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Better Crops, Better Environment...through Science

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MANAGING NUTRIENTS TO MITIGATE GREENHOUSE GASES

Greenhouse gases are grabbing attention. The awarding of the 2007 Nobel Peace Prize to prominent leaders in the climate change issue reflects a global surge of public concern. While agriculture emits less than 10% of the total greenhouse gases in North America, its share of the issue is still important. And it has implications for managing crop nutrients.

Crop growth absorbs the greenhouse gas carbon dioxide, but requires activities that emit it. Photosynthesis captures carbon dioxide from the air. A smaller quantity is released back into the air by tractors, trucks, and the manufacture and transport of materials moving to and from the field.

Carbon dioxide is not the only concern. Methane and nitrous oxide also contribute to global warming potential. Methane emissions can increase sharply when flooded crops like rice are grown. But the biggest part of the issue for agriculture may be nitrous oxide.

Nitrous oxide is emitted sporadically when soils are not quite soaking wet. The biological processes and controls are not fully understood. Emissions tend to increase when soils contain high levels of plant-available N – the nutrient that most often limits crop yields.

Carbon captured by crops can mitigate emissions. Crops can increase the organic carbon in the soil. Crop products can replace fossil fuels. Mitigation can be enhanced by increasing crop yields. Optimum levels of all plant nutrients therefore help capture carbon.

Since cropping systems both emit and absorb, the net balance is critical. A full greenhouse-gas balance for a cropping system requires year-round tracking of all three gases, plus life-cycle analysis for all the inputs used. The few studies available show that most systems are net sources of global warming potential, but some have smaller footprints than others.

Intensive crop management systems balance mitigation and production. Because of their increased ability to take carbon dioxide from the air and produce higher yields, they do not necessarily increase greenhouse gas emissions per unit of production. Conversion of cropland to forest usually provides a net sink for greenhouse gases. Intensive crop management makes more room for such conversion, while supplying the world's needs for food, fiber, and biofuel.

The nutrient N demands particularly careful management. It plays a critical role in plant capture of carbon and its storage in soil. But its manufacture and transport entail carbon dioxide emissions, and its use is associated with nitrous oxide emissions. Its contribution to the net balance of greenhouse gases is highly sensitive to management. Best management practices ensure it effectively supports high yields with minimum associated emissions.

Managing N is critical for intensive cropping systems. Enhanced-efficiency technologies can help manage transformations of fertilizers applied to the soil and reduce residual soil nitrate. They include controlled-release coatings, and inhibitors of urease and nitrification. They can be effective in increasing N use efficiency while maintaining or improving yields. Some show promise for cutting nitrous oxide emissions directly as well.

Is there a technological solution to the nitrous oxide issue? A specific inhibitor of conversions that produce nitrous oxide is theoretically possible. Certain pesticides have been observed to stimulate nitrous oxide production. Could a specific chemical do the opposite? Scientific information on this question is scant.

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Abbreviations in this article: N = nitrogen.