

Scientific registration : 2742

Workshop : D

Presentation: oral

Analytical Determination of Concentric Carbon Gradients within Stable Soil Aggregates

Détermination analytique de gradients concentriques de carbone au sein d'agrégats stables de sol

SMUCKER Alvin J.M., PAUL Eldor A.

Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI, USA

Soil aggregation dynamics directly control agricultural production and reduce environmental contamination by convection-dispersion sequestrations of most ions. Greater containment and longer residence times of most plant nutrients, pesticides, and water would better sustain most agricultural production systems without polluting nearby groundwater supplies. In short, the large surface areas associated with the plethora of porosities within each natural soil aggregate provide dynamically interactive areas for chemical sequestration. Once known, it is these active/inactive centers which can be modified to improve plant productivity and water quality.

Recently, our laboratory has reported concentric gradients of soil C, N, several cations, and clay minerals at the surfaces and within aggregates from several different soil types. Developments in the mechanical separation of layers from within soil aggregates, by the soil aggregate erosion (SAE) apparatus (SSSAJ 61:720-724), provide a method for quantitatively separating soil aggregates into more meaningful biophysical components. Delta (δ) ^{13}C techniques can be used to identify sources of C produced by plants having different photosynthetic pathways. Plants with C_3 pathways generate average $\delta^{13}\text{C}$ values of -27 ‰ by discriminating against $^{13}\text{CO}_2$ during photosynthesis. In contrast, C_4 plants generate an average $\delta^{13}\text{C}$ values of -12 ‰. Now these $\delta^{13}\text{C}$ values can be determined for C associated with very small samples from SAE-separated concentric soil layers of aggregates. Samples are introduced to the ratio mass spectrometer, via a CHN high-temperature oxidation furnace analyzer, using an auto sampler. All ^{13}C analyses automatically provide total C. Total N is determined by the CHN analyzer and C/N ratios can be calculated for each aggregate layer. Carbon sources which accumulate in each soil layer are calculated by the equation:

$$\% \text{ from } \text{C}_3 \text{ plant} = \frac{\delta^{13}\text{C from each layer} - \delta^{13}\text{C from original soil}}{\delta^{13}\text{C from } \text{C}_3 \text{ plant} - \delta^{13}\text{C from original soil}} \times 100$$

Mechanical fractionation of larger aggregates into smaller and more biophysically meaningful components are essential before new management programs can be designed to promote the sustainability of agricultural systems.

Keywords : delta ^{13}C , microgradients, mass spectroscopy

Mots clés : delta ^{13}C , microgradients, spectroscopie de masse

