Refining Nitrogen Rates for Crops

This project brought scientists together to study the effects of over-fertilizing and to develop tests for nitrogen mineralization in a variety of soils that illuminated ways to minimize crop losses and reduce the amount of contaminates that run off field and into ground and surface waters.

Who cares and why?

When farmers apply more nitrogen to their fields than the crops can use, the excess nitrogen flows into ground and surface water and jeopardizes water quality, human health, and the aquatic food chain. This is the water that people in towns, cities, and rural areas use for drinking water. In the Gulf of Mexico and other coastal waters, excess nitrate and dissolved organic carbon from agricultural runoff are causing hypoxia, or oxygen deficiency. Excess nitrogen also contributes to leaching of dissolved organic carbon from agricultural soils. This carbon reacts during water purification treatment and forms by-products that are a human health threat. In addition, the carbon that escapes the soil may be contributing to the greenhouse effect and global warming. While the environmental and human health threats are clear, surveys indicate that farmers are reluctant to adopt improved nitrogen management practices because they fear these practices will lower their yields and incomes. To develop best management practices that will minimize losses and reduce the amount of nitrogen, carbon, and other contaminates that run off into ground and surface water, we need to better understand how carbon and nitrogen work in cropping systems. Better quantification of nitrogen mineralization will let us make more accurate recommendations to optimize crop production and reduce impacts on water quality. We need to develop research and educational programs and materials to demonstrate the agricultural, economic, and environmental effects of various nitrogen management practices to producers and agriculture professionals. This information should help producers make research-based decisions about adopting improved practices.

Excess nitrogen can run off farms and into ground and surface water. In bodies of water, excess nitrogen causes chemical and physical reactions that affect the oxygen content, temperature, and visibility of the water, making it uninhabitable for many aquatic creatures and unsafe for humans. Photo by Lamiot/Wikimedia Commons.

The green extending from the northern shore in this aerial image indicates the worst algae bloom Lake Erie has experienced in decades. Algal blooms when there are excess nutrients, like nitrogen, in the water. Photo courtesy of Lynn Betts/USDA.

What has the project done so far?

NC-1032 scientists have worked together to develop rapid tests for nitrogen mineralization in a variety of soils and climates. Researchers have also studied how farmers use fertilizers and the effects of over-use. This work has improved our understanding of ways to keep nitrates, dissolved organic carbon, and other contaminates in the soil and out of the water.

Impact Statements

Found that up to 25 percent of agricultural fields are non-responsive to nitrogen fertilizer applications and that farmers over-fertilize fields by about 25 to 30 pounds of nitrogen per acre. These results have convinced many farmers to cut back on unneeded or excessive fertilizer, which has reduced environmental degradation and lowered the farmers' production costs.

Tested a variety of published methods for determining the responsiveness of agricultural soils to nitrogen applications and found that none predict responsiveness very accurately. Believed to be a result of differences in soil types, fertilizer history, agronomic management, crop varieties, and climate across the U.S. , these results showed that more information is needed to help farmers safely and effectively use nitrogen fertilizers.

Want to know more?

Administrative Advisor:
Sue Blodgett
sblodg@mail.iastate.edu

This project was supported by the Multistate Research Fund (MRF) established in 1998 by the Agricultural Research, Extension, and Education Reform Act (an amendment to the Hatch Act of 1888) to encourage and enhance multistate, multidisciplinary research on critical issues that have a national or regional priority. For more information, visit *http://ncra.info/*.

Edited and designed by Sara Delheimer

What research is needed?

Developing a test or suite of tests to determine fertilizer responsiveness of soils remains a top research priority. Further collaborative esearch is needed to increase our understanding of the factors that control the rate of mineralization in soils. This research requires field studies to measure the effects of various nitrogen application rates on crop productivity and water quality at a variety of sites that represent different soils and cropping systems throughout the U.S. In addition to field experiments, we need to examine laboratory soil tests. Scientists can use this data to develop computer models that use field and laboratory results to make predictions for additional cropping systems and geographical regions.

Worried about maintaining high crop yields, many farmers use excessive amounts of fertilizer. Excessive fertilizer use often does not improve crop yield, and instead, costs the farmers time and money and causes environmental problems when the excess nutrients run off the fields and into surface and ground waters. Photo by Lamiot/Wikimedia Commons.