Removing Crop Residues Without Hurting Soil

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With today's technology, at least 30 percent of agricultural residues can be removed for power, fuels and chemicals to displace fossil fuels, without hurticng soil. Above ground, nongrain plant matter can be converted to energy, fuels and fertilizer. Presently, nearly all U.S. consumption of these commodities is derived from fossil fuels, predominantly from foreign sources. Several important benefits are realized when biomass (specifically lignocellulosic, or nonfood, organic material) is used instead of fossil fuels as a feedstock for the manufacture of these high-volume products:

First, emissions of greenhouse gases and other environmental pollution (e.g., heavy metals, sulfur, etc.) can be greatly reduced. Second, a greater domestic proportion of energy sources provide enhanced energy security for our country. Third, a smaller fraction of our national wealth is sent to foreign regimes, many of which are hostile to U.S. interests. Fourth, with emerging technologies for alternative methods to produce energy, fuels and chemicals, the economics of farm operations becomes both less expensive and less volatile, thereby reducing price pressures on food.

Agricultural residue, the organic matter left over after grain harvesting, has the potential to replace a large fraction of our petroleum and coal use, making this a significant national benefit. However, agricultural residues also serve a useful function in farm soils, so it is important to understand the impact of removing some of these residues. This monograph provides a brief introduction to this impact. For more information, a list of references is included.

Soil: Benefits of Organic Matter

Soil (also called earth) is a porous aggregate of minerals and organic matter, including solids, liquids and gases. On farmland, agricultural residues contribute to a soil's productivity-the ability to grow food. Ag residues, such as corn stover (the stalks, husks, cobs and leaves) or wheat straw, contribute to healthy soil in several ways: residue on top of the soil reduces erosion from raindrop impact and wind shear, affects radiation balance (sunlight in, infrared emissions out) and affects moisture evaporation rate; the physical presence within the bulk of the soil affects water infiltration and retention, aeration, penetration resistance (to roots and to worms) and tilth (how easily a plow cuts through); and chemicals from the breakdown of organic matter affects acid/base balance (pH level), nutrient availability and cycling, ion exchange capacity, and micronutrients such as phosphorus and potassium.

Agriculture residue is not entirely benign. Too much residue is a detriment to no-till farming in several ways: it is harder to plant through; it insulates the ground, and can delay planting; and the thicker mat tends to inhibit early plant growth, possibly reducing yields. In conventional farming, when residue is tilled under in the fall, agricultural residue can decompose to form methane, a greenhouse gas 22 times more potent than carbon dioxide. Ag residue has other uses, such as animal bedding or feed extender, so there is farm equipment dedicated to collecting, baling and transporting bales of corn stover and wheat straw.

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Agricultural Residues Removal

Complete removal of agricultural residues is harmful to soils. No removal also has deleterious effects. Somewhere there is a happy medium between the national imperatives to displace fossil fuels and the farmer's need to maintain healthy, productive soil. Fortunately, this issue has been studied in depth for at least 30 years. A summary of the findings of the nine references at the bottom of this monograph is presented below.

Considering above-ground material, the highest removal rate recommended is 70 percent. Many sources cite 50 percent, but nearly all agree that 30 percent of agricultural residues can be removed without harm to soil quality. These are general guidelines, but a more accurate and specific removal rate depends on soil type (clay, sand, silt), slope and prevailing weather conditions. An individual farmer can make a scientific assessment of a suitable removal rate (determined by settings on harvesting equipment) using software tools such as Revised Universal Soil Loss Equation, Version 2, which factor in all these variables, and provide a recommendation.

Summary

Agricultural residues can be partially removed without hurting soil. Software tools already being used by farmers allow them to make accurate decisions based on their farm soil. This happy circumstance allows the U.S. to meet its national imperatives while increasing revenues for the farmer, without harm to the food supply.

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