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Impacts of Crop Rotation, Cover Crops, Nutrient and Manure Application on Grain Yield and Ground Water Quality: The New Treatments

Rameshwar S. Kanwar
Iowa State University, rskanwar@iastate.edu

Matthew J. Helmers
Iowa State University, mhelmers@iastate.edu

Carl H. Pederson
Iowa State University, carl@iastate.edu

Antonio P. Mallarino
Iowa State University, apmallar@iastate.edu

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Comments
One of the major challenges that Iowa's crop and livestock producers face is the growing concerns of society on environmental issues and how production systems may affect ecological quality of Iowa's landscape. Some of the proposed environmental regulations,such as nutrient water quality standards and total maximum daily loadings of pollutants (TMDLs) to Iowa's water bodies, are likely to govern the future of our livestock and farming activities on the landscape. For example, one of the ongoing discussions in the Environmental Protection Commission (EPC) is to consider putting a ban on applications of liquid swine manure prior to soybeans. If approved, this could bring some serious implications for swine producers and remove their flexibility of applying swine manure to soybean. Another issue being discussed is the impact of cover crops on nutrients loss from row-crop production systems.

Impacts of Crop Rotation, Cover Crops, Nutrient and Manure Application on Grain Yield and Ground Water Quality: The New Treatments

Rameshwar S. Kanwar, professor/chair
Matt Helmers, assistant professor
Carl Pederson, research associate
Department of Agricultural
and Biosystems Engineering
Antonio Mallarino, professor
Department of Agronomy

Introduction

One of the major challenges that Iowa's crop and livestock producers face is the growing concerns of society on environmental issues and how production systems may affect ecological quality of Iowa's landscape. Some of the proposed environmental regulations, such as nutrient water quality standards and total maximum daily loadings of pollutants (TMDLs) to Iowa's water bodies, are likely to govern the future of our livestock and farming activities on the landscape. For example, one of the ongoing discussions in the Environmental Protection Commission (EPC) is to consider putting a ban on applications of liquid swine manure prior to soybeans**.** If approved, this could bring some serious implications for swine producers and remove their flexibility of applying swine manure to soybean. Another issue being discussed is the impact of cover crops on nutrients loss from row-crop production systems.

Materials and Methods

Application of swine manure to soybeans is much less frequent than for corn, but does occur and manure management plans sometimes include swine manure application to soybean. When manure is applied to soybean, the purpose is usually not to use manure as a nitrogen (N) source but to supply phosphorus (P), potassium (K), and other nutrients to plants. Since soybeans result in a net removal of N from the soil (despite being a legume, and symbiotically fixing atmospheric N, the net removal has been estimated to be around 80 lb-N/ac), adding manure N to help offset soil N depletion should help maintain soil N, and thus soil organic matter and associated beneficial factors. This effect on the short- or long-term soybean production and impacts on nutrient loss with subsurface drainage are not well documented. In the previous study, we applied liquid swine manure for corn at 150 lb-N/acre to corn and for soybean at 200 lb-N/acre to soybean. We compared this system to a system in which swine manure was applied only for corn and P fertilizer was applied for soybean only when needed to soybean. The results of this study have showed statistically similar soybean grain yield but much higher nitrate loss to groundwater when swine manure was applied to both corn and soybean plots in comparison to only corn plots.

Based on this previous work, there is a further need to evaluate effects of lower manure-N application rates to soybean however. In addition to questions related to manure application for soybean there is growing interest and discussion of the impact of continuous corn production on nitrate leaching as well as methods to reduce overall nitrate concentrations in tile drainage. Therefore, the previous study was modified and new treatments were established in 2007 at the Northeast Research Farm Water Quality Site to answer some of these questions.

The new treatment list for this water quality research site is shown in Table 1. In 2007, we adjusted the rates of swine manure application for soybeans to 100 lb-N/acre but kept manure-N application rates to corn at 150 lb/acre. So,

one objective of our study will provide us better science-based information on reduced application rates of manure for soybean when manure also is applied for corn and the effects on crop yields, residual soil N and P, and ground water quality.

Also, a new treatment integrates a winter rye cover crop into a corn-soybean rotation system. Cover crops are a technology that has been shown in certain settings to reduce nitrate loss via subsurface drainage systems. However, existing information for Iowa is scarce and has been obtained at N rates higher than usually applied for corn. Therefore, there is a need for further evaluation of the environmental benefits of cover crop production. The objective of this component of the new project is to evaluate the environmental benefits of a rye cover crop. The treatment will specifically evaluate nitrate and P leaching when a rye cover crop is grown both after corn and soybean grown in rotation. Nitrate and P leaching and crop production from cover crop treatment will be directly compared with a similar treatment where no cover crop is grown. Subsurface drainage volume, nitrate and P concentration in the subsurface drainage, rye biomass production, rye N uptake, and corn and soybean yields will be measured as part of the project. The rye will be planted immediately after the harvest of the corn or soybeans and then killed with glyphosate approximately two weeks before corn planting and at or immediately following soybean planting.

Another objective is to obtain data to help develop and recommend appropriate manure, nutrient and tillage management practices to producers in order to minimize the water quality degradation and enhance the use of swine manure as an alternative nutrient source to inorganic fertilizers. Production system #3 would be of particular interest to the principle investigators but other systems need to be evaluated for comparison purposes and to further the scientific understanding related to these production systems.

A final objective is to evaluate long-term environmental effects and nutrient removal of harvesting continuous corn grain and stover for potential cellulosic biofuel production.

Table 1. New treatments for Nashua manure management and water quality study.

System	Timings and source of N	Crop	Tillage	Application method	Rate, lb/acre N-based	Rate, lb/acre P-based
1	Spring (UAN)	Corn	Chisel plow	Spoke inject	150	As needed
	-	Soybean	Field cultivate	-	-	As needed
2	Fall (manure)	Corn	Chisel plow	Inject	150	-
	-	Soybean	Field cultivate	-	-	As needed
3	Fall (manure)	Corn	Chisel plow	Inject	150	-
3	Fall (manure)	Soybean	Field cultivate	Inject	100	-
4	Fall (manure)	Cont. corn	Chisel plow	Inject	200	As needed
4	Fall (manure)	Cont. corn Round bale removal	Chisel plow	Inject	200	As needed
5	Spring (UAN)	Corn/rye cover	NT	Spoke inject	150	-
	-	Soybean/rye cover	NT	-	-	As needed
6	Fall (manure)	Corn	NT	Inject	150	-
		Soybean	NT	-	-	As needed