Nitrous oxide emissions respond differently to no-till depending on the soil type

October 22 2008

The practice of no-till has increased considerably during the past 20 yr. The absence of tillage coupled with the accumulation of crop residues at the soil surface modifies several soil properties but also influence nitrogen dynamics. Soils under no-till usually host a more abundant and diverse biota and are less prone to erosion, water loss, and structural breakdown than tilled soils. Their organic matter content is also often increased. In addition, no-till is proposed as a measure to mitigate the increase in atmospheric carbon dioxide concentration. To assess the net effect of no-till on greenhouse gas emissions, other gases also have to be examined.

Researchers at Agriculture and Agri-Food Canada (Québec City) investigated the short-term impacts of no-till on soil nitrous oxide emissions. They compared emissions of nitrous oxide as well as nitrogen contents and physical properties between moldboard plowed (early fall) and no-till soils near Québec City, Canada. Measurements were made during three growing seasons in a poorly drained clay and a well-drained loamy soil cropped to barley. The results of the study were reported in the 2008 September-October issue of the *Soil Science Society of America Journal*.

The authors concluded that their investigation indicates "that no-till can result in incremental nitrous oxide emissions that can more than offset the soil carbon dioxide sink during the first 5 yr after adoption of this soil conservation practice in a heavy clay soil…. Consequently, the potential of no-till for decreasing net greenhouse gas emissions may be

limited in fine-textured soils that are prone to high water content and reduced aeration".

Differences in the response of nitrous oxide emissions when converting to a no-till practice between the clay and loam soils were striking. While emissions were similar in both tillage treatments in the well-aerated loam, they more than doubled under no-till in the clay soil. Differences in emissions between tillage practices in the clay soil were observed in spring and summer but were greater and more consistent in the fall after plowing operations. The influence of plowing on nitrous oxide flux in the heavy clay soil was likely the result of increased soil porosity that maintained soil aeration and water content at levels restricting denitrification and nitrous oxide production. Accordingly, denitrification rates are usually increased in denser and wetter no-till soils and the anticipated benefits of the adoption of soil conservation practices on net soil-surface greenhouse gas emissions could be offset by increases in nitrous oxide emissions.

Predicting the impacts of no-till on nitrous oxide emissions is required for a full assessment of the influence of this practice on net greenhouse gas emissions. Researchers at Agriculture and Agri-Food Canada are pursuing their investigations to understand the factors that control the mechanisms leading to nitrous oxide emissions under contrasting soil tillage practices. Specifically, they now focus their efforts on the role of soil aeration with the hypothesis that the "adoption of no-till only increases nitrous oxide emissions in poorly aerated soils". Field studies and mathematical modeling of the impact of no-till on soil nitrous oxide emission has yielded contrasting results and an explanation of the high intersite variability of the influence of no-till on soil nitrous oxide emissions is still lacking.

Source: Soil Science Society of America