MSU Pork Quarterly

Vol. 9, No. 2 — *"Information for an industry on the move!"* — 2004

"Water Use Reporting & Methods of Estimating Water Use for Swine Operations"

Lyndon Kelly, MSU Extension Groundwater Agent & Jerry May, MSU Extension Swine Agent

Two recently enacted Michigan laws (P.A. 177 & P.A. 148) will require annual water use reporting to the State by many farm operations. Over time these Acts should provide information that will assist with the State's response when small well user's voice concerns aimed at large well users. These public acts reflect changes to the Natural Resources & Environmental Protection Act (NREPA) and fall under the enforcement provisions defined therein. Copies of Michigan P.A. 177 and P.A. 148 may be found at http://www.michiganlegislature.org .

Both acts use the like definition for a "large capacity well". Large capacity wells are those with the **capacity** to withdraw 100,000 gallons per day (70 gallons per minute) average in any consecutive 30-day period. The combined capacity of more than one well at one site, which when totaled is 100,000 gallons or greater per day capacity, also meets the large capacity well definition. These laws apply to all agricultural water uses including animal watering and cooling, and facility washing.

Well capacity may be found on the well-log filed with the county health department when the well was established, or in the owner's manual of the well's pump.

This new legislation requiring users of "large capacity wells" to file annual reports has several sections that pertain to swine producers. These Pubic Acts will require all hog farms with wells meeting the "Large Capacity" (70 gallons per minute **Capacity**) threshold to report the following information:

a) **The amount and rate of water withdrawn on an annual/monthly basis in either gallons or acre-inches (**acre-inches is applicable to crop irrigation only).
b) **The type of crop irrigated, if applicable.**
c) **The acreage of each irrigated crop, if applicable.**
d) **The source or sources of the water supply** (well water for swine operations, a description of your well is contained in the Well Log written by your well driller at installation).
e) **If the water withdrawn is not used entirely for irrigation, the use or uses of the water being withdrawn** (examples: animal watering, cooling and facility washing).
f) **If the source of water withdrawn is groundwater, the static water level of the aquifer or aquifers needs to be identified** (the original static water level at installation may be found in the Well Log or maybe measured, a certified well driller is required if the well must be opened).
g) **Applicable water conservation practices and an implementation plan for those practices** (examples include wet/dry-feeders,

(Continued on page 2)

What's Inside ...

This newsletter is edited by:
Ronald Bates, MSU Extension Swine Specialist
(517-432-1387) batesr@msu.edu
& Kathy Lau, MSU Animal Science Office Assistant III

Funded by The Animal Initiative Coalition Grant Program

water saving watering systems, pre-wash soaking devices for cleaning, or other devises that reduce water usage).

Methods of Estimating Water Use for Swine Operations

Beginning in 2004 all swine farms with "Large Capacity" wells will be required to file an estimate of monthly water consumption used for production purposes. In December 2004, the Michigan Department of Agriculture will be requesting that these farms file records indicating estimates of the water used per month throughout 2004. The following information will help farms estimate water consumed by the swine operation. Water used for pig production may be broke down into Direct and Indirect uses.

Direct Water Use- Book values

Direct water use is drinking water offered to swine through the watering system. Consumption may be estimated by using book values or measured through use of flow meters or water use monitors. Table 1 is one set of book values for estimating daily drinking water consumption by pigs. The lower ranges would be used in cooler months on farms using water conservation practices (ie cup waters, wet/dry feeders) the higher ranges would be used for warmer months on farms not using water conserving practices. Midwest Plan Service, *MWPS-8* Page 69, and the *Tri State Swine Nutrition Guide,* Page 10, are also acceptable sources of book values.

Table 1: Water requirements of pigs*

Animal type	Gal/head/day	Animal type	Gal/head/day
Sow and litter	2.5 - 7	Finishing pig (100 – 250# BW)	3 -5
Nursery pig (up to 60# BW)	.7	Gestating sow	3 -6
Growing pig (60 – 100# BW)	2 - 3	Boar	8
		Replacement Gilt	3

**Swine Care Handbook:* National Pork Board, 2002, pg. 33

Direct Water Use – Flow meter or water use monitors

Some swine producers use flow meters to monitor water consumption on a daily or weekly basis as a management practice. These records may be used to calculate monthly water use.

Indirect water Use - Flow rate multiplied by time used

Cleaning and cooling water may be actually measured by a flow meter, or estimated by using the water flow rate multiplied by usage time. Power washers, pre-wash soaking devices, and cooling systems may have flow ratings listed in the owner's manual, or may be measured by capturing and measuring output for one minute. Records of wash time may be multiplied by the flow rate to estimate total water used for cleaning. Pre-wash soaking devices and cooling systems often have run timers as part of the control panel, or the run time may be calculated from a record for typical week then multiplied by the flow rate or output.

Example- Estimate of water use by book values

Fred owns a 150 sow farrow to finish operation. The following chart gives Fred's July inventory for each stage of production, the estimated daily water consumption for each stage, and the monthly totals. (Head x daily water consumption x number of days = monthly total) The chart also shows the water used for soaking, washing, and cooling.

Fred's monthly water estimate for July using book values

Stage of production	Head	Daily consumption		Monthly total – gal.
Sow and litter	30	(6 gal/sow)	180	5,580
Gestating sows	120	(5 gal/sow)	600	18,600
Gilts	10	(3 gal/gilt)	30	930
Nursery pigs	300	(0.7 gal/head)	210	6,510
Growing pigs	600	(2.5 gal/head)	1,500	46,500
Finishing pigs	600	(4 gal/head)	2,400	74,000
		Direct use water		152,120

Indirect use	Run time	Gallons/time unit*	
Wash farrowing	4 hours	2.5 gal/min	600
Wash nursery	3½ hours	2.5 gal/min	525
Pre-soak finisher	2 hours	(10 units) 0.5 gal/min	600
Wash finisher	4 hours	2.5 gal/min	600
Finish barn misters	140 hours	0.02 gal/hd/hr	3,360
Farrowing drippers	140 hours	0.75 gal/sow/hr	3,150
		Indirect use water	8,835
		Direct use water	152,120
		Monthly total	160,955 gal.

*From owners manual

Flow Meter
A flow meter may be used to measure both direct and indirect water use depending on where the meter is placed in the water line. Water flow meters use either impellers or sonar for estimating water flow through the pipe. These meters are available from farm suppliers and industrial supply houses.

Example- Estimate of water use by flow meter
Allen installed a flow meter in the main water line that all water for the swine operation flows through. He calibrated the unit per the owner's manual and has scheduled an annual re-calibration. His monthly and annual totals are contained in the following chart.

Allen's monthly and annual water estimates from flow meter

Month	Monthly Total	Month	Monthly Total
January	433,200	July	657,600
February	428,400	August	712,200
March	445,800	September	479,400
April	451,200	October	447,000
May	474,400	November	441,400
June	507,000	December	435,600
		Total Annual Water Usage	5,913,200 gal.

Timer on the well pump

Run timers track the number of minutes or hours that the pump actually runs. The run time is then multiplied by the pump's capacity at the average system pressure. Most water systems pump against a pressure tank, regulated by a pressure switch. The average of the low pressure "on" and the high pressure "off" setting may be checked against the pump's output curve, found in the owner's manual, to arrive at an estimate of the system's capacity.

Example-Timer on the well pump

Jim has a 4,000 head finishing facility sharing the site and well with the house. His Well Log for the system shows a capacity of 80 gallons/minute, requiring him to file annual reports. The well pressure switch has an "On" setting of 40psi., an "Off" setting of 60psi., for an average of 50psi. The pump's output curve, from the owner's manual, shows a flow of 70 gallons/minute at 50psi. Jim estimates his home water use at 250 gallons/day (91,250 gallons/year)

Jim's monthly an annual water use estimate from timer on pump*

Month	Run time (min.)	Monthly Total	Month	Run time (min.)	Monthly Total
January	6,077	425,390	July	5,303	371,210
February	5,317	372,190	August	6,135	429,450
March	5,579	390,530	September	6,512	455,840
April	6,150	430,500	October	6,290	440,300
May	6,005	420,350	November	5,649	395,430
June	6,230	436,100	December	5,874	411,180

Total Annual Water Usage 4,978,470 gal.

Less Water Used for Household Purposes (91,250) gal.

Total Annual Water Usage for Swine Production 4,887,220 gal.

(Run time in minutes) x (70 gallons/minutes).

"Animal Identification in the Pork Industry"

Ronald Bates, State Swine Specialist, Michigan State University

After the identification of Bovine Spongiform Encephalopathy (BSE) in European cattle, Foot and Mouth Disease outbreaks in Europe as well as the tragedy of September 11, 2001 the U.S. government became much more aware of how disease outbreaks and possible terrorist attacks could threaten the U.S. Food Supply and the commerce that moves it from the farm to the consumer. These concerns were further heightened with the identification of a cow in Canada with BSE and later another cow in the state of Washington.

It has become apparent that if a major disease outbreak or catastrophic event occurs within the U.S. livestock sector the only means to reduce its impact on the country would be to be able to know where a suspect animal originated and what movement it had incurred, so that isolation and quarantine programs could be enacted. To quickly identify all animal movement within the U.S. and back track the movement of animals to their birth place, a national identification system must be developed, along with data base systems, that could, within 48 hours, provide all the necessary information regarding herd of origin and when, where and how a particular animal had been transported and housed during and after transportation.

The USDA is developing a United States Animal Identification Plan (USAIP) that has as its ultimate goal that every animal will be identified and its origin and its movement to different locations and change of ownership cataloged. This information will be stored such that if a suspect animal is identified for a catastrophic disease or condition, the animal in question can be traced back to its herd of origin and identify all other animals it had been in contact and all other locations where the animal in question had been, within 48 hours.

This is an ambitious plan and one that will take several years to complete through multiple phases. Different livestock industries will have different challenges to try an implement such a plan. The swine industry is in a lead position for such a plan due to existing federal regulations that require identification for interstate transportation. These rules were developed in the late 1980s and were critical for the eradication of pseudorabies. For swine, the USDA will build upon existing regulations and create the appropriate databases to track information.

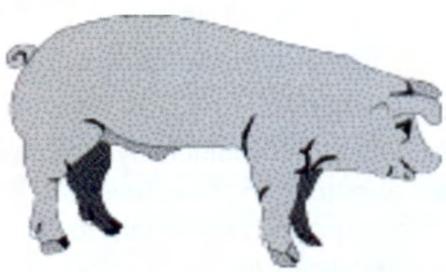
The USDA plan has three phases that will be implemented over a period of approximately 3 years. Phase I will assign Premises ID's for all farms and all physical locations where animals are assembled including, markets, holding facilities, exhibitions etc. Within Phase I, all breeding swine will have a visual ID (probably an ear tag) with the premises ID. The individual animal ID can be added to the premises ID. For purposes of the program the "last premises" ID must be on the visual ID of breeding animals. Groups of pigs sold into the market place or moved from one location to another can be identified with the premises ID on a bar code or some other similar means of identification with the paper work that accompanies them. In phase I there will be no need to individually identify animals managed in groups if not meant for breeding stock. However, if producers choose to, they can.

The second phase will develop a Group/Lot ID system for species, like swine, that are managed as groups/lots and are kept together throughout their production history. This Group/Lot ID will be added to the Premises ID so to differentiate different Groups/Lots within a premise. Information contained within a Group/Lot ID will include the initiation date of a Group/ Lot ID, the number of animals included within a particular Group/Lot, dates and numbers when further animals are entered or removed and the date a Group/ Lot is completed.

The third phase will be the implementation of extensive date tracking. In essence, Phase III will be the development of tracking systems to use the data being cataloged for individual animals and animal groups within and across premises. This step will develop the ability to determine, within 48 hours after a suspect animal has been identified, all locations and animals it had been in contact with.

The program has been initiated with cattle being the primary target species to begin Phase I. State Departments of Agriculture are responsible for assigning premises codes in coordination with the national plan. At this time, cattle farms in Michigan are being assigned premises ID codes along with sale barns, feed yards etc. USDA had planned that premises ID codes would be assigned for swine farms during the summer of 2004. However, at this time it appears that this will be delayed by 3-6 months. However, sometime in the near future all pork producers, contract feeding operations, buying stations and other places that house swine will be contacted by the Michigan Department of Agriculture and assigned a premises code.

The U.S. swine industry will be a part of the national plan for livestock identification for tracking to mitigate a significant animal health event, should one occur. All sectors of the swine industry will be impacted and producers and agribusiness associated with the markets should be preparing to incorporate these new regulations into their businesses.



"Evaluating Distiller's Dried Grains with Solubles[a]"

Jerry Shurson, University of Minnesota & John Goihl, Agri-Nutrition Services, Shakopee, MN

[a]Published with permission from National Hog Farmer, March 15, 2003 edition

New generation DDGS is a corn co-product produced by relatively new dry mill ethanol plants in the Midwest. It is nutritionally different from corn gluten feed and corn gluten meal produced by wet mill ethanol plants. This is an important distinction because some corn co-products are being marketed as DDGS — but they are really different corn co-products produced under different processing methods. For example, one product being marketed as DDGS is really corn gluten feed with some corn gluten meal added.

University of Minnesota research has shown that true DDGS is an excellent alternative feed ingredient for swine in all phases of production. It is also a good value compared to the cost of the feed ingredients it partially replaces in typical swine diets — corn, soybean meal and dicalcium phosphate. With a projected 66% increase in DDGS supply by 2005, supply will be plentiful throughout much of the Midwest.

Producers are most interested in the feed cost savings and other benefits DDGS offer. We'll focus on seven questions related to the economic value of DDGS in swine diets:

1. **How does price of DDGS compare to corn, soybean meal and dicalcium phosphate?**

   The price of DDGS, like all other feed ingredients, is determined by a variety of external factors that affect supply and demand. Commodity traders establish the market price based on protein and energy value. DDGS prices track corn and soybean meal prices fairly closely.

   Since DDGS has traditionally been used more in the dairy industry, it has been valued more for its by-pass protein content than its energy value. However, simply basing your decision on cost/lb. of protein when comparing the price of DDGS to other ingredients will undervalue its energy and phosphorus value and overvalue protein in swine feeds. Phosphorus is the third most expensive nutrient in swine diets.

   One of the main advantages of using DDGS in swine diets is its relatively high available phosphorus content (0.66%) compared to other grains and grain co-products. This high available phosphorus level enables nutritionists to use less supplemental inorganic phosphate (e.g. dicalcium phosphate) to reduce diet cost while meeting the pigs' phosphorus needs.

2. **What's the energy value of your source of DDGS?**

   The three nutrient categories of greatest economic importance in swine diets are energy, amino acids and phosphorus. Research at the University of Minnesota has shown that new generation DDGS has a high metabolizable energy (ME) value (1,527 kcal/lb.) that is comparable to corn (1,550 kcal/lb.). However, depending on the source, the energy value can be substantially lower.

   For example, in a recent University of Minnesota report, the calculated ME value of DDGS obtained from an "old generation" ethanol plant was 1,405 kcal ME/lb. (approximately 92% of the energy value of new generation DDGS). The National Research Council "Nutrient Requirements of Swine" 1998 publication lists the ME value of DDGS at 1,210 kcal/lb. (79% of the value obtained for new generation DDGS).

   By using high quality, new generation DDGS, virtually no additional supplemental fat is needed to maintain desired dietary energy levels in typical corn-soybean meal diets.

Recent economic analysis at Kansas State University suggests grow-finish diets containing 15% new generation DDGS (1,527 kcal/lb.) could result in more than a $1/pig increase in margin over feed costs compared to traditional corn-soybean meal diets.

3. **What are the total and digestible amino acid values of your DDGS source?**

The total amino acid levels, especially lysine, in DDGS are important for determining the economic value. The higher the lysine, the more soybean meal it can replace in the diet. Like all feed ingredients, the nutrient content of DDGS varies among sources. However, once you've identified your source and the nutrient profile, you can be relatively precise in your diet formulations.

Lysine is the most variable amino acid in DDGS. In a recent University of Minnesota study, DDGS samples were obtained from 10 new generation ethanol plants and analyzed for nutrient content, including total lysine. The range in total lysine levels varied from 0.63% to 0.90% (average: 0.73%). It appears that much of the variation in total lysine content is related to the normal variation in lysine content of corn being delivered to plants.

If we use the average lysine, methionine + cystine, threonine, and tryptophan values found in the Minnesota study, and calculate values that are 10% below and 10% above these average values, this range would be typical of the variability in amino acid values among new generation DDGS sources (Table 1).

Using the nutrient values in Table 1, grower diets (0.85% total lysine) were formulated on a digestible amino acid and available phosphorus basis using 200 or 400 lb./ton of new generation DDGS. The composition and cost of these diets are shown in Table 2.

Compared to a typical corn-soybean meal diet containing 3 lb. of synthetic lysine/ton, adding 200 lb. of DDGS/ton of complete feed will reduce diet cost by 19¢/ton. This cost savings is realized because adding 200 lb. of DDGS/ton will replace 177 lb. of corn, 19 lb. of soybean meal and 6.5 lb. of 18.5% P dicalcium phosphate using the ingredient prices listed. Doubling the amount of DDGS will double the cost savings. Using this formulation approach, there is a 31¢/ton difference in diet cost savings when using a DDGS source high in lysine compared to the low lysine source at an inclusion rate of 200 lb./ton. The spread in DDGS value between the low and high lysine values used in this example is $3.10/ton of DDGS (low lysine, $83.40/ton vs. high lysine, $86.50).

4. **Do you formulate diets on a total amino acid or a digestible amino acid basis?**

The method used to formulate DDGS diets will greatly affect its value in swine diets. Many nutritionists formulate corn-soybean meal-based diets to achieve a desired level of total lysine and total phosphorus. Using this approach, adding 200 lb. of DDGS to a typical early grower diet (1,486 kcal ME/lb., 1.0% lysine, 0.55% P) will replace 162 lb. of corn, 36 lb. of 44% soybean meal, and 5 lb. of dicalcium phosphate (Table 3). Using prices shown in Table 3, this would result in a feed cost savings of $1.40/ton of complete feed over a typical corn-soybean meal diet with 3 lb. of synthetic lysine added. Under this scenario, you could afford to pay an additional $14/ton for DDGS ($99/ton) and break even with the cost of the typical diet.

If a 10% DDGS diet is formulated on an apparent digestible amino acid basis using amino acid and available phosphorus values obtained from Minnesota research, you replace more corn (177 lb.), less soybean meal (19 lb.), and more dicalcium phosphate (7 lb.) compared to formulating DDGS diets on a total lysine and phosphorus basis. The net result is that because more corn ($3.57/cwt.) and less soybean meal ($9.50/cwt.) is being replaced by DDGS, the cost savings is reduced to 62¢/ton compared to the typical corn-soybean meal diet used in this report. This means that you could afford to pay an additional $6.20/ton for DDGS ($91.20) using this formulation method, and break even with the cost of the typical diet.

5. **What are the total and available phosphorus values of your DDGS source?**

   Like energy and amino acid levels, phosphorus levels can also vary — as low as 0.62% to as high as 0.87% (average: 0.78%). One of the primary reasons for variability is the variable amount of solubles (high in phosphorus) added to the distiller's grains before drying at various ethanol plants.

   University of Minnesota research places phosphorus availability at 90%, while the NRC (1998) lists the availability at 77%. Because of the economic significance of phosphorus in swine diets, and its impact on manure management plans, diets should be formulated on an available phosphorus basis. This approach takes advantage of the available phosphorus provided by DDGS, thereby reducing the need for supplemental dietary phosphorus and phosphorus excretion in manure.

6. **Do you use phytase in your diets?**

   As shown in Table 4, adding 225 FTU of phytase/lb. of complete feed and 376 lb. of DDGS (18.8%) to a swine grower diet (containing 0.85% total lysine), no supplemental dicalcium phosphate is needed when the diet is formulated on an available phosphorus basis. However, diet cost would be slightly increased by $0.11/ton compared to feeding a typical corn-soybean meal diet containing 3 lb. of synthetic lysine and no phytase. Using new generation DDGS and phytase is an economical and practical way to significantly cut phosphorus levels in manure.

7. **How much DDGS do you want to use?**

   Most pork producers who are feeding diets containing DDGS are using a rate of 5 to 10% in grow-finish and lactation diets, and up to 20% in gestation diets. Based on current feed ingredient prices, the cost savings increase as more DDGS is used.

However, when adding more than 10% DDGS, diets must be formulated on a digestible amino acid and available phosphorus basis in order to ensure good performance and to capture the economic savings. Using this approach, DDGS can be successfully fed at levels greater than 10% of the diet and support excellent pig performance while reducing phosphorus content in swine manure.

Finally, formulating on a digestible amino acid and available phosphorus basis results in a more conservative assessment of the economic value of DDGS in swine diets.

For more information on feeding DDGS, visit the University of Minnesota DDGS Web site: www.ddgs.umn.edu.

Editor's Note: Producers using DDGS in swine diets in Michigan must account for the increased available phosphorus in this feedstuff. Please read questions 4, 5 and 6 carefully to better understand how this feedstuff should be used in swine rations in Michigan.

Table 1. Average 10% Below Average and 10% Above Average Total and Apparent Digestible Amino Acid Levels in DDGS.

Nutrient	Avg DDGS Amino Acid Levels	10% Below Avg DDGS Amino Acid Levels	10% Above Avg DDGS Amino Acid Levels
Met. Energy, kcal/lb	1,500	1,500	1,500
Crude Protein, %	27.0	24.3	29.7
Lysine, %	0.73	0.66	0.80
App. Dig. Lysine, %	0.39	0.35	0.43
Meth + cys, %	0.99	0.90	1.09
App. Dig. Meth+cys, %	0.52	0.47	0.57
Threonine, %	0.99	0.90	1.09
App. Dig. Threonine, %	0.55	0.49	0.60
Tryptophan, %	0.21	0.19	0.23
App. Dig. Trypt., %	0.14	0.12	0.15
Phosphorus, %	0.78	0.78	0.78
Avail. Phosphorus, %	0.66	0.66	0.66

Table 2. Comparison of Diet Composition and Cost When Using Average 10% Below Average, 10% Above Average Apparent Digestible Amino Acide Levels to Formulate Diets When Adding DDGS at 10% and 20% of the Diet Compared to a Typical Corn-SBM Diet Containing 3 lb. of Synthetic Lysine.

Ingredient[a]	Corn-SBM + 3lb of lysine	Avg Lysine 200lb/ton	Low Lysine 200lb/ton	High Lysine 200lb/ton	Avg Lysine 400lb/ton	Low Lysine 400lb/ton	High Lysine 400lb/ton
Corn, lb	1596.6	1419.0	1415.5	1422.4	1241.3	1234.5	1248.1
SBM 44%, lb	353.7	334.4	337.9	331.0	315.2	322.0	308.3
DDGS, lb	0	200	200	200	400	400	400
Dical, Phos., lb	23.2	16.6	16.6	16.6	16.6	16.6	16.6
Limestone, lb	14.5	18.0	18.0	18.0	18.0	18.0	18.0
Salt, lb	6.0	6.0	6.0	6.0	6.0	6.0	6.0
L-Lysine HCL, lb	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Vit Premix, lb	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total, lb	2000	2000	2000	2000	2000	2000	2000
Total Cost, $	96.25	96.06	69.22	65.91	95.87	96.19	95.56
Difference, $	——	-0.19	-0.03	-0.34	-0.38	-0.06	-0.68

[a]Feed ingredients prices used: corn=$2.00/bu, DDGS=$85/ton, soybean meal (SBM) 44%=$165/ton, Dicalcium Phosphate (Dical. Phos.)=$12.50/cwt, limestone=$1.75/cwt, salt=$6.90/cwt, L-Lysine HCL=$1.00/lb, Vit. Premix=$117/cwt.

Table 3. Composition and Cost of Grower Diets Containing 10% DDGS and Formulated on Total Lysine and Phosphorus Basis or Digestible Lysine and Available Phosphorus Basis Compared to a Typical Corn-SBM Diet Containing 3 lb of Synthetic Lysine.

Ingredient[a]	Corn-SBM +3 lb Lysine	10% DDGS Formulated on a Total Lysine Basis	10% DDGS Formulated on a Digestable Lysine Basis
Corn, lb	1463	1301	1286
SBM 44%, lb	482	446	463
DDGS, lb	0	200	200
Dical, Phos., lb	24	19	17
Limestone, lb	14	17	17
Salt, lb	6	6	6
L-Lysine HCL, lb	3	3	3
Vit Premix, lb	8	8	8
Total, lb	2000	2000	2000
Total Cost, $	109.80	108.40	109.18
Difference, $	—	-1.40	-0.62

[a]Feed ingredients prices used: corn=$2.00/bu, DDGS=$85/ton, soybean meal (SBM) 44%=$190/ton, Dicalcium Phosphate (Dical. Phos.)=$15/cwt, limestone=$1.75/cwt, salt=$6.90/cwt, L-Lysine HCL=$1.00/lb.

Table 4. Composition and Cost of Grower Diets Containing DDGS and Phytase, Formulated on an Available Phosphorus Basis, Compared to a Typical Corn-Soybean Meal Diet Containing 3 lb of Synthetic Lysine.

Ingredient[a]	Corn-SBM with 3 lb Lysine	DDGS+Phytase
Corn, lb	1596.6	1272.6
SBM 44%, lb	353.7	318.8
DDGS, lb	0	376.0
Dical, Phos., lb	23.2	0.0
Limestone, lb	14.5	19.6
Salt, lb	6.0	6.0
L-Lysine HCL, lb	3.0	3.0
Vit Premix, lb	3.0	3.0
Phytase, 225 FTU/lb	0.0	1.0
Total, lb	2000	2000
Total Cost, $	96.25	96.36
Difference, $	—	+0.11

[a]Feed ingredients prices used: corn=$2.00/bu, DDGS=$85/ton, soybean meal (SBM) 44%=$190/ton, Dicalcium Phosphate (Dical. Phos.)=$15/cwt, limestone=$1.75/cwt, salt=$6.90/cwt, L-Lysine HCL=$1.00/lb, Phytase 1000 FTU/g-$1.38/lb.

"Feeding Phytase to the Breeding Herd to Manage Phosphorus"

Dale Rozeboom, State Swine Specialist, Michigan State University
Tom Guthrie, MSUE AoE Swine Agent, Jackson

Identification of the Issue

Heightened awareness of the impact that swine production systems may have on the environment has led to an increased emphasis on the management of phosphorus. Phytase is an enzyme manufactured specifically for inclusion in swine and poultry diets to reduce phosphorus excretion and pollution. The addition of phytase to swine grower-finisher diets is well documented. However, less is known about its usefulness in other phases of production. As more environmental constraints are being imposed on swine producers, the use of phytase in breeding herd diets is frequently becoming a topic of discussion.

Phytase Mode of Action

Phytase is an enzyme that breaks down the indigestible phytic acid (phytate) in grains and oil seeds. Physiologically, pigs do not produce phytases. Therefore, pigs are unable to utilize this unavailable form of phosphorus which is commonly present in vegetative feedstuffs such as corn and soybean meal. Approximately 2/3 of the phosphorus in a corn-soybean meal diet is phytate phosphorus. Phytase breaks down the phytate molecule, improving phosphorus digestibility, and increasing phosphorus utilization by the pig. Consequently, less supplemental phosphorus is needed in the diet and subsequently less phosphorus is excreted by the pig.

Research Results

Little research concerning the effectiveness of feeding sows phytase to reduce phosphorus excretion has been conducted at universities. The commercial feed industry is believed to have conducted more studies into this topic and consequently secured current general recommendations to feed phytase to the breeding herd at 500 FTU/kg and keep available phosphorus in sow diets at least 0.48%.

Overall, what we do know from public research is this. Phytase in sow diets improves digestibility of phosphorus by sows in late gestation and lactation, and decreases the amount of phosphorus excreted in lactation, both expected responses which have been seen with growing-finishing pigs. However inclusion of phytase, does not significantly change phosphorus digestibility when fed during early to mid gestation, and does not affect reproductive performance (Kemme et al., 1997a; Kemme et al., 1997b, Bowers et al., 2001; Baidoo et al., 2003; and Sulabo et al., 2004).

In more detail, the research accumulated to-date suggests that the improvement of phosphorus digestibility in sows varies by reproductive stage and is quantitatively different than the response in growing-finishing pigs. Kemme and coworkers (1997) reported that phytase (500 FTY/kg) improved apparent total tract digestibility of phosphorus 1.03, 0.83, 0.74, and 0.66 g/kg of diet for lactating sows, growing-finishing pigs, d 100 gestating sows, and nursery piglets, respectively. So in this study the increase in P digestibility with phytase was greatest for the lactating sow (21.5%), next greatest for the growing-finishing pig (17.2%), then the sow in late gestation (15%) and then the nursery piglet (13.6%). They saw no improvement in phosphorus digestibility when phytase was provided to gestating sows in mid gestation (d 60). Why digestibility varies across stage of production and why gestating sows in early to mid gestation may not experience increased digestibility with phytase are not understood presently, but the later finding was recently confirmed by Sulabo et al. (2004), who also observed no improvement in apparent total tract phosphorus digestibility during early and mid gestation with phytase supplementation (500 FTU/kg). CAUTION. This is not enough evidence to conclude that phytase should not be fed for the first two trimesters of gestation, but it

(Continued on next page)

1. **Jerry May, North Central Swine Agent**
Farm Records, Productions Systems
(517) 875-5233

2. **Ron Bates, State Swine Specialist**
Michigan State University
(517) 432-1387

3. **Dale Rozeboom, Swine Extension Specialist**
Michigan State University
(517) 355-8398

4. **Barbara Straw, Extenstion Swine Veterinarian**
Michigan State University
(517) 353-9831

5. **Roy Kirkwood, Extenstion Swine Veterinarian**
Michigan State University
(517) 432-5198

6. **Roger Betz, Southwest District Farm Mgt.**
Finance, Cash Flow, Business Analysis
(616) 781-0784

7. **Tom Guthrie, Southwest Swine Agent**
Nutrition and Management
(517) 788-4292

All comments and suggestions should be directed to:

MICHIGAN STATE UNIVERSITY EXTENSION

raises questions that need further investigation before gestation diets can be reformulated to more accurately benefit from phytase use.

Lactation is the phase of production where the evidence from phytase research is most clear thus far. In lactation, there is a substantial improvement in phosphorus digestibility by supplementing phytase, as first shown by Kemme and others (1997a and 1997b). Baidoo and others added phytase (500 FTU/kg) and decreased dietary P (from 0.74% to 0.54%; a 27% decrease) in the diet of lactating sows (Baidoo et al., 2003). They reported that under this protocol, total phosphorus in the feces of lactating sows fed phytase was decreased by 27.1% as compared to the feces of sows not fed phytase.

Implications

Phytase may be fed to the breeding herd. The amount that total manure phosphorus content will be decreased is not known for sure, because we do not know if we are getting a consistent decrease in phosphorus excretion in gestation. So for the time being, it would be safe to follow the recommendations mentioned earlier in this article. Feed phytase to all phases of the breeding herd at 500 FTU/kg and keep available phosphorus in sow diets at least 0.48%, or about 0.65% total phosphorus in a corn-soybean meal diet. Expect refinement in these recommendations as more is learned about the response of the gestating sow to supplemental phytase.