Crop performance matters when evaluating greenhouse gas emissions: study

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Measuring the emission of greenhouse gases from croplands should take into account the crops themselves.

That's the conclusion of a study in the Sept.-Oct. issue of the Journal of Environmental Quality, which examined the impact of farm practices such as tillage on the greenhouse gas, nitrous oxide. Expressing emissions per unit of crop yield rather than on a more conventional per area basis produced very different results, says the study's leader, Rod Venterea, research soil scientist with the United States Department of Agriculture's Agricultural Research Service.

In particular, his team found that total nitrous oxide emissions were not significantly affected by tillage practices when expressed on an area basis. When they were calculated per unit yield of grain, however, emissions were significantly greater under no-tillage compared with conventional tillage. A byproduct of many agricultural systems, nitrous oxide is a potent greenhouse gas (GHG) with a heat-trapping potential more than 300 times that of carbon dioxide.

The findings have important implications for how the greenhouse gases generated by agriculture are reported, evaluated, and potentially mitigated. Nitrous oxide emissions were slighter higher under no-till on a per area basis in the study, Venterea explains, but not high enough to differ statistically from those under conventional tillage. "But when we added in the fact that no-tillage also reduced yields, the effect of tillage did become significant," he says. "The point is that you need to look at

both nitrous oxide emissions and yield together."

While previous studies have shown that practices like fertilizer and tillage management can affect nitrous oxide emissions, relatively few have reported the effects of these practices on crop performance at the same time. In addition, GHG emissions are commonly expressed with respect to area of field: for example, kilogram nitrous oxide emitted per hectare. Recent research has suggested that expressing GHG emissions per unit of yield may be more meaningful, although few studies have actually done that.

To see how yield-scaled calculations might change the picture on emissions, USDA-ARS researchers in collaboration with University of Minnesota colleagues measured the effects of tillage and nitrogen (N) fertilizer management on nitrous oxide emissions, grain yields, and crop N uptake over three consecutive growing seasons in Minnesota. The experiment was conducted in research plots used for corn and soybean production, which were maintained under either no-till or conventional tillage for 18 years.

When the scientists calculated nitrous oxide emissions per unit yield of grain or grain N, they found that emissions under no-tillage were 52 and 66% higher, respectively, than with conventional tillage. In other words, for this cropping system and climate, Venterea says, no-till practices would generate substantially more nitrous oxide than would conventional tillage for the same amount of grain. The effect was due to lower yields under no-till, combined with slightly greater area-scaled nitrous oxide emissions.

Reduced yields under continuous no-till management in parts of the upper Midwest and other regions have been attributed to lower soil temperatures in spring, which may inhibit plant development. In other geographic regions, though, no-till can actually increase yields.

"So, for these other regions, expressing GHG emissions on a yield-basis could reveal benefits to no-till management that otherwise might not be quantified," Venterea says.

More information: www.agronomy.org/publications/ …/abstracts/40/5/1521

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