Promoting and supporting the commercially viable and environmentally sound recycling of coal combustion byproducts for productive uses through scientific research, development, and field testing.

Department of Energy
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Power Plant Combustion Byproducts for Improved Crop Productivity of Agricultural Soils

Project Objectives

- Identify potentially beneficial and harmful constituents of coal combustion byproducts (CCBs)
- Characterize the water-holding capacity of CCB-amended soils
- Demonstrate increased productivity of these soils with the addition of CCBs from local coal combustion power plants

Background

Two coal combustion power plants in the Four Corners region consume approximately 14.5 million metric tons of sub-bituminous coal on an annual basis for the generation of electricity. These power plants also generate substantial CCBs in the form of 3.4 million metric tons of ash and 0.39 million metric tons of flue gas desulfurization (FGD) materials. The Navajo Agricultural Products Industry (NAPI), a large commercial farm currently operating nearly 600 automatic center pivot irrigation systems on 25,000 ha of farmland, is located near the two power plants. Soil texture on the NAPI farm is generally sandy to sandy loam with limited water-holding capacity, low inherent nutrient status, and elevated pH. The addition of bottom ash, fly ash, and/or FGD materials to agricultural soils may increase water-holding capacity and contribute to the soil pool of micro-nutrients available for plant uptake.

Description

Researchers are working to identify potentially beneficial and harmful constituents of CCBs, characterize the water-holding capacity of CCB-amended soils, and demonstrate increased productivity of these soils with the addition of CCBs from local coal combustion power plants. The demonstration of environmentally sound management strategies for applying CCBs to agricultural lands will address regional and national priorities for the increased utilization of these products.

Preliminary Results and Status

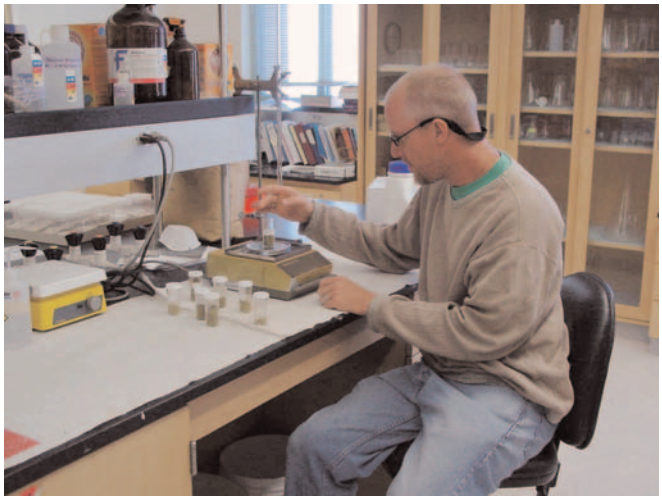
In May 2004, researchers began a pilot project located at the New Mexico State University (NMSU) Agricultural Science Center research farm in Farmington. During this period, the project team characterized the various CCBs for macro- and micro-nutrient content and then applied them at common agricultural rates recommended for other soil amendments, such as animal manures, at 10 and 20 T/acre to hybrid poplar clones grown in standard nursery containers. Preliminary data and methodology from this pilot study enabled researchers to establish a container study in Las Cruces, New Mexico, utilizing the NMSU Department of Agronomy and Horticulture greenhouse facility. They performed non-destructive monthly chlorophyll measurements on the leaves and destructively harvested the trees by separating them into roots, stem, and leaf portions and sending them to the lab for biomass measurements, which included

height, basal stem diameter, total leaf area, and dry weights of each plant part.

NAPI laboratory staff analyzed the soil samples from each container for pH, macro-, and micro-nutrients. The NMSU Agronomy and Horticulture soils group lab analyzed the samples for electrical conductivity and sodium adsorption ratio, and the NMSU Soil, Water, and Air Testing Lab analyzed the samples for Dietylene triamine pentaacetic acid (DTPA) extractable iron, zinc, and manganese. The NAPI laboratory also analyzed leaf portions for uptake of macro- and micro-nutrients. Researchers then began two more greenhouse trials of hybrid poplar and wheat cultivated with CCB-amended soil utilizing preliminary results from the first greenhouse trial.

Researchers then developed a leachate column methodology to simulate field conditions at the NMSU Agricultural Science Center Farmington site. They filled soil columns to a uniform bulk density of 1.5–1.6 g/g and applied CCBs as amendments to the tops of the columns. Researchers are conducting artificial rain/irrigation applications to simulate a worse case scenario during a typical six-month crop growing season.

Hybrid poplar pot studies using various soil amendments.



Graduate student Kevin Lombard weighing out soil samples.