Manure management education and demonstration project

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Manure management education and demonstration project

Abstract
Proper methods and rates for applying livestock manure to crop land are critical to preserve water quality. The growth and concentration of Iowa's swine production facilities in recent years pose environmental concerns in terms of manure application to agricultural land. This project demonstrated a feasible, economical testing program to evaluate the nutrient content of livestock wastes. A portable kit was used that can test for ammonia nitrogen and phosphorus in both liquid and solid manure, facilitating on-site, immediate testing. The results of this on-farm testing kit, which is currently available to producers, were then compared with laboratory analysis to determine the kit's accuracy. By analyzing the nutrient value of manure immediately prior to land application, producers can make more environmentally sound manure management decisions.

Keywords
Nutrient management

Disciplines
Agriculture | Water Resource Management

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Abstract: Proper methods and rates for applying livestock manure to crop land are critical to preserve water quality. The growth and concentration of Iowa’s swine production facilities in recent years pose environmental concerns in terms of manure application to agricultural land. This project demonstrated a feasible, economical testing program to evaluate the nutrient content of livestock wastes. A portable kit was used that can test for ammonia nitrogen and phosphorus in both liquid and solid manure, facilitating on-site, immediate testing. The results of this on-farm testing kit, which is currently available to producers, were then compared with laboratory analysis to determine the kit’s accuracy. By analyzing the nutrient value of manure immediately prior to land application, producers can make more environmentally sound manure management decisions.

Background

Nitrate contamination of surface and ground water is a major public concern. Agriculture is a contributor to high nitrate levels in Iowa’s water supplies because of the use of nitrogen fertilizer for row-crop production. At the same time, storage and utilization of livestock manure is under increasing scrutiny, and the U.S. Environmental Protection Agency estimates that as much as 25% of surface water pollution nationwide is attributable to livestock manure.

As the swine industry changes rapidly, liquid manure systems are beginning to dominate construction of new hog production facilities. Yet each hog farm operation faces different manure management challenges. Although Iowa producers report a reduction in commercial fertilizer use, studies indicate that less than half of these producers take adequate credit for the nutrients contained in livestock manure.

This demonstration project was designed to enhance producers’ confidence in the nutrient value of manure in order to help them reduce the amount of commercial fertilizer they purchase without reducing crop yields. Correlating the results of tests—such as the manure nitrogen test, the soil fertility test, the late-spring soil nitrate test, and the fall cornstalk tissue test—with yield results was viewed as one strategy for helping farmers to manage manure nutrients in ways that protect profits and the environment.

The objectives of this project were to

1. demonstrate manure management practices that best utilize the fertility value of animal manure in crop production, with an emphasis on nitrogen, while protecting the environment;
2. work directly with several swine producers to test manure on-site for nitrogen content;
3. correlate the results of nutrient tests with yield results;
4. develop a manure/fertility application plan based on the principle that the amount of manure applied to land should not exceed the nutrient needs of the next crop(s) to be grown, nor should it build soil fertility test levels of phosphorus (P) or potassium (K) above the "high" test classification;
5. assist the swine producers in assessing animal manure/fertility production, sites (fields) that have received excess nutrient loads from current practices, and in locating abandoned wells for plugging; and
6. report results to other farmers and agribusiness.

Principal Investigator: Jerry W. Long

Co-investigators: Greg Brennemen, Kenneth Muller

ISU Extension

Budget
$2,500 for year one
$1,500 for year two
(project completion deadline extended to 1995)
Approach and methods

A commercially available manure nitrogen testing kit developed in Sweden was purchased, and multiple samples were taken at each of several farms as the manure was pumped from storage. (The kit consists of a reagent, a hydrometer, a vessel to contain the sample, and a pressure-sensing gauge.) Over a two-year period, participating swine producers used the test to measure the nitrogen content of manure before spreading and determine the amount of nitrogen in the manure being applied. Coordinating producers also worked with project staff to develop a manure/fertilizer application plan based on field-testing techniques and field records, according to the following schedule:

1. **Analyze manure**
   A. Conduct nitrogen test(s), 5-10/farm (fall or spring, while pumping manure from storage).
   B. Submit 1-2 manure samples per farm unit to a commercial laboratory for P and K content analysis. Analyze and correlate on-site nitrogen content test (fall or spring while manure is pumped from storage).

2. **Take or use current farm soil tests to determine soil P and K levels** (in fall after crop harvest and before manure spreading).

3. **Take 2-4 spring soil nitrate tests per farm to determine nitrogen needs for crop production before additional N is applied** (early spring at 2-in. depth and when corn plants are at 6 to 12-in. height and 3-in. root depth).

4. **Assess nitrogen sufficiency of corn plants at the end of the growing season using a lower stalk tissue test** (1-2 per farm; early fall, shortly after corn reaches black layer stage).

5. **Develop field records:**
   A. Fields manured and rate applied (application time).
   B. Field rotation schedule for applications to prevent nutrient build-up (January-March).
   C. Establish yield goals for crops grown on manured fields (January-March).

6. **Determine the nutrient value of animal manure spread and cost savings from proper application while protecting the environment** (annual summary of results).

Findings

Samples were taken at various stages during the withdrawal of liquid manure from storage structures (most were the enclosed pit type). Of the 19 samples taken from the operations of ten participating farmers for on-site testing, nine were compared with results from the Minnesota Valley Testing Laboratory in Nevada, Iowa. Initially, results varied widely, but refinements in measuring approaches greatly reduced differences between lab and field test results. Table 1 shows the average nutrient test results from all nutrient tests for both the lab and the nitrogen test kit.

Reliable on-site testing allows producers to adjust application rates with each load of liquid manure pumped from the storage pit. Although nutrient content is unlikely to vary greatly from load to load, differences between manure in the top versus the bottom of the pit can be significant. The critical advantage of on-site testing is the minimal time delay between sampling, testing, and manure application. When samples are sent away for laboratory analysis, there is greater likelihood of a shift in the nutrient content of the sample because of temperature fluctuations and other factors attributable to a time lag.

A direct relationship appears to exist between solids and phosphorus levels in manure.

Table 1. Manure Testing Analysis, Cedar County, 1992-1995 (nine lab and test kit comparisons)

<table>
<thead>
<tr>
<th>Test type</th>
<th>DM%*</th>
<th>lb. N/1,000 gal.</th>
<th>P/1,000 gal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab tests</td>
<td>5.3%</td>
<td>21.9 lb.</td>
<td>29.1 lb.</td>
</tr>
<tr>
<td>N test kit</td>
<td>7.4%</td>
<td>25.0 lb.</td>
<td>42.9 lb.</td>
</tr>
<tr>
<td>Kit vs. lab results</td>
<td>+2.1%</td>
<td>+3.1 lb.</td>
<td>+13.8 lb.</td>
</tr>
</tbody>
</table>

*dry matter
Producers completed an inventory form that was used to project soil nutrient recommendations on the basis of soil and crop history. This tool also provided a recommended rate at manure application time. Another form developed later during the project period was distributed at meetings designed to "train the trainers"—namely, staff from Extension, the Natural Resources Conservation Service, and others.

Ten producers received individual training about water pollution problems related to the timing of manure spreading, the spreading technique used, the problems caused by nutrient excesses applied to soil, and the value of keeping field records. They also learned to test manure on-site for nitrogen content as it was being pumped from storage facilities in order to determine the optimal application rate.

In summary, the use of a nutrient test for on-farm use was shown to have the potential for significant impact on a producer’s nutrient management plans. Careful measuring and monitoring of the test cycle is necessary to assure accurate results. Producers appeared to grow more comfortable with test use over time.

**Implications**

One project cooperator changed his manure application method from broadcast to in-field injection. In another situation, the producer adopted a field irrigation system in which a hose is pulled behind the applicator. This reduced field traffic and soil compaction. A third cooperator observed that better utilization of manure in his operation as a result of this demonstration project increased soybean yields 8-10% over the past three years.

Over-application of manure nutrients results in runoff that can affect water quality. By applying manure at rates consistent with crop nutrient needs, producers can avoid negative impacts on water quality and help to close the energy cycle on their individual farms.

Additional research into the economics and timeliness of application is needed. While most producers agree that proper application of manure can be profitable, more information on timeliness and procedure is needed to maximize this profit potential. Odor control is an important aspect of this emphasis on optimal application procedures.
For more information contact J. W. Long, Cedar County Extension Service, Tipton, Iowa, 52772; (319) 886-6157.

**Education and outreach:** One-on-one education of crop/livestock producers was the major thrust of this project. The project investigator explained to each producer the advantages of and techniques for testing manure on the farm. The value of conserving nutrients was emphasized. Project staff fielded questions from other educators and producers in other states, and one major agricultural supplier utilized the test results from this project to promote a commercially available field test kit.

Other cooperators included the Natural Resources Conservation Service and the Cedar County Soil and Water Conservation District.