

Odor

and Nutrient Management



Dietary phytase study shows positive results

by Larry McMullen, Jones County Extension; and Sherry Hoyer, Iowa Pork Industry Center

A yearlong demonstration project on the effect of dietary phytase on phosphorus levels in manure has yielded positive results. In the study, funded by the Iowa Pork Industry Center, phytase was fed to finishing pigs in treatment and control groups. In general, positive results were seen in several areas: phosphorus content in liquid manure was reduced by more than 23 percent over that of control diets, phytase inclusion did not reduce pig performance as measured by average daily gain and feed efficiency ratios, and phytase inclusion did not increase the cost of the diet.

Phytase is an enzyme that breaks down the indigestible phytic acid (phytate) in grains and oil seeds and releases more digestible phosphorus that pigs can use. By reducing the unused portion of phosphorus in feed, less phosphorus is eliminated in manure, which is important for producers because of water quality concerns due to phosphorus in manure moving off-site and into surface waters. It is possible that future manure management plans in Iowa will



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require producers to address phosphorus application rates. If phosphorus-based rather than the current nitrogen-based plans are required, it could take approximately twice the land base for manure application.

When choosing to use phytase, producers must be aware of the correct or appropriate levels of phosphorus at specific levels of the production stage, which means the amount of inorganic phosphorus sources (for example, dical) can be reduced in the diet.

Phytase activity is measured in “phytase units” such as FTU/lb or FTU/kg. Currently, if a corn-soy diet is being fed to finishing hogs, the inclusion of phytase in the diet would be approximately 115 to 150 FTU/lb of diet fed. Adding phytase to swine diets is easy because premixes containing phytase are readily available from most commercial feed companies. However, you must remember to calculate and review feed rations to make sure you are not overfeeding inorganic phosphorus sources in the diets. As a rule of thumb when feeding phytase in swine diets, the percentage of reduction of the inorganic phosphorus will be the amount of phosphorus reduced in the swine manure.

Reducing phosphorus in swine manure through the use of dietary phytase has several environmental advantages. In addition to reducing the crop acres needed for manure application, this practice can help to limit the buildup of soil phosphorus levels. Also, it helps reduce potential water pollution due to nutrient

runoff and leaching. And, if a phosphorus-based manure management plan is approved by the Iowa legislature, using phytase will enable producers to comply with state regulations.

Although this study shows promising results in terms of reducing phosphorus levels in manure by including phytase in the diets, there are factors that affect the level of phosphorus reductions in different operations and even in different buildings within the same operation. One of these factors is related to feed ingredient variation and amounts, such as levels of phosphorus, calcium, and protein in a specific diet. Also, using an incorrect ration formulation for phosphorus and calcium with phytase might affect the reduction. And, the amount of manure dilution with wastewater can easily distort or change a projected or expected reduction level.

Regardless of whether you are using phytase in your swine diets, for the correct manure application rate for your acres, have the manure analyzed for nitrogen, phosphorus, and potassium. Do not guess on the analysis because nutrient levels can vary. Applying appropriate amounts and keeping accurate records are imperative, and if there is a switch to phosphorus-based levels, your record keeping skills will be just as important.

For more information on this project, call (319) 462-2791 or e-mail lkcmull@iastate.edu

Project specifics

- Four trials of grow/finish pigs, conducted from November 1999 to December 2000.
- Location was room 1 of the Kirkwood Community College finisher unit in Cedar Rapids.
- Each trial had a control diet group and a phytase diet group. Approximately 50 head were allocated to each diet group per trial.
- Each diet group had a separate manure pit for accurate measuring. Initial water level in each pit was equalized to 30 gallons per pig to give a 5–6-inch beginning level.
- Liquid and solid manure samples were collected every 2 weeks for each diet group.

Project implications

- Phytase addition did not impair pig performance.
- Diet costs were not increased.
- Liquid and solid phosphorus levels were reduced significantly with phytase addition: phosphorus in liquids (–23.16 percent), phosphorus in solids (–17.60 percent), P_2O_5 in liquids (–22.1 percent), P_2O_5 in solids (–17.79 percent).
- With a 22 percent reduction in liquid manure P_2O_5 level, a manure management plan based on phosphorus that required 100 acres would now need only 78 acres.



Manure management demonstration at Thole-Humphrey Farm

by Eric Palas, Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

What are all those orange stakes doing in your field? This question has been a common one for Don Thole this spring. Although the field in question may have looked like a housing development early in the season, it is actually the site of a manure management demonstration. The goal of the demonstration is to gain insight into the crop nutrient value of the dairy manure Don hauls and spreads.

Manure provides a good source of nitrogen (N), phosphorus, and potassium for crop production. Because manure is a concentrated source of these nutrients, proper management of this resource also has become an environmental concern. Refining commercial fertilizer and manure applications can have a major impact on a farm's bottom line, as well as on the water quality of Ensign and Hewett creeks.

One of the first steps in the demonstration was to determine the amount of manure being spread. ISU Extension nutrient management specialist Chad Ingels used a set of portable scales to calibrate Don's manure spreader in April. After determining the loaded weight of the spreader, Chad measured the area Don covered with manure and reweighed the empty spreader. A sample of the manure was then collected and submitted for laboratory analysis.

Based on the calibration, Don was spreading 17.8 tons of manure per acre. The laboratory analysis showed that for each ton of manure, 13 pounds of N, 6 pounds of phosphate, and 10 pounds of potash were applied. The significance of the nutrient value of the manure becomes apparent. A total of 231 pounds of N, 107 pounds of P_2O_5 , and

178 pounds of K_2O was being applied per acre from the manure.

Half of the plot area was spread with manure. A conservative first-year N credit of 88 pounds per acre was used. This number was determined by first multiplying the total of 231 pounds of N available in the manure by the 40 percent or the first year N availability

for dairy manure (according to ISU Extension publication PM 1811, *Managing Manure Nutrients for Crop Production*) to equal 92 pounds of N. The next step was to determine the N availability based on the type of manure



application. Because the manure was incorporated within 24 hours of application, approximately 95 percent of the total N would be available for crop growth, or $0.95 \times 92 = 88$ pounds of N. If the field had a history of manure applications in recent years, a larger N contribution from manure would have been estimated. The plot is approximately a half-acre. Aside from not applying any commercial N, Don has managed the corn exactly as he would normally treat his crop acres.

Various increments of N were hand applied after planting in April. Each plot treatment is roughly six rows in width by 40 feet in length and is replicated three times within the demonstration. In June, the late-spring test for soil nitrate was used to estimate the amount of available N within the plot treatments. This test is conducted when the corn plant is 6–12 inches in height at the whorl. Results of 20 parts per million (ppm) or more generally indicate sufficient amounts of available N for corn production. Results are shown in Table 1.

Table 1. Late-spring soil nitrate test results from Thole-Humphrey demonstration for 2001.

Plot Treatment	ppm
Check (no manure, no N)	13.9
Manure only	19.6
Manure plus 50 pounds of N	31.6
Manure plus 100 pounds of N	36.5
Commercial N at estimated manure credit value	35.9
100 pounds of commercial N	36.4

Table 2. Corn yields from eight manure management demonstrations for 2000.

Plot Treatment (8 sites)	bushels/acre
Check (no manure, no N)	131
Manure only	149
Manure plus 50 pounds of N	157
Manure plus 100 pounds of N	154
Commercial N at estimated manure credit value	152
100 pounds of commercial N	149

Based on the results of the test, all of the treatments except for the check area seemed to have adequate amounts of available N this spring. The end-of-season cornstalk test will help determine whether there was adequate N available to the crop throughout the growing season. Corn yields will provide another key source of information from the plot. Approximately 20 feet of the middle two rows of each treatment will be hand-harvested and weighed after crop maturity this fall. Similar demonstrations were conducted at eight sites in the Maquoketa River Watershed during the 2000 crop season. Average corn yields for the

spreading the manure on the right acres, and making the necessary adjustments to commercial N applications once the manure is applied. The demonstration conducted this crop season provides a key source of information for this purpose.

This article was adapted from the Ensign Hollow II Watershed Project Summer 2001 Newsletter. For more information on this demonstration call (563) 245-1048.

Photo by Charles Wittman, Maquoketa River Watershed Project.

eight sites are shown in Table 2.

A good rule of thumb is that each cow and her replacement in a dairy herd produce enough N from manure to fertilize 1 acre of corn at a 150-pound N rate. Because Don and his family milk more than 100 cows, the manure that is produced by the dairy herd has the potential to meet the N needs of a significant portion of Don's corn acres. It is just a matter of properly collecting, storing, and

Producers learn value of manure sampling and use on crop acres

by Greg Brenneman, Johnson County Extension; and Sherry Hoyer, Iowa Pork Industry Center

A recent study designed to educate Iowa producers on how to better use swine manure as a fertilizer and to encourage them to test their manure for nutrient content before applying it has produced some unexpected positive results. Study leaders Greg Brenneman and Kris Kohl say these results should help producers realize that manure sampling need not be difficult to

be effective; a simple collection procedure can be used without affecting the accuracy of the sampling.

The two Iowa State University Extension agricultural engineers designed the study that was funded by the Iowa Pork Industry Center. Manure sampling of deep pits was conducted at 20 locations throughout Iowa, and five different samples from each pit were

compared. A profile sample and a surface sample were taken prior to land application and three samples were collected while the pit was being pumped. Profile samples were collected with a probe and surface samples were collected with a bucket.



and the surface sample is a better predictor of nitrogen content, producers should plan to use the surface sampling technique that requires only a plastic pail. Although book values can be used to estimate nutrient content of deep pit manure, doing the individual pit testing provides the most

accurate and timely levels. Samples were analyzed at a commercial laboratory and the results were somewhat surprising. Not only was there less variability within a pit than expected but also many of the samples showed higher nutrient content values in the surface sample than the profile sample. These data were combined with similar data from a separate project in Sioux County and analyzed at the ISU Statistical Lab to determine the best presampling technique for assessing nutrient content of manure to be field-applied. The combined results show that, when looking for nitrogen prediction, a sample collected from the pit surface was superior to the probe (profile sample) of the pit. For P_2O_5 , the profile sample was better, although the difference was small.

Manure testing is an important management tool for determining the correct rate of manure application to fields for optimum crop yields, without causing environmental damage. Because all manure studies show variation between pits, producers get the best results by conducting their own testing. The ideal time for collecting manure samples is during agitation and land application, but average laboratory turnaround time is 10 to 14 days. By the time the analysis reaches producers, the manure application is complete and no rate adjustments are possible.

Because most producers are applying swine manure based on its nitrogen content,

and the surface sample is a better predictor of nitrogen content, producers should plan to use the surface sampling technique that requires only a plastic pail. Although book values can be used to estimate nutrient content of deep pit manure, doing the individual pit testing provides the most

accurate and timely levels. A second part of the study involved field trials with swine finishing manure as the sole source of fertilizer for corn following soybean. In 1999 and 2000 at two different locations, fall-injected swine finishing manure applied at approximately 4000 gallons per acre produced as high or higher yields than normal rates of commercial fertilizer. Also, addition of more manure or nitrogen did not result in additional yield.

Data from this study help validate the reliability of manure testing and help make recommendations regarding sampling prior to pumping out a pit. By knowing the amounts of specific nutrients in the manure from their operation, producers gain confidence in using swine manure for meeting their crop nutrient needs.

Results of this study also should encourage more producers to accurately and easily test for nutrient content and use the manure as a valuable fertilizer source for their crop acres. Project findings are being summarized and will be included in upcoming confinement site manure applicator certification programs offered by ISU Extension.

For additional information about manure sampling, see the article *Sampling and agitation of swine manure pits* in the Fall 2000 issue of this newsletter.

Calibrating manure spreaders

by Jeff Lorimor, Department of Agricultural and Biosystems Engineering

As manure application issues become more critical, it is important to know exactly how much manure you are applying, and that you are applying the manure uniformly. If you do not know how much manure you are spreading, you are probably not using the manure effectively.

Research in northeastern Iowa with farmer producers showed that they often thought they were applying significantly less than they actually were. Calibrating your spreader is a simple, effective way to know that you are doing what you think you are when you pull onto a field. Whether you spread solid or

liquid manure, you should calibrate your spreader.

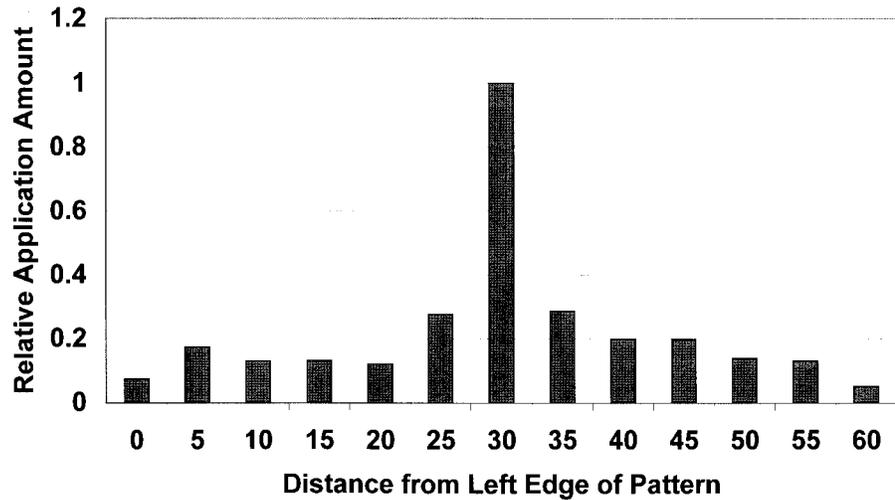
One way to calibrate a solid manure spreader (20 percent or more solids) is the tarp method. All you need is a bucket, a 56-inch by 56-inch tarp, and a set of small scales. First, weigh the bucket and tarp to get a tare weight. Then spread the tarp on the ground and drive over, and next to, the tarp while spreading manure. Make three passes; the first centered exactly over the tarp then one on each side. Be sure the tarp is always within the spread pattern. Weigh the bucket, tarp, and manure, and subtract the tare weight. Because the 56-inch by 56-inch tarp is 1/2000th of an acre and a ton is 2000 pounds, the weight you read from the scale equals tons per acre. Repeat the procedure at least three times. You can change application rates by changing speeds and swath widths, but be careful about changing swath widths because that also changes the uniformity across the field. As manure gets wetter it gets heavier, so your application rates change with different manures.

Another way to calibrate either liquid or solid spreaders is to weigh and apply an entire load, or loads, either with portable scales (if you can find some) or by pulling across a commercial scale such as those at grain elevators. Measure the area covered, length \times width (in feet), and multiply the two dimensions to get square feet. Divide by 43,560 to get acres. Divide the manure weight by the acres to get pounds per acre. To get gallons per acre for liquid manure, divide your pounds per acre by 8.34. To get tons per acre for either liquid or solid, divide your pounds per acre by 2000.

The other calibration concern is uniform distribution across the width of the spreader pattern. The distribution should be as uniform as possible, taking into account the overlaps of adjacent passes. To determine uniformity and optimum overlap of broadcast systems, place a line of small, equally spaced pans or trays across the spreader path. They should be fairly large and shallow. Cookie or cake pans, or cafeteria trays work well. The number needed depends on the spread width but plan on a minimum of five pans. Figure 1 shows results of placing 13 pans across the 60-foot spread width of a dry poultry manure spreader.

Figure 1. Dry manure distribution across width of spread.

**Double Spinner Poultry Manure Applicator Pattern
Average of Two Machines**



Injectors that place the manure below the ground surface can be calibrated for overall application by weighing as described above. Determining distribution is more difficult because the trays cannot be used very well. The best way to determine distribution with injectors is to place a bucket under each injector and run the applicator in one spot for several seconds. See whether every bucket has the same amount of liquid in it. This type of uniformity check is especially important when low application rates are being used. If your injector has a rotating valve or other mechanism in the distribution manifold to ensure uniform distribution, check it anyway. It should be OK, but calibrating is your insurance policy for getting a good application.

Calibrating always seems like a nuisance for applicators, but it can yield big benefits. It will either confirm that you are doing a good job, or you might discover a problem that you can fix to improve the job you are doing. Either way, you win by calibrating.





Changes in manure applicator program

by Karen Grimes, Department of Natural Resources

Three major changes in the Iowa Department of Natural Resources' Manure Applicator Certification program went into effect on July 1, 2001. Commercial applicators and confinement site applicators need to be aware of how these changes will affect the certification program and their training needs in the future.

Universal expiration date. Starting July 1, 2001, a universal expiration date of December 31 kicked in for all manure applicator certificates. Commercial applicators whose certificates started expiring on July 1, 2001, can expect to be extended to December 31, 2001, if they have completed their 3 hours of annual training. There will be no charge for this extension and the applicator should receive a new certificate in the mail. Those who have not completed their annual training should complete the required 3 hours of annual training before their certificate expires. Commercial applicators whose certificates expire this year should not send money, but they can send in their application forms marked "for training verification only." Current commercial applicators whose certificates expire between January 1 and June 30, 2002, will pay a reduced fee of \$25 next spring and be extended to December 31, 2002. This fee reduction will give them the same kind of financial break that the other commercial applicators are getting this year.

Private or confinement site applicators who have a 3-year certificate will automatically be extended to December 31 of the year that their certificate expires. For the majority of confinement site applicators, this date will be December 31, 2002. Confinement site applicators still need to complete their annual 2 hours of training or pass a test at the end of the 3-year period.

Grace period. Another change in the program provides for a 2-month grace period after the expiration date. This grace period means that commercial and confinement site applicators can still legally apply manure until March 1 following the expiration of their certificates on December 31, but they must complete their training or test, and send in the application and fee postmarked by March 1.

Commercial applicators should plan to attend the satellite downlink training on January 8, 2002, to qualify for their 2002 certificate. They can contact their local Iowa State University Extension office to determine the nearest training location. Specific dates for confinement site training will be listed in the Winter 2002 issue of this newsletter.

Family farm fee exemption. Another change in state rules allows members of the same farm family to be eligible for free confinement site applicator certificates.

Confinement site applicators who farm the same agricultural operation with a spouse, parent, grandparent, child, grandchild, or sibling can qualify for a free certificate, provided one member of the family has a paid certificate. The person who applies for the free certificate must apply within a year of when the paid member was certified and complete annual training or pass a test once every 3 years.

Other rule changes mean that producers who lose their certificates can expect to pay a \$15 fee for a duplicate certificate. There also will be a late fee of \$12.50 for any renewal applications postmarked after March 1.



Gravity unloading slurry stores are now legal

by Karen Grimes, Department of Natural Resources

Producers can now legally use gravity unloading of aboveground manure storage systems in Iowa because of a new rule passed by the Environmental Protection Commission in June. Producers can use gravity to pump these out, provided they implement the following practices:

- two or more shutoff valves on external outlets or inlets below the liquid level, with at least one of the valves located inside the structure;
- a protective barricade around all external outlets or inlets;
- construction that complies with the manufacturer's requirements; and

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- an emergency response plan that indicates how manure will be retained and cleaned up if the structure fails or there is an accidental discharge.

The emergency response plan should include the Department of Natural Resources (DNR) phone numbers that must be called to report a manure release or spill, and a list of contractors, equipment, technical support, and alternative sites that can be used for storage or land application in bad weather.

The phone numbers that producers should call include any of the following DNR field offices during normal work hours: Manchester at (563) 927-2640, Mason City at (641) 424-4073, Spencer at (712) 262-4177, Atlantic at (712) 243-1934, Des Moines at (515) 725-0268, or Washington at (319) 653-2135. After normal work hours, producers should call DNR at (515) 281-8694 and contact their local police department or county sheriff's office. Spills or manure releases must be reported as soon as possible but not later than 6 hours after the release occurred or was discovered.

For more information about developing an emergency response plan, please review a copy of ISU Extension publication PM 1859, *Emergency Action Plans*. This publication is available by contacting ISU Extension Distribution Center, 119 Printing and Publications Building, Iowa State University, Ames, Iowa 50011-3171, phone (515) 294-5247, Fax (515) 294-2945.

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... and justice for all

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