

# IOWA Nutrient Research Center



The purpose of the Iowa Nutrient Research Center is to pursue a science-based approach to nutrient management research through evaluating the performance of current and emerging nutrient management practices, and using an adaptive management framework for providing recommendations for the implementation of nutrient management practices and the development of new nutrient management practices. In four years, the center has received \$5.475 million in state appropriations to continue to add to the knowledge base and advance the science of nutrient management, with 99% of those funds going directly to faculty for their research. The center funds are significantly leveraged, expanding the potential impact of its work. (For example, in the last five years, Iowa State University has received \$17 million from nearly 50 funding sources in support of over 100 water quality projects.) We continue to gain a better understanding of nutrient movement through the landscape in Iowa, and from that research, scientists funded by the center have made progress towards nutrient loss reduction.

## Progress on Practices

### ***Water Quality Performance of Prairie Strips***

Building on a long running research project, scientists are now evaluating the water quality benefits when prairie strips are installed on a full farm field scale. The Science-based Trials of Rowcrops Integrated with Prairie Strips (STRIPS) project at the Neal Smith National Wildlife Refuge near Prairie City has documented water quality benefits since 2007. By integrating tallgrass prairie vegetation into row-cropped watersheds, the diverse mix of plants reduces erosion and runoff by slowing water and holding soil in place. The STRIPS research team has helped implement prairie strips on 20 farms in Iowa and one in Missouri. The current experimental test plot resides on a 152 acre site at the Whiterock Conservancy.

### ***Cover Crops Influence Nutrient Cycling, Yield and Diseases of Corn and Soybean***

Cover crops are proven to limit nutrient loss and improve nutrient cycling when planted between a corn-soybean rotation. However, ISU researchers have documented instances of seedling disease under certain conditions following cover crops. Currently a team is investigating whether there are differences between a variety of cover crop species (in this study, cereal rye and flax) their ability to retain nitrogen all the while decreasing the chances of seedling disease. It is hoped that by determining the most suitable cover crop for corn-soybean rotations, adoption of planting cover crops will increase across the state.

### ***Bioreactor Research and Assessment of Woodchip Tile Denitrification Bioreactors: Optimal Design/Performance and Experimental Bioreactor Installation and Study***

Bioreactors are edge-of-field systems that receive water from drainage tiles. As that water passes through woodchips, nitrogen is converted to a harmless gas by microbes. Studies show bioreactors can reduce from 15 to 60 percent of a field's annual nitrate load. To more closely study the performance of bioreactors, the Iowa Nutrient Research Center partnered with Iowa State University Research and Demonstration Farms to build a bioreactor research site with nine plot-scale bioreactors. ISU researchers are working to determine best practices and the ideal combination of fill material to customize bioreactors. They are able to compare a control bioreactor to bioreactors with variables including different water flow rates and types of woodchips. The research system is unique in that water from a large drainage area is pumped into the bioreactor, making it no longer weather dependent.

## **Progress on Watersheds**

### ***Establishment and Monitoring of Saturated Buffers within High-Priority HUC-12 Watersheds***

Riparian buffers are a proven conservation tool for reducing the movement of nutrients from surface runoff and shallow, subsurface water flow. Sometimes water bypasses this zone through drainage tile. Research shows that one promising approach to intercept this water is by installing a saturated buffer. Additional plumbing is added under riparian buffer areas to divert some water from field tiles into a stream-side saturated buffer. As water moves through the saturated buffer, microorganisms and plant roots process the nitrate. The scope of the INRC project includes establishing saturated buffers in some of the 16 Iowa Water Quality Initiative Demonstration watersheds. Despite some variable performance, all sites have shown a decrease in nitrate concentration as a result of the saturated buffers. Saturated buffers are now approved as a nationwide cost-shared nitrate removal practice and can be paired with CRP buffers.

## ***Phosphorus Transport in Iowa Streams: Importance of Stream Bed and Bank Erosion***

Recent findings show that the origin of some phosphorus found in surface water can be traced back to stream bed and bank erosion. To better understand how erosion impacts phosphorus transport into surface water, scientists installed a water quality monitoring station and estimate erosion rates by using erosion pin measurements. Over the last four years, recorded data supports the theory that stream bed and bank erosion acts as another delivery system of phosphorus to surface water.

## ***Measuring the Effectiveness of Stacked Nutrient Reduction Practices***

A side by side comparison of two sub-watersheds shines a light on the effectiveness of stacked nutrient reduction practices. Scientists collaborated with the Johnson County Soil and Water Conservation District to install sensor technology in a control sub-watershed and a sub-watershed with nutrient reduction BMPs (including cover crops, bioreactors, wetlands and buffer strips) to monitor continuous discharge and stream nitrate concentrations. Real-time monitoring data will continue through 2017 and is available at: <http://iwqis.iowawis.org>

## **Progress on Behavior and Landowner Attitude**

### ***Reducing Nutrient Losses While Increasing Farm Profit Through Precision Conservation***

Reluctance of farmers and landowners to adopt certain conservation practices to reduce nutrient loss is possibly linked to the perceived economic loss and fear of disclosing information about the exact nitrate levels leaving their fields. To combat this mindset, a web-based tool has been designed to show farmers where in their fields they might benefit the most from adopting conservation practices without forcing them to disclose data or negatively impacting their profits. Model simulations compared to data collected from Gilmore City, an ISU research site for over 40 years, indicates that while estimates need to be adjusted to improve simulations, overall acres of land that are seldom profitable to farmers would be ideal locations to install nutrient reduction practices.

## **Emerging Technology and Issues**

### ***Improving the Capacity to Detect Load Reductions***

As more nutrient reduction practices are adopted state-wide, Iowans are eager to see the resulting water quality improvements. To address this need for data, scientists will generate projection models based on field measurements of

nitrogen concentrations in corn grain, soybean grain and fixation to projections from the Agricultural Production Systems sIMulator. Models based on field data and projections will be used to interpret variations in nitrate load. To date, five watersheds with implemented conservation practices have been identified to serve as a sites for field data collection.

### ***Impacts of Cover Crops on Phosphorus and Nitrogen Loss with Surface Runoff***

Research has confirmed cover crops as a way to reduce nitrate loss through subsurface drainage. However, scientists are now examining if they have a similar benefit in instances of surface runoff in corn and soybean production systems with no-till or tillage. On an Iowa State University managed research farm, 12 different sites will be monitored under natural rainfall conditions to observe the impact of cover crops on total or dissolved nitrogen and phosphorus loss by way of surface runoff.

### ***Impacts of Prairie Pothole Hydrology on Field-Scale Losses of Nitrogen and Dissolved Phosphorus***

Pothole depressions are a common feature of Iowa agricultural landscapes that have potentially large but uncertain implications for managing nitrogen (N) and phosphorus (P) use efficiency and hydrologic losses. It is possible farmed pothole depressions are hot spots of N and P loss to water and/or the atmosphere that generate a disproportionate impact at the field scale. If so, altering cropping strategies in the most poorly drained potholes could yield important gains for water quality, as well as potential economic benefits from efficient fertilizer use.

### ***Utilizing Beef Stocker Cattle to Enhance the Value of Cover Crops***

The increasing popularity of cover crop usage presents a substantial amount of potential forage available to the beef industry that would otherwise be wasted beyond their agronomic purposes. While research has shown the benefits of improved soil health and nutrient retention from cover crops, very limited data is available on utilization of cover crops by beef animals.

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The Iowa Nutrient Research Center was established in 2013 by the State Board of Regents in response to legislation passed by the Iowa Legislature and signed by Governor Branstad.