Animal manure utilization in crop nutrient planning

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Abstract
On northeast Iowa’s karst limestone terrain, the impact of agriculture on water quality is an important concern. This project cooperated with and built on other initiatives aimed at encouraging livestock producers to take credit for the nutrients in their livestock manure. Improved management of the manure resource can help avoid over-application of purchased nutrients and potential pollution of water supplies. Cooperating farmers were instructed in manure spreader calibration and other means for taking advantage of manure’s fertilizer value. All of the farmers who participated in the program are now taking credit for more of the nutrient resources available on their farms. Seventy percent increased their manure credits, and 30% also increased legume credits.

Keywords
Agronomy, Nutrient management

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences | Soil Science

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Abstract: On northeast Iowa’s karst limestone terrain, the impact of agriculture on water quality is an important concern. This project cooperated with and built on other initiatives aimed at encouraging livestock producers to take credit for the nutrients in their livestock manure. Improved management of the manure resource can help avoid over-application of purchased nutrients and potential pollution of water supplies. Cooperating farmers were instructed in manure spreader calibration and other means for taking advantage of manure’s fertilizer value. All of the farmers who participated in the program are now taking credit for more of the nutrient resources available on their farms. Seventy percent increased their manure credits, and 30% also increased legume credits.

Background

Shallow groundwater and cold water streams in northeast Iowa’s limestone hills are uniquely susceptible to contamination from agriculture. Surveys conducted in the past decade in Clayton, Allamakee, Winneshiek, and Fayette Counties have documented that livestock producers in this region (where livestock enterprises predominate) are ignoring or greatly underestimating the nutrient value of manure that they apply to crop fields. In addition, the On-Farm Management Services Project, a part of the Iowa Integrated Farm Management Demonstration, found that producers frequently applied two to three times more manure per acre than they had estimated.

Manure inventories collected by the On-Farm Management Services Project showed that overall, manure could supply 17% of nitrogen (N), 88% of phosphorus (P), and 40% of potassium (K) needs in this area of Iowa. Taking adequate credit for legumes could supply another 11% of N. The NEIDP (Northeast Iowa Demonstration Project, a USDA Water Quality Initiative project) showed that manure is routinely applied to 33% of total crop acres. The project described in this report worked one-on-one with selected farmers to improve their use of manure as a nutrient, decrease the pollution potential of excess fertilizer inputs, and improve the profitability of early-career farmers through refined, more sustainable management methods.

Other conservation and water quality projects in the area enhanced the impact of this manure management assistance program. For example, 28 manure storage and feedlot runoff control structures were implemented on 24 farms in the NEIDP area. In this project, manure nutrient planning workshops were held for farmers receiving cost-share assistance in both NEIDP and the French Creek watershed project.

Farmers enrolled in the Agricultural Conservation Program Water Quality Incentive Program, which requires manure nutrient management plans wherever applicable in whole-farm plans, received assistance from local private sector consultants and coop agronomists. The project provided information and training to these local, private-sector service providers and also encouraged use of the project’s portable truck wheel scales to aid in the calibration of manure spreaders.

Rationale and approach

FmHA offices in Clayton, Fayette, and Winneshiek/Allamakee Counties in northeast Iowa sent letters concerning the manure utilization project to 33 beginning farmers in their program. The manure management specialist for the NEIDP contacted each of them, and 20 agreed to sign up for the project.

The specialist visited each cooperator’s farm two or three times during the project to provide
Manure management planning assistance was also completed for other local farmers, including some NEIDP, Bloody Run Creek, and Trout Run Watershed project cooperators. Two meetings to write nutrient management plans were scheduled for farmers in the NEIDP area and the Coon Creek and French Creek watersheds in Allamakee County who received cost share on manure storage facilities through those projects. These meetings were also attended by personnel from the local Soil and Water Conservation District offices.

To help cooperators refine their nitrogen management skills, the late-spring N test was conducted on fields to which manure had been applied. Also, in cooperation with other local projects, demonstration plots using varying rates of fertilizer N on manure-covered ground were established on several farms to document N crediting from manure applications.

Methods and outcomes
Seventeen cooperators had dairy operations; eight of those also had swine and/or beef cattle.
One cooperator had beef cattle only, and two had swine only. All cooperators participated in the initial survey and manure inventory. Seventeen completed the program. Their manure and nutrient management plans covered 4,075 crop acres with 2,198 acres of corn, 290 acres of soybeans, 250 acres of oats, and 1,183 acres of hay.

When the project began, cooperating farmers were given responsibility for obtaining soil samples for their own farms. Fourteen of the 20 took their own samples; three used recent soil sample results from their coops. Three farmers have not yet completed the program. Two plan to sample their farms but have not yet done so. One quit farming.

Farmers used a worksheet to estimate their farms’ manure inventory and crop nutrient needs. Nutrient credits from manure were estimated along with application rates. Sixteen farmers had their spreaders calibrated using the portable scales, and six with long-term storage sampled their manure to further refine their nutrient credit estimates. Thirteen farmers used the late-spring soil nitrate test to monitor N management on manure-covered ground or on first-year corn following alfalfa or soybeans.

Cooperators also completed a spreader calibration worksheet (at left) to calculate the amount and nutrient content of manure spread per acre. A group of local banks financed truck wheel scales for spreader calibration. The total number of spreaders calibrated for manure utilization in northeast Iowa projects is now 81. Sixty-one were box-type spreaders, eight were slinger type, and six were liquid. Average application rate for all box-type spreaders was 22 tons/acre, with a range of six to 60 tons/acre. No effect of equipment type or rate of travel on application rate was evident. The most important variable was the “solids” content of the manure. Slinger spreaders averaged 27 tons/acre with a range of eight to 82; liquid tanks averaged 3,475 gallons/acre, with a range of 2,559 and 5,400. Spreaders calibrated for the FmHA cooperators averaged 17 tons/acre (including liquid hog manure applications converted to estimated solid tons).

Cooperators estimated that they collect 26,200 tons of manure annually from the livestock on their farms. This manure is spread on 1,545 acres, or about 38% of their crop and hay acres, at a rate of about 17 tons/acre. The average available N credit from the manure was approximately 6,300 pounds/farm. If applied only to their corn acres, the available N credit would be 107 pounds/acre. The project baseline survey showed cooperators were taking an average 23 pounds/acre N credit from manure on corn. By the end of the project, N crediting had increased to an average 48 pounds/acre.

Most cooperators were taking close to the recommended N credit for soybeans where applicable. Relatively few soybeans are grown in the project area, although the amount is increasing. However, many producers have rotations that include corn following alfalfa hay. ISU research has shown that additional N is usually unnecessary for corn following a good stand of alfalfa. At the start of the

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Manure spreader calibration worksheet.
program, the average cooperator was taking a 60-pound legume credit for corn after alfalfa. This credit had increased to only 66-67 pounds by the end of the project. There is clearly potential for greater N reduction and cost savings from this practice.

Overall, 85-90% of soil samples taken for NEIDP Integrated Crop Management cooperators came back high or very high in P; 80-85% were high to very high in K. High test results correlated strongly with fields where manure had been routinely applied. When participants’ soil test results were high and very high, they were advised to apply no additional fertilizer or use only a low rate of starter. The same recommendation was made, even when soil tests were unavailable, for fields that had received manure. No records were collected of participants’ actual P and K use.

The late-spring soil nitrate test was used in 1993 and 1994. However, in both years the test seemed unreliable. Results did not correspond to the known history of many fields. Low tests occurred where a history of manure application would have been expected to give a high residual reading. Farmers were interested in the test, but its interpretation seems to require additional consideration of weather and soil conditions (see p. 26).

Comparison of the baseline and exit surveys showed that

- 70% of cooperators increased manure credits and 30% increased legume credits;
- the number who say they make the fertilizer decisions for their own farms increased from three to 14;
- cooperators also say they now test soil more often and take greater N credits for legumes;
- cooperators are more likely to haul manure to more distant fields in order to apply nutrients according to crop needs;
- cooperators are also more like to recognize carry-over credits for P and K; and
- the most helpful project activities were (a) learning to work through an inventory of livestock manure nutrients and compare it to crop removal and (b) calibration of manure spreaders.

By applying manure nutrient management practices, farmer cooperators were able to apply smaller amounts of purchased nutrients per acre, thus increasing their overall farm profits by better use of on-farm resources. The increased manure N credit translates to a total of more than 19 tons/acre of potential excess fertilizer that was not purchased or applied during the project.

The 25-pound increase in manure crediting, to 48 pounds/acre, is still a long way from the 107-pound N credit that the manure inventory suggests could be taken. Management changes take time, and farmers are unwilling to put crops at risk until they can be sure of manure credits. However, at least six cooperators who had never taken manure N credits were taking an average of 38 pounds/acre when they completed the program.

To help farmers adapt more readily to taking manure credits, manure demonstration plots were established on several area farms. Eight manure management demonstration sites were conducted in crop year 1994 and eleven in 1995. Data from local farms were effective in convincing farmers of the impact that crediting can make in their own operations.

Implications

All of the farmers who participated in the program are now taking credit for more of the nutrient resources available on their farms, either with manure credits or legume credits. Potential for additional improvement exists; however, the number of participants who report that they make fertilizer decisions for their own farms has risen significantly—a sign that the project will have a lasting impact.

Most farmers reported that they had previously relied on suppliers for information. The principal value of the project has been to give cooperators a new perspective on the value of manure as a fertilizer. Once farmers are aware of their application rate and potential nutrient credits, they can work with suppliers to use commercial fertilizer to supplement fertility programs. Suppliers tend not to recognize the
value of manure as a fertilizer source because they do not manage the rate or uniformity of application. Thus, recognizing the value of these manure credits is the farmer's responsibility.

The project has contributed to the design of a model Nutrient and Pest Management Incentive education program that is being developed by NEIDP staff. This program will enroll additional participants who receive nutrient management education consisting of the same basic information used in this project, plus more on pest management. They will receive incentive payments to encourage timely, complete soil sampling and other tasks. This program will allow farmers to learn from each other and develop confidence in using new management practices as they hear of each others' successes.

**Education and outreach:** The project's educational program began with the "Manure Happens, Take Credit" display at the 1993 Farm Progress Show. This display has been used at a number of events around Iowa. Project results have been featured in local, state, and national farm media, as well as bimonthly in the Northeast Iowa "Water Watch" project newsletter. The "train the trainer" approach has magnified the impact of the project. Many USDA agency staff throughout Iowa, along with personnel from other water quality initiatives, private-sector consultants, and agronomists, have been trained in how to offer similar manure management assistance to their own clients.

On-farm demonstrations of manure management included spreader calibration, manure application to no-till fields and summer-seeded alfalfa, credit estimates for dairy manure, N credit for hog manure the second year after application, the effect of manure on corn rootworm populations, poplar plantings below a manure storage facility, and other topics.

Other support for the Manure Management Initiative has been provided by the Iowa Integrated Farm Management Demonstration Project, the USDA Northeast Iowa Water Quality Demonstration, and the U.S. EPA 319 program administered by the Department of Natural Resources.

This project also produced an Extension publication on "How to Sample Manure for Nutrient Analysis" (PM-1558, April 1995).