Bioenergy Activities at Ames, IA

Research Unit: Soil and Water Quality Research Unit
National Soil Tilth Laboratory
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Research Project: Ecologically-Based Soil Management for Sustainable Agriculture and Resource Conservation (3625-12000-012-00D) (D.L. Karlen, LS)

Objective: To develop innovative, ecologically-based crop and soil nutrient management practices for enhanced productivity and negligible off-site agricultural impacts.

Hypotheses:

1. Long-term average crop yield from chisel-plowed Clarion-Nicollet-Webster soils will decrease significantly by removing crop residues for biofuels production.
2. With no-tillage, at least 2 t/ac of the surface crop residue can be harvested from Clarion-Nicollet-Webster soils for biofuels production without significantly decreasing long-term average yield.
3. With intensive crop management (i.e. increased plant population, fertilizer rates, and narrow row spacing) more than 2 t/ac of biomass can be harvested from Clarion-Nicollet-Webster soils for biofuels production without significantly decreasing long-term average no-till yield.
4. With cover crops more than 2 t/ac of biomass can be harvested from Clarion-Nicollet-Webster soils for biofuels production without significantly decreasing long-term average no-till yield.
5. Applying charcoal (biochar) will significantly increase the Soil Management Assessment Framework (SMAF) rating for Clarion-Nicollet-Webster soils where crop residues are harvested for biofuels production.

Research Project: Biogeochemical processes influencing formation and stabilization of soil organic matter and soil structure (3625-11120-011-00D) (D.L. Laird, LS, David.Laird@ars.usda.gov)

Objective: Determine the role of clay minerals and charcoal in the formation and stabilization of soil organic matter and soil structure

Hypotheses:

1. Charcoal additions to soil will have a positive impact on crop productivity in a Midwestern corn-soybean cropping system.
2. Charcoal additions to soils will stimulate formation of clay-humic complexes and the formation and stabilization of new biogenic soil organic matter.
3. Charcoal additions to soils will reduce nitrogen and pesticide leaching by increased adsorption.

Key Accomplishments:

1. Collaborative research with an Iowa State University (ISU) Agricultural Engineer has been established to design and evaluate a one-pass harvest system to collect both corn grain and stover

2. Harvestable stover yields ranged from 2.0 to 3.2 tons/acre depending upon whether the whole plant or only the cob and top 50% were removed.

3. Soybean yield following one-time removal of corn stover was significantly lower that where residues were returned, probably because soil-test P and K levels were subsequently found to be very low

4. A column leaching study showed the addition of charcoal reduced soil bulk density and decreased N leaching

5. A large field-scale (25 acres) study has been initiated to examine three levels of crop residue removal (0, 50, and 100%) with chisel plow and no-tillage practices, intensive crop management, charcoal additions, and cover crops on subsequent corn grain yield, soil quality indicators, and economics of the various production systems..

Other Scientific Expertise:

1. Established collaboration with scientists from the Idaho National Laboratory provides sugar analysis and other feedstock characterization data.

2. Established watershed-scale research programs, associated with the Conservation Effects Assessment Project (CEAP), that are leading to on-farm evaluations regarding the sustainability of harvesting crop residues

3. A certified analytical laboratory that provides optimum QA/QC for all sample analyses

4. Established collaboration with ISU scientists addressing many bioenergy questions.