Crop Residue May Be Too Valuable to Harvest for Biofuels

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(PhysOrg.com) -- In the rush to develop renewable fuels from plants, converting crop residues into cellulosic ethanol would seem to be a slam dunk.

However, that might not be such a good idea for farmers growing crops without irrigation in regions receiving less than 25 inches of precipitation annually, says Ann Kennedy, a USDA-Agricultural Research Service soil scientist and adjunct professor of crop and soil sciences at Washington State University.

“With cultivation, organic matter tends to decline in most places around the world,” she said. “In the more than 100 years that we have been cultivating soils in the Palouse,”—the wheat growing region of Eastern Washington, Northern Idaho and Northeast Oregon—“we have lost about half of the original organic matter.”

Ideally, according to Kennedy, soils in the Palouse should have about 3.5 percent organic content. In most farm fields, she said, it is now closer to 2 percent.

She said organic matter provides nutrients crops need, helps the soil hold water and contributes to the formation of soil clods that help prevent wind erosion. The percentage of organic matter in a given soil varies naturally from region to region, depending on climate, soil disturbance, moisture and vegetation. Generally speaking, more moisture leads to more vegetation, which is the feedstock for the microbes that break

down residue into organic matter.

“A lot of people think residue is part of organic matter,” Kennedy said, “but that is not correct. Organic matter is well-decomposed plant material and microbes. It is black and rich and gives soil its dark color.”

Kennedy, who researches the composition of cereal crop residues and the amount of residue needed to maintain soil quality, said that the tillage system used to prepare the soil for planting has a big effect on the conversion of residue to soil organic matter. In no-till (direct seed) or one-pass tillage systems, she said, at least a ton of residue per acre per year is needed to build soil organic matter over time. In these minimum tillage systems, the intact and slowly decomposing roots also add to organic matter. She found that the percentage of organic matter in no-till research plots at the Palouse Conservation Field Station increased from 1.9 percent to 3.6 percent over the course of 20 years.

In fields with multiple tillage passes, on the other hand, organic matter may not increase even if all the drop residue is left in the field.

Kennedy thinks multiple tillage may mix the soil and residue too well, in essence over-feeding the microbes. The microbes will consume the incorporated residue too quickly and release most of it into the air as carbon dioxide.

“It is like going to an all-you-can-eat restaurant every day and eating too much,” she said “You cannot adequately metabolize all the food you ate. Cultivated soil is like a ‘pig out’ for microbes.”

For the long-term health of the soil, leaving residue on the soil surface works best.

“It will tend to stay around longer, and the microbes will slowly invade it

and convert it into organic matter with less lost as carbon dioxide," said Kennedy. And about proposals to bale off crop residue for production of biofuels?

"You could remove the extra residue," she said, "but it still provides surface cover and will eventually become organic matter; this residue layer is especially important if you rotate with low-residue crops legumes and canola."

If residue were harvested, she said, soil fertility would drop and farmers would have to find other ways to increase the amount of organic matter in their soils.

"We need to constantly replenish organic matter—so removing valuable residue, especially in areas with low rainfall, may not be the best practice."

Provided by Washington State University