can be harvestable as biofuel from these soils, and only about 25% of stover might be available for removal based on the needs to maintain SOC levels and structural stability," Blanco says.

Further long-term monitoring of impacts is warranted to conclusively establish the threshold levels of stover removal for these soils, the authors say.

Research is ongoing at the Ohio State University, and similar studies are needed in other regions with different soil and climate characteristics

"Based on these results, only a fraction of stover produced can be harvestable as biofuel from these soils, and only about 25% of stover might be available for removal based on the needs to maintain SOC levels and structural stability."

to objectively consider the effects that a high removal of stover may have on soil quality, gaseous emissions, erosion and nonpoint source pollution, and crop production at regional and national scales.

Blanco-Canqui, H., and R. Lal. 2009. Corn stover removal for expanded uses reduces soil fertility and structural stability. Soil Sci. Soc. Am. J. 73:418–426. View the full article at http://soil.scijournals.org/content/vol73/issue2