Proposal for 2008-2009
Northwest Columbia Plateau PM_{10} Project

Objective 7: **Identify Sustainable Farming Practices for the Columbia Plateau by Measuring Changes in Soil Quality**

Title: ***The Effect of Wind Erosion and Control Measures on Soil Carbon, Communities and Quality***

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Project Objectives

Our overall objective is to determine the effect of wind erosion and management practices on soil organic matter, soil biological communities and soil quality characteristics. The first objective of this research is to characterize biological, physical and chemical soil quality parameters and monitor their changes over time in tillage systems of dryland farming systems. Our second objective is to quantify the carbon content and biological fingerprints found in wind-eroded sediments from agricultural soils.

Recent Accomplishments

Water and air quality issues resulting from displaced soil can cost the U.S. over one billion dollars annually. In dryland agriculture, wind erosion is a major source of soil resource depletion. Soil quality measurements can indicate management practices that are either soil building or degrading. Our data illustrated that the change with soil quality parameters in the transition period from conventional tillage to no-till took longer and was more variable in lower rainfall zones. We showed that no-till and conservation tillage slowly increased soil organic carbon, altered soil communities and improved soil quality. Soil organic carbon levels in long-term no-till increased slowly to approach the levels of soil organic carbon found in nearby undisturbed or native sites. Soils in long-term conservation tillage contained larger aggregates, more carbon, and more of the carbon in the larger sized aggregates and thus less available for wind erosion compared to conventional tillage. This information will provide growers and scientists with practical advice on soil quality to aid in the development of management practices that enhance soil quality.

We also showed that the biological component of soil can be used to identify the source of displaced particles. We found that fatty acid methyl ester fingerprints of soils were unique and reproducible. Fingerprints from samples taken from road sites were dissimilar to those from agricultural sites. Agricultural soils exhibited unique patterns depending on their origin. Biological assessment of soil particles is a powerful tool that will not only assist in source identification, but will help verify modeling efforts of wind and sediment movement to ensure success in efforts to curb wind and water erosion. However, an unanswered question about soil loss is ‘How much organic carbon is lost from agricultural fields due to wind erosion?’ Organic matter, being lighter in mass than mineral soil, may be lost at greater rates than the mineral fraction or travel farther; however, this relationship is not quantified. Using soil quality analyses and soil community fingerprints we may uncover more information on the amount and pattern of soil eroded in a given area. The product from these analyses will be methods to determine the areas of greatest loss to be targeted for adoption of soil saving management practices.

Planned Research

Objective 1. Characterize biological, physical and chemical soil quality parameters and monitor their changes over time.

Research will be conducted in conjunction with the ongoing wind erosion projects at various locations, such as the undercutting projects; the Jirava no-till seeding study near Ritzville, WA; and the canola-winter wheat study at Lind, WA. Soil samples will be collected annually to characterize soil quality. Soils will be incrementally sampled from the 0 to 10 cm depth in early spring and mid-summer to monitor soil quality changes over time (Table 1). For each treatment, four replications will be taken with seven subsamples bulked per replication. Soil quality and crop production data will be used to assess the influence of management practices on these parameters.

The soil properties to be analyzed include bulk density; soil pH (1:1 ratio of soil:water); electrical conductivity; organic C and N (Leco Analyzer); and aggregate size distribution. Nutrient cycling and N movement with depth are being followed with periodic samplings and subsequent analysis for inorganic nitrogen and organic carbon (Hart et al., 1994). The soil microbial constituents of various management systems will be assessed by several different microbial methods. A study of the microorganisms in the selected plots involves soil biomass, respiration and dehydrogenase enzyme activities (Tabatabai, 1994). Soil from each of the cropping systems will be analyzed using phospholipid fatty acid (PLFA) and fatty acid methyl ester (FAME) analyses (Kennedy and Busacca, 1995) to determine microbial community structure and effects of stress on the system (Ibekwe and Kennedy, 1998). The statistics to be used include analysis of variance (ANOVA) using Fisher’s protected least significant difference and Principal Component Analysis (Steel et al., 1997; SAS, 1999).

Objective 2. Quantify the carbon content and biological fingerprints found on wind-eroded sediments from agricultural soils.

The soil lipid content is indicative of diverse biological communities, plant and root litter origins, and humic structures; therefore, biological analyses of a particular soil can be used to identify and distinguish soils in a manner separate from, yet often dependent upon, the mineral portion. We propose to investigate the carbon content and biological fingerprint of fractions of agricultural soil collected in BSNE (Big Spring Number Eight) sample collectors. We propose to determine the amount of organic C lost to wind erosion and the impact of type of wind event, location and management on this loss. Along with the carbon content we are also interested in determining the biological fingerprint of the suspended material. It may be possible to use biological fingerprinting to determine the microsite or microaggregate origin of particles that are more erodible than others.

We will evaluate carbon content and the community profiles of soil emissions from agricultural land collected at various heights above the soil surface. The amount of carbon found in emissions at various locations will be measured and FAME profiles of the particulates will be determined and compared with adjacent bulk soil. We will utilize particulate matter collected in BSNE samplers adjacent to conventionally tilled agricultural fields. Over a ten year period, samples from various wind events at several different locations have been collected in 0.1, 0.2, 0.5, and 1.0 m increments to 1.5 m. The soil properties to be analyzed include total C and N (Leco Analyzer); and fatty acid methyl ester (FAME) analyses (Kennedy and Busacca, 1995) to determine soil biological community structure. We will use a progressive approach to investigate these samples. Initially we will test height differences, then progress to location or event, and then management differences.

Data will be analyzed by one-way ANOVA analysis using Fisher's protected least significant difference or a multiple ANOVA (MANOVA, SAS, 1999). We will determine those characteristics that separate the samples from one another and from the bulk soil. We will also calculate the amount of carbon lost from fields and determine the changes in the soil community markers of the suspended particulate material.

The information from this proposed research will ultimately provide growers and scientists with information on changes in soil organic matter and the soil biota due to wind erosion to aid in the development of management practices. Information will be disseminated during field days, at workshops, professional meetings, in the popular media, technical publications, and scientific journals.