*Iowa Manure Matters*

# Odor and Nutrient Management

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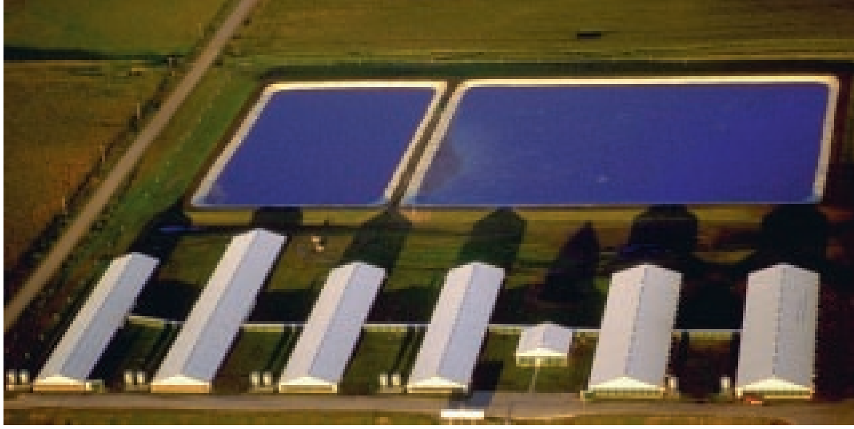

## Crop and Soil Response to Liquid Swine Manure Phosphorus Application

*by Antonio P. Mallarino, John E. Sawyer, John Lundvall, and Monica Barbazan, Department of Agronomy*

This article summarizes partial results from a project that has been demonstrating crop utilization of liquid swine manure nutrients, mainly nitrogen (N) and phosphorus (P). During the first 3 years of the project (2000–2002), we worked with 16 producer cooperators at 39 production / field sites located in 12 Iowa counties. General goals of the project and details of methods such as manure sampling, analyses, and application rates used were outlined in the Winter 2002 issue of the *Odor and Nutrient Management* newsletter. Partial results for corn response to manure N and supplemental N fertilization were presented in the Spring 2003 issue. In this article, we present partial results for crop and soil response to applied manure and supplemental P fertilizer.

**Corn and soybean response to manure P application.** Effects of direct manure application and supplemental P fertilization on yield of corn or soybean and on soil-test P were demonstrated at 16 locations from 2000 to 2002. Residual effects on second-year crops also were evaluated at several locations, but analyses are

Swine manure lagoon.

### This issue



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**Table 1. Summary of corn response to supplemental P fertilization after applying swine manure for various manure-N based application rates.**

| Manure Nutrient Application | | | Corn Yield and Supplemental P Fertilizer Rates (lb $P_2O_5$/acre) | | | |
|---|---|---|---|---|---|---|
| N Range* | Average N Rate lb N/acre | Average P Rate lb $P_2O_5$/acre | 0 | 20 | 40 | 60 |
| | | | bu/acre | | | |
| 70–100 | 79 | 47 | 177 | 184 | 186 | 183 |
| 101–140 | 115 | 75 | 198 | 198 | 196 | 204 |
| 141–180 | 161 | 99 | 193 | 198 | 193 | 196 |
| 180–207 | 194 | 120 | 206 | 199 | 211 | 202 |

*Ranges across eight sites and two manure application rates at each site.

not complete and are not discussed in this article. Two manure rates and a nonmanure check were applied to long strips, and small plots were superimposed to the manure strips to apply various P fertilization rates. Extra N and potassium fertilizer was applied to the entire area of the small plots to mask any effect of these nutrients in the manure. The manure application rates were planned to apply approximately one-half and the full amount of estimated N needs of corn (based on analyses of total N in the manure). Details about manure nutrient concentrations and corn response to manure were given in the Spring 2003 newsletter article.

Table 1 shows corn response to four supplemental P fertilizer rates after applying manure. Because the actual P amount varied across sites and treatments, the results across locations are summarized for several ranges of N-based manure rates. The lower manure-N application range (70–100 lb N / acre) applied on average an amount of P equivalent to the P removed by a corn yield of about 150 bu / acre. The higher manure rates applied amounts of P that were up to 4 times the P usually removed by an average corn crop. The yield data showed no significant yield response to supplemental P fertilization, although there was a small responsive trend for the lower manure application range. The initial soil-test P values were highly variable within a site, but at most sites the average initial soil-test P before applying manure tested in the optimum (16–20 ppm, Bray-1 test) or higher interpretation classes for corn. These results demonstrate that manure application based on N needs of corn (usually 100–150 lb N / acre) supply excessive P for corn and sometimes enough P for two crops.

In these fields, manure and fertilizer P often increase early-season corn growth and plant P uptake (not shown), but these responses did not translate into higher grain yield. The P uptake response was mainly due to increased early growth compared with P tissue concentration. Previous research based on P fertilization also showed early growth responses at soil-test P levels higher than levels needed to maximize grain yield; however, factors other than P from the manure could explain early growth responses seen at some field sites.

Effects of manure applications on soybean yield were tested at eight locations in 2000–2002 (Table 2). Because most fields tested optimum or higher in soil-test P, a lack of soybean yield response at most fields is reasonable. There was a statistically significant response to manure application in one low-testing field (Clay County, in 2001). However, there was also a significant yield response in one high-testing field (Washington County, in 2002) and small responsive trends in other fields testing optimum or higher. These results coincide with results from other studies

**Table 2. Soybean grain yield as affected by liquid swine manure application.**

| Year | County | Yield and Manure Rate None | Low | High | Manure N and P Application Low | High | Low | High |
|---|---|---|---|---|---|---|---|---|
| | | bu/acre | | | lb N/acre | | lb $P_2O_5$/acre | |
| 2000 | Clay | 47 | 48 | 49 | 114 | 228 | 73 | 146 |
| | Webster | 42 | 44 | 45 | 91 | 182 | 58 | 115 |
| | Hardin | 54 | 54 | 55 | 62 | 83 | 41 | 100 |
| 2001 | Clay | 47 | 51 | 51* | 100 | 201 | 53 | 105 |
| | Washington | 50 | 47 | 52 | 114 | 201 | 68 | 125 |
| 2002 | Floyd | 60 | 60 | 61 | 147 | 271 | 103 | 189 |
| | Hamilton | 55 | 56 | 55 | 107 | 214 | 53 | 107 |
| | Washington | 58 | 65 | 65* | 124 | 249 | 95 | 189 |

*Statistically significant response to manure application.

**Table 3. Summary of soybean yield response to supplemental P fertilization after applying liquid swine manure for various manure application rates.**

| Manure P Range* | Average Rate Manure P Rate | Soybean Yield for Four Supplemental P Fertilizer Rates (lb $P_2O_5$/acre) | | | |
|---|---|---|---|---|---|
| | | 0 | 20 | 40 | 60 |
| lb $P_2O_5$/acre | | bu/acre | | | |
| 41–60 | 51 | 44.8 | 45.3 | 45.5 | 46.3 |
| 61–100 | 80 | 48.7 | 49.7 | 48.0 | 47.7 |
| 101–140 | 111 | 46.2 | 45.0 | 46.4 | 47.8 |
| 141–189 | 168 | 58.5 | 57.0 | 56.5 | 59.5 |

*Ranges across seven sites and two manure application rates at each site.

showing small soybean yield increases from manure application when soil-test P is high. Soybean yield response in high-testing soils is not observed when fertilizer P is applied. The response to manure is most likely due to complex, poorly understood nutritional and physical factors influenced by manure application (not the manure P itself).

Table 3 shows the soybean response to four supplemental P fertilizer rates after manure application. Because the actual manure P applied varied across sites and treatments, the results across locations are summarized for several ranges of manure P application rates. The lower manure application range (40–60 lb $P_2O_5$ / acre) applied an amount of P equivalent to the P removed by a soybean yield of about 60 bu / acre. The higher manure rates applied as much P as 3.5 times the P usually removed by an average soybean crop. The yield data showed no significant yield response to supplemental P fertilization. These results also demonstrated that manure application ahead of soybean can be used to supply the needs of this crop and to build up P if needed, but also can apply unneeded high N rates. Evaluation of the effects of manure application at rates greater than P removal in grain of one crop on the yield of second-year crops (not shown) indicates that the manure-P is available in the second year and that producers should account for it when planning for the next crop.

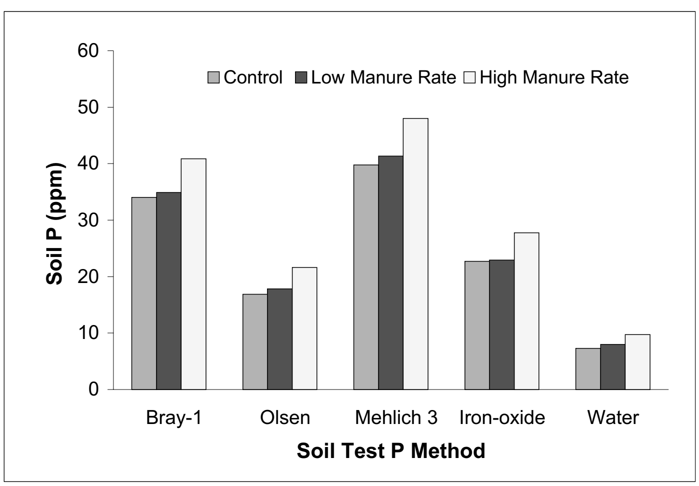



Figure 1. Effect of the liquid swine manure application rate on post-harvest residual soil P as measured by three routine tests (Bray-1, Olsen, and Mehlich-3) and two environmental tests (iron-oxide impregnated paper and water extraction).

**Effect of manure applications on soil-test P.** An additional component of the demonstration is to evaluate manure effects on soil P measured by commonly used agronomic soil tests and environmental P tests. Although P losses from fields are not being measured in this project, there is the need to assess the impact of manure application on soil P because of possible impacts on P loss from fields. Environmental tests are not designed to assess plant-available P, and relationships between these tests and P loss from fields are being assessed in other projects conducted by Dr. Mallarino and his graduate students. For example, a test based on P extracted by shaking soil with water could provide better estimates of amounts of dissolved P lost from manured fields with surface runoff or tile drainage than the agronomic tests. A test based on P extracted by iron-oxide–impregnated paper gives a different estimate of bioavailable P than routine agronomic tests. Preliminary results of this project summarized in Figure 1 (averages across all sites) show that all tests detected little change in postharvest soil-test P levels after low manure application rates. These rates were planned to maintain soil-test P levels based on expected P removed in grain harvested from one crop. However, manure application rates that supplied more P than one crop year of the rotation increased postharvest soil-test P levels measured by all tests. Increases in soil-test P provide an indication of the high crop availability of P in liquid swine manure. The results demonstrate that excess manure P applied for one crop increased available P for the second crop of the rotation.

The three agronomic soil P tests used in Iowa (Bray-1, Olsen, and Mehlich-3) and two environmental P tests provided similar estimates of the relative effect of manure application on soil P, even though the tests extracted widely different amounts of P. Correlations among all agronomic and environmental P tests were high (Figure 2). The trend lines also reveal no difference in soil test performance for nonmanured and manured soils other than the soil P level. Agronomic and environmental tests seemed similar in estimating P availability in fertilized or manured soils. However, the water environmental P test was less sensitive to changes in soil P caused by manure P application compared with the other tests.

These preliminary results suggest that all soil P tests adequately evaluate the impact of swine manure on soil P (once amounts of P extracted are considered through appropriate field calibrations). Previous research showed that the agronomic soil P tests are better correlated to yield response from soil nutrient additions. Producers are advised to use the currently recommended routine soil tests (Bray-1, Olsen, and Mehlich-3) for both agronomic and environmental assessments of the impact of manure on soil P.

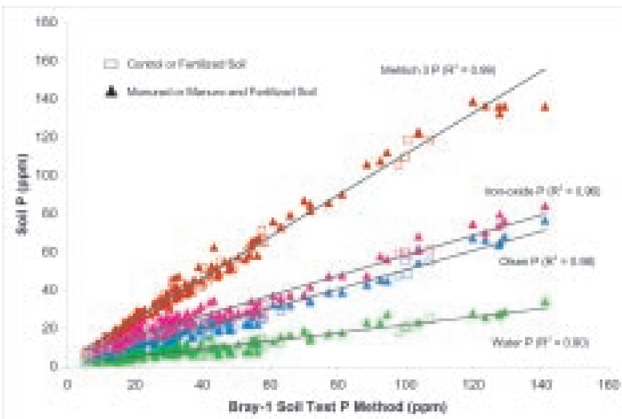



Figure 2. Correlations between soil P measured with three routine tests (Bray-1, Olsen, and Mehlich-3) and two environmental tests (iron-oxide impregnated paper and water extraction) for manured and unmanured soils.

**Summary.** This project is documenting the importance and value of liquid swine manure as a nutrient source for crop production in Iowa. Following a comprehensive approach of preapplication manure sampling and laboratory analyses, manure sampling during application, and calibrated rate applications, it is feasible to agronomically provide crop N and P nutrient needs of crops from swine manure. Soil testing to determine crop-available P and to provide information for environmental P management can be accomplished with routine agronomic soil P tests on soils receiving swine manure. Results from these 3 years also confirm that best management of liquid swine manure should consider practices that enhance achieving desired manure rates for providing N or P, minimize potential for loss, and closely estimate rates of N or P needed for crop production.

*The ISU Swine Manure Nutrient Utilization Project, part of the Integrated Farm/Livestock Management (IFLM) Demonstration Program, receives funding from the Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation, USDA Natural Resources Conservation Service, and the Leopold Center for Sustainable Agriculture.*

*This is the fourth and final article in this series. The first three articles highlighting efforts of this project can be accessed in the Fall 2002, Winter 2002 and Spring 2003 Odor and Nutrient Management Newsletters available online at http://www.extension.iastate.edu/Pages/communications/EPC/.*

# Regional Animal Manure Management Working Group

*by John Lawrence, Iowa Beef Center*

The Heartland Regional Water Quality Coordination Initiative is a USDA-funded project to coordinate water quality efforts of land-grant universities, EPA, USDA, and regulatory agencies in Missouri, Iowa, Nebraska, and Kansas. The project will strengthen multistate and interagency partnerships and enhance resources focused on federal, state, and local water quality improvement efforts in EPA Region 7. The project will target three primary water quality themes: animal manure management (AMM), nutrient and pesticide management, and community involvement in watershed management. Visit our Web site at http:/ www.heartlandwq.iastate.edu.

The AMM theme has two main objectives centered on recent changes in federal regulations and national guidelines:

- Assist state regulatory agencies and federal partners within EPA Region 7 with integration of new federal concentrated

animal feeding operation (CAFO) regulations and comprehensive nutrient management plan (CNMP) guidelines into state rules.
- Expand the understanding of public and private sector livestock industry advisors concerning federal and state CAFO regulations and the tools to implement those regulations.


**Dewatering solids settling basin at beef feedlot.**

Each state in the Heartland region will evaluate their current CAFO regulations and make necessary changes to comply with the new federal rules. Likewise, the Natural Resources Conservation Service (NRCS) has implemented new guidelines in CNMPs and technical service providers. There are opportunities for states to learn from one another as well as for the scientific community to learn how to address these changes.

The AMM working group is collecting appropriate resources relevant to the implementation of proposed CAFO regulations and CNMP guidelines. These resources will be reviewed and shared electronically via the project Web site. Outreach efforts targeting private and public sector advisors for the purpose of introducing CAFO regulations and appropriate implementation tools are being coordinated on a regional basis. Additional needs and opportunities will be identified for communication of land-grant university science with regulatory staff to support implementation plans.

The AMM group has already well under way with three activities. First, a steering committee with representation from regulatory agencies and extension in each state, NRCS, and EPA have been identified and are holding monthly conference calls to share information and identify priorities for the group.

Second, the steering committee identified an immediate need for a workshop to facilitate regional discussions about implementation of CAFO regulations and consistency between state regulatory agencies. Held April 21 and 22 in Nebraska City, NE, the workshop gathered state agency regulatory staff, NRCS representatives, and extension staff to share current scientific-based and related resources relevant to implementation of the CAFO regulations. The presentations focused on four specific CAFO topics: phosphorous regulation, setback requirements, alternative performance standards, and NRCS nutrient planning. The presentations are posted to the AMM Web site at http://www.iowabeefcenter.org/heartlandwq/home.htm. Additionally, the workshop helped promote communication and possible collaborative activities among technical resource communities and regulatory agencies.

Third, conference participants indicated they would like to stay abreast of activities in the Heartland states, including updates on research and news from EPA and NRCS on CAFO and CNMP. The AMM group has developed a monthly newsletter that will be e-mailed to a list of people responsible for implementing the CAFO and CNMP programs in the member states. If you would like to be added to the AMM newsletter e-mail list, please visit our Web site to view the newsletter and register.

The steering committee is continuing to meet by conference call and will provide direction to the project. Additional workshops are being discussed as well as "train the trainer" programs for extension and industry consultants directly serving livestock producers.

**Web addresses**

Heartland Regional Water Quality Coordination Initiative
http:/www.heartlandwq.iastate.edu

Animal Manure Management
http://www.iowabeefcenter.org/heartlandwq/home.htm

# 2003 Manure Field Days, Demonstrations, and Workshops

*by Angela Rieck-Hinz, Department of Agronomy*

Manure management field days, demonstrations, and workshops provide many opportunities for producers, service providers, and agency staff to learn more about manure handling and storage, land application, equipment calibration, manure for crop production, potential impacts on water quality, residue management, and cost-share opportunities for nutrient management. If you have questions, please contact the person at the number listed in the table. For a complete list of field days and workshops, including links to more information, locations, and registration for events, visit the Iowa Manure Management Action Group events page at http://extension.agron.iastate.edu/immag/events.html.

| Date | Time | Location | Demonstration/Workshop | Contact Information |
|---|---|---|---|---|
| August 1, 2003 | 12:30 p.m. | Keith Miller Farms, 2/5 miles North of Hubbard, IA, on S-33 | Manure Application Demonstration | Kapil Arora, ISU Ag Engineer (515) 382-6551 |
| August 20, 2003 | 9 a.m. | Sportsman Restaurant, Oelwein, IA | Manure Digester Workshop | Registration required. Dan Meyer, ISU Ag Engineer (563) 425-3331 |
| August 22, 2003 | 10 a.m. | ISU Northwest Iowa Research and Demonstration Farm near Calumet | Manure Application Field Day in the morning. Simulated Manure Spill Response Field Day in the afternoon | Kris Kohl, ISU Ag Engineer (712) 732-5056 |
| August 26, 27 & 28 2003 in conjunction with Iowa Farm & Field Fest | 10:30 a.m. T-W-Th<br><br>2 p.m. T-W | Farm Fest Site east of Boone, IA, on Hwy 30 | Manure Application and Calibration Demonstration | Kapil Arora, ISU Ag Engineer (515) 382-6551 |
| September 3, 2003 | 1–4 p.m. | Bremer County Corn and Soybean Growers Plat—Junction of Hwy 63 and 188 | Manure Application and Calibration Demonstration. Speakers will discuss residue management, cost-share opportunities for manure management, and water quality issues | Darrin Siefkin, Bremer County Extension Director (319) 882-4275 or Angie Rieck-Hinz (515) 294-9590 |
| September 18, 2003 | 1 p.m. | ISU Northwest Research and | Manure Application and Calibration Field Day | Krist Kohl, ISU Ag Engineer, (712) 732-5056 |

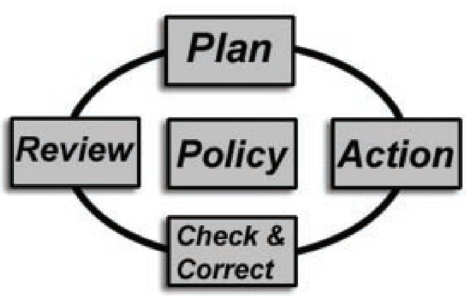
# Livestock Environmental Management Systems

*by John Lawrence, Iowa Beef Center*

A livestock Environmental Management System (EMS) is a systematic approach that identifies, corrects, and monitors the environmental performance of a livestock enterprise. It involves a continuous cycle of risk assessment, action planning, implementation, review, and improvement to fully integrate environmental responsibility into the business of farming. In a nutshell, it is a strategy to manage a farm for profits while incorporating environmental regulations and personal stewardship principles. It is not mandatory, nor is it a new regulation. Producers develop and implement their own EMS and self-check their implementation against their own plans and expectations.

Successful business plans start with a mission statement and involve a continuous process of management, including the following:

- assessing strengths and weaknesses,
- setting goals and objectives,
- identifying priorities and developing action plans,
- monitoring progress, and
- reviewing the plan for effectiveness.




An EMS involves the same steps. Everything revolves around the producer's Policy Statement, a commitment to regulator compliance, continuous improvement, and personal stewardship principles. The planning phase begins with a farm assessment, priority setting, and action plan. The producer then documents his or her implementation of the plan, monitors progress and corrects problems, reviews the plan periodically, and continues to work toward goals.

**Cows on earthen lot above solids settling basin.**

Experience in other industries has identified several benefits of an EMS. Companies with EMS improved their environmental performance in part because EMS helps companies meet regulatory compliance by keeping those regulations at the forefront and also because it helps companies implement their own stewardship principles and document the results. Producers have a strong stewardship ethic, and a formal EMS is an excellent way to document what they are already doing to protect and enhance the environment.

Experience from other industries also has taught us that an EMS can become very complex and burdensome to operate. But, it doesn't have to be difficult. The challenge is striking the balance between what is practical to implement and economically feasibly to maintain while producing meaningful outcomes that are beneficial to the environment. The goal of the Iowa livestock EMS project is to develop a "functional" EMS that is easy to adopt and effective in environmental protection.

Iowa is pursuing a functional livestock EMS along two parallel tracks. First, two stakeholder meetings were held in March to discuss the EMS concept with producers, agencies, and organizations representing producers and environmental groups. These round table discussions featured examples of

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EMS activities in Iowa as well as a producer-led initiative in Ontario, Canada, that has reached more than 20,000 farms in 10 years.

Second, four EMS workshops for open beef feedlots were held in March. Extension field staff recruited the participants. Thirty-seven feedlots attended the two-part workshop and worked through a step-by-step guidebook on EMS development. At the first workshop, producers began developing their policy statements and discussed on-farm assessments. Before the second workshop, producers completed their policy statements and conducted assessments with extension staff. At the second workshop, they shared their policy statements, discussed the priorities they identified through the policy statements and assessment process, and worked on developing objectives and action plans to address their priorities. Jim Venner has been hired as the project coordinator to work one-on-one with producers implementing EMS on their farms. Jim will follow up with participants on a regular basis to provide encouragement and direct them to technical advice as needed. Producers will meet again in the fall to discuss their progress and share experiences.

Many livestock producers are concerned about evolving environmental regulations and are waiting for direction and / or cost share assistance from USDA. The producers who attended the workshop are using EMS to take control of the process. They cannot change the regulations, but they can develop and implement a plan to manage the environmental aspects of their operations.

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