TECHNICAL NOTES

U. S. Department of Agriculture Natural Resources Conservation Service

TN – PLANT MATERIALS – 58 August 2000

SOIL SEQUESTRATION OF CARBON AND BIOMASS-TO-ETHANOL

Increasing interest in soil carbon storage has created the need to establish the quality and quantity of carbon in plant materials used for conservation and resulting from conservation practices. Biomass-to-ethanol technologies using conservation plant materials needs to be developed. Grasses whose roots can store carbon also lead to increased soil carbon sequestration, and the above ground biomass that can be harvested for ethanol production, is a win-win for farmers. Farmers can be paid for the crop, for sequestering carbon and also obtain the benefit of reduced soil erosion, improved soil and water quality. While this will require a "U.S. GOVERNMENT TEAM" effort, the Lockeford Plant Materials Center and plant materials program can provide a lead role in the development of these new technologies. The Lockeford Plant Materials Center, plant materials program, NRCS Institutes and centers, Natural Resources Inventory (NRI) staff, range, soil, economics, forestry, and agronomy disciplines, Agriculture Research Service (ARS), Cooperative Extension Service (CES), Environmental Protection Agency (EPA), and Department Of Energy (DOE) will need to work together to develop these technologies.

Soil Carbon Technology Evaluation Efforts

The interest in soil carbon storage by increased sequestration in what some call "carbon banks" has created the need for new technologies. It is reported that carbon banks may have the potential to increase farm income up to 15 percent (1). The trading of carbon credits will establish the value of the carbon in the soil and or above and below ground biomass. The Lockeford PMC can establish the quantity and quality of carbon in conservation plant materials and resulting from different conservation practices.

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Conservation plant materials, which are deep rooted and have a high lignin content in their roots, may extend the soil carbon retention time in the soil. The oxidation and reduction in soil sub-horizons is less and high lignin content roots in this zone will lead to less breakdown of the sequestered carbon (4). High levels of soil organic carbon are linked to improved soil quality and materials with high lignin contents will help to increase soil organic carbon. Lignin has 61 to 64 percent carbon, cellulose has 44.5 percent carbon and soil organic matter has 58 percent carbon (2).

Soil C is at the center of good soil quality, sustainable agriculture and environmental sustainability. Soil, water and air qualities are all enhanced with increased amounts of soil C. Increased amounts of soil C increase the water holding capacity, the water use efficiency, improve soil fertility, infiltration rates and at the same time help to reduce soil erosion. There are many other benefits to increased amounts of soil C (3).

Biomass-to-Ethanol Technology

There is demand for ethanol because MTBE (methyl tertiary butyl ether) fuel in California will be phased out in 2002 and other states will not be far behind. California's demand is about a billion gallons a year. Arkenol, based in Mission Viejo, California is planning an 8-million gallon plant in Sacramento, California (5). Executive order 13134, *Developing and Promoting Biobased Products and Bioenergy*, can be implemented with an increased emphasis on plant materials centers caring out studies which determine conservation plant materials potential for biomass-to-ethanol use.

Lockeford PMC and Plant Materials Program Roles:

- Develop study plans, which establish the quantity and quality of carbon in conservation plant materials and from different practices.
- Establish and maintain test plots.
- Using scientific methods collect and send conservation plant material samples to agricultural laboratories for determination of plant organic mater and ash test (converts to C), soil organic matter, root lignin and organic matter (converts to C), total plant sugar and bulk density (6).
- Interpret and analyze the laboratory data.
- Evaluate energy crop and conservation plant materials and evaluate bio-products residue for lignin content and the amount of residue which needs to left in place to increase soil carbon.

- Evaluate the biomass-to-ethanol potential of conservation plant materials.
- Evaluate the potential of plant materials and conservation practices for soil C sequestration. This would include the evaluation of tillage, no tillage and irrigation on the speed of organic material decomposition.
- Technology transfer with papers and technical notes.
- Assist local landowners, resource conservation districts and RC&D Areas to increase their understanding of soil carbon sequestration and the use of different plant materials through training.

Lockeford Plant Materials Center Study Example

Use a 15-year-old stand of 'Perla' Koleagrass in field 7 at the Lockeford PMC for sampling. Establish three random sample points. At each point, obtain a plant sample for determination of ash or plant organic matter and total sugar, a root sample for a lignin and organic matter, and soil samples for soil organic matter carbon. Establish three random sample points in field 6 where the soil is the Columbia series and there has been an annual cropping system. Obtain soil samples for determination of soil organic carbon at each sample point. The complexity of this study could be increased by establishing a standard sampling protocol for obtaining samples throughout the soil profile for root density, root lignin, organic mater, soil organic matter, and bulk density testing.

Citations:

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4. S. El-Swaify, S.A., with an international group of contributors. 1999. Sustaining the Global Farm – Strategic issues, principles, and approaches. International Soil Conservation Organization (ISCO), and the Department of Agronomy and Soil Science, University of Hawaii at Manoa, Honolulu, Hawaii, USA. 60p.
5. California Farmer, February 2000.
6. A & L Western Agricultural Laboratories, Inc., Modesto, California.