pork checkoff®

Practical Ideas
to Address High Feed and Production Costs

Inside: Related Pork Checkoff Research

PRACTICAL IDEAS TO ADDRESS HIGH FEED & PRODUCTION COSTS

Introduction

Pork producers are facing high production costs primarily due to rising corn and soybean prices, which greatly affect feed costs. However, there are ways to combat this challenge at the farm level – even one that comprises roughly two-thirds of production costs. So, with that in mind, the Pork Checkoff has compiled management tips and resources, along with relevant Checkoff-funded research, to assist producers in identifying opportunities to increase on-farm efficiencies and reduce costs.

There are many resources available to find ways to reduce production costs. These include contacting your state's swine extension specialist, nutritionist or veterinarian for additional information and regional recommendations. Also, websites such as **pork.org** (under the Resources and Research tabs) and the Pork Information Gateway, **www.porkgateway.org,** are great places to find valuable information on this and related topics.

Another good reference is the *Pork Industry Handbook*. It contains more than 270 science-based and cutting-edge articles for pork producers and related industries Produced by swine experts at Purdue University and 18 other land-grant universities, the *Pork Industry Handbook* is also underwritten by the National Pork Board, in cooperation with the U.S. Pork Center of Excellence. The revised version of is available in both print and DVD versions. Also, the new *National Swine Nutrition Guide* offers practical nutrient recommendations and feeding guidelines. The guide consists of nutrition factsheets and diet formulation and evaluation software. The guide was written as a collaboration between university swine nutritionists and swine industry specialists.

As always, producers should keep in mind that decreasing feed and production costs is very complex and should be considered carefully. The focus should be on production practices that optimize feed costs and efficiencies while maximizing profitability.

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FEED PROCESSING & MANUFACTURING

Decrease feed particle size

For every 100 micron change in particle size, feed efficiency is impacted by 1.2 percent. Decreasing particle size from 750 microns to 600 microns will result in substantial savings per pig. In most cases, this particle size is not fine enough to worry about ulcer problems, but feed dust will be increased. For more information on analysis of particle size, go to **http://www.asi.k-state.edu/DesktopDefault.aspx?tabid=1225**. Spreadsheets and guidelines for calculating particle size are available on this site. For a fact sheet titled, "Effects of diet particle size on animal performance", go to **http://www.oznet.ksu.edu/library/grsci2/mf2050.pdf**. Similar information may be found at other universities. Contact your local extension educator for assistance.

Improve pellet quality

Fines cause feed wastage but feed utilization and efficiency can be improved by implementing a quality pelleting process that ensures less than 20 percent fines at the feeder. Research at Kansas State University shows that pelleted diets result in more highly available nutrients, less dust, less feed wastage, better feed conversion and lower incidence of ulcer problems. Always check the cost of pelleting against expected efficiency gains to determine if pelleting is economically beneficial. For more technical information, go to **http://jas.fass.org/cgi/content/abstract/73/3/757**.

Maintain equipment for optimal efficiency

Rotate or replace hammers in the hammer mill to ensure consistent particle size. Also, make sure rolls on the roller mill are properly maintained for the desired particle size. Make sure that mixing equipment is maintained so that distribution of nutrients is ensured throughout the entire volume of feed. Also, calibrate and maintain the scales for weighing pigs and feed at least twice per year.

Consider use of wet-dry feeders

Wet-dry feeders may reduce feed wastage and dust due as pigs can wet the feed to the consistency they desire. Palatability also is improved over dry diets thereby increasing consumption and performance in some cases. For the article titled, "Impact of feeders and drinker devices on pig performance, water use, and manure volume", go to **http://www.aasv.org/shap/issues/v8n2/v8n2p51.html.**

Repair or replace broken feeders

Broken or damaged feeders can result in excess costs due to feed wastage or inadequate feed provisions for the pigs resulting in poor performance. Consider replacing older or inefficient feeders with well designed, efficient feeders that minimize feed wastage and promote maximum performance.

Adjust feeders to reduce waste

Adjusting feeders to reduce feed wastage should be a routine practice. Minor adjustments of feed bins and transport systems can also result in big savings. Kansas State University recommends the following steps for proper feeder adjustment:

- Close feeder completely after cleaning before putting any feed in the feeder
- Open feeder just enough to start small feed flow
- Shake feeder to increase amount of pellets or meal in pan (to cover 1/3 of pan)
- Clean corners daily instead of increasing feeder adjustment to increase feed flow
- Prevent moisture damage and spoilage in feed systems and storage
- Eliminate all rodents, birds and other pests

For feeder adjustment cards showing properly adjusted feeders for nursery, grow-finish and lactation, go to **http://www.asi.k-state.edu/desktopdefault.aspx?tabindex=1007&tabid=889.**

For a useful reference on how to prevent feed waste, go to **http://www.thepigsite.com/articles/6/production-and-mgmt/2169/management-practices-to-reduce-expensive-feed-wastage.**

FEED MANAGEMENT

Monitor feed ingredients for potential mycotoxin contamination

Scientists have identified several mycotoxins that cause significant, detrimental health and performance problems in swine fed contaminated plant based feedstuffs. Fungal infestation and subsequent mycotoxin production can occur during plant growth, maturity, harvesting, storage and processing of grains, and is influenced primarily by moisture level, temperature, and availability of oxygen. In addition, grain that is damaged, immature, drought stricken or otherwise stressed is more susceptible to mold growth. For more information, see **http:www.extension.umn.edu/distribution/livestocksystems/M1179.html.**

Monitor feed allocations or budgeted amounts and utilize least-cost formulations

Follow feed budgets aggressively to ensure accurate compliance for each class of pig. Inaccurate rations or incorrect budgets decrease efficiencies and increase costs. For example, rations that have mistakes due to inaccurate scales or measurement or rations that are formulated for the incorrect class or pig weight are inefficient and increase costs. Formulating diets with economic costs in the equation, as well as modeling input requirements, will allow the development of diets at optimum performance and the least cost of ingredients. There are always trade-offs, so it is important to be aware of any detrimental effects of diet formulation on overall cost and/or performance. For a standard feed budget chart based on a feed efficiency of 2.8 from 50 to 250 pounds, visit the Swine Nutrition Guide available at **http://www.oznet.ksu.edu/library/lvstk2/MF2301.pdf.**

Reevaluate phase feeding and options for split sex feeding

Review all protocols for each ration phase. Make sure your weight categories and genetic description fit your current rations for each phase as closely as possible. Consider split-sex feeding to further increase feed efficiency. Both of these techniques can improve the accuracy of your rations and increase your production efficiencies. Consider finishing rations that limit or eliminate excess nutrients just prior to slaughter to lower feed costs on your heaviest weight hogs just prior to market.

Target sows' nutrients

Improve sow productive lifetime by targeting diets for different parity ranges. Diets should have higher protein and energy levels for replacement gilts through parity two to prevent excess mobilization of body reserves during lactation. As sows become older, micronutrients (zinc, copper, iron, etc.) become critical nutrients that need to be maintained at high levels in order to maximize production efficiency. Consider the added costs of adding additional feed storage and delivery equipment in gestation and lactation and strategies to sort and feed sows accordingly against the benefits of targeting sow nutrition more accurately and efficiently.

To order sow body condition posters, contact the Pork Checkoff at (800) 456-7675 or visit the **pork.org** Web site. For an article titled, "Feeding strategies for lactating swine", go to **http://nationalhogfarmer.com/mag/farming_feeding_strategies_lactating/.** For the publication, "The changing mineral status of high producing sows—what are their needs and when are the critical periods?" go to **http://www.livestocktrail.uiuc.edu/uploads/porknet/papers/MWSNC%20Proceedings-2006.pdf.**

Decrease/eliminate feed outages

Feed outages significantly impact the efficiency of feed utilization in pigs. The frequency and duration of feed outages needs to be assessed and should be minimized or eliminated whenever possible. For an extension publication titled, "Out of feed events in grow-finish pigs: Causes and consequences", go to **http://ianrpubs.unl.edu/swine/ec05-219.pdf.**

Make measuring of feed intake/ wastage part of the work routine.

While difficult to measure feed intake on individual pigs, pen feed intake should be monitored continually to quickly recognize feed wastage, pen health problems, water quality/availability, ventilation challenges and other issues.

Check water flow and quality often

Water is an often-overlooked essential nutrient of pigs. Inadequate flow or availability of water or poor water quality can seriously impact performance or even cause death. Waterers should be easily accessible and checked regularly. Be sure waterers are delivering the designed volume at the proper rate. Check waterers furthest from the well head as this is the point at which pressure is likely to be the poorest. Excessive water use is also inefficient because it has to hauled or pumped as manure. An extension publication on suggested daily water intake and water quality guidelines is titled, "Water: the essential nutrient", and is available at **http://agebb.missouri.edu/commag/swine/water.htm.** This information also is available in the PQA Plus program. Download the PQA Plus manual at **http://www.pork.org/Producers/PQA/PQAPlusEdBook.pdf.**

Practice proper feed withdrawal prior to marketing hogs

Consider withdrawing feed from pigs to be marketed for up to 12 hours prior to when the pigs are scheduled to be processed to save on feed consumed, lighten the actual live weight of the hogs marketed and to enhance average carcass quality. For medicated feed, follow recommended withdrawal times for feed additives to prevent costly carcass condemnations, disruption of market channels, bad publicity for the pork industry or costly rejections of pork in foreign markets. Inadvertently including an ingredient that requires a withdrawal period may force a producer to feed a group of hogs longer than desired which adversely impacts feed efficiency. For more information, see the PIG fact sheet on feed additives at **www.porkgateway.org.**

Use DDGS when available at cost effective prices

Distillers dried grains with soluble (DDGS) are readily available in most areas where pigs are fed and corn is grown. Where transport distance is feasible and product quality and variability can be verified, these byproducts are usually available at competitive prices. Be careful with feed formulation. Typical DDGS have only about 90 percent of the nutrient value of corn with a poor amino acid balance. Follow guidelines for inclusion rates closely.

Recommended levels of DDGS in swine diets – University of Illinois

Stage of Production	Recommended Level (% of diet)
Gestation	40
Lactation	20
Early Nursery	0
Late Nursery	20
Growing	20
Early Finishing	20
Late Finishing	20

From Stein, H.H. 2007. Distillers dried grains with solubles (DDGS) in diets fed to swine. Swine Focus #001, Department of Animal Sciences, College of ACES, The University of Illinois at Urbana-Champaign.

Sows and older market hogs can utilize higher percentages of DDGS in their ration. However, high levels of DDGS in market hogs may negatively impact carcass quality. In proceedings from the 2007 Al Leman Conference, J.E. Pettigrew suggests the following:

- Buy DDGS from one or a few plants with which you have developed a relationship
- Buy only light-colored DDGS
- Buy only DDGS in which lysine is at least 2.8 percent of crude protein
- Avoid DDGS with a high level of "syrup balls"

For additional technical information on feeding distillers grains to livestock, go the University of Minnesota's Web site at **http://www.ddgs.umn.edu/info-swine.htm.** South Dakota State University, the University of Illinois, and other universities have done considerable research work with DDGS. For more information, contact your local extension service professional.

Look for alternative feed ingredients

There are alternative feedstuffs and byproducts available in many areas. Some of these have become very competitive with high grain prices. However, determine the nutritional profile of an alternative feedstuff and its feeding value at the price quoted before you decide to use it. Also, make sure to understand the form in which it will be delivered so extra labor or machinery is not required to make it practical. Examples of alternative feedstuffs include bakery products, glycerin (byproduct of biodiesel manufacturing), poultry fat, etc. A publication, "Alternative feed ingredients for pigs" can be viewed at **http://www.londonswineconference.ca/proceedings/2007/LSC2007_SteindeLange.pdf.** A resource from the Prairie Swine Center is available at **http://prairieswine.usask.ca/database/pdf/34493.pdf.**

Use crystalline amino acids to replace protein ingredients

The cost of many crystalline amino acids such as lysine, methionine, tryptophan and threonine have decreased to the extent that replacement of soybean meal in the diet can result in a very palatable, semi-synthetic diet for the pigs with real cost savings. Producers should aggressively monitor ingredient prices and reformulate rations accordingly. An extension publication titled, "Role of crystalline amino acids in reducing grow-finish feed costs" can be found at **http://porkcentral.unl.edu/amino.pdf.**

Reduce traditional animal protein sources in starter diets for pigs

Animal protein sources should be strictly budgeted in starter diets. Research from North Dakota State University suggests that lower cost, nutrient-dense, high performance, transition pig starter diets can be effectively prepared using reduced levels of spray-dried animal plasma, soy protein concentrate, spray-dried blood meal and dried whey when high energy hull-less oats and hard red spring (HRS) wheat are selected as basal grains. The nutrient-dense ingredients to use in pig starter formulations will depend largely on availability and current economics. For more information, go to **http://www.ag.ndsu.nodak.edu/dickinso/research/2000/swine00a.htm.**

Reformulate rations based on energy - review animal requirements for both energy and amino acid levels

Historically, protein has been the most expensive component of a swine ration. Today, energy costs are higher in many rations than protein. Consequently, producers should pay close attention to both the energy and protein costs in the diet to meet the nutritional requirements of their pigs. Rations should be reformulated as often as ingredient prices change. Currently for most producers, energy is the single most critical nutrient because it is the most expensive to provide in the diet. All other nutrients, including protein, are now less expensive and can always be included in amounts that meet or exceed the pig's requirement for optimum growth. For more information on energy in swine rations, go to **http://www.thepigsite.com/articles/1/health-and-welfare/1532/evaluating-the-impact-under-commercial-conditions-of-increasing-dietary-energy**

Evaluate the use of antimicrobials, enzymes, acidifiers and other non-nutritive additives.

Feed grade antimicrobials have been used for many years in numerous production systems to improve growth and efficiency in nursery and grow-finish hogs. Always follow the label requirements and monitor withdrawals closely. Certain enzymes when added to the ration may help to enhance efficiency. Acid blends and feed medications fall in this category as well. These opportunities should be evaluated for value in each operation. Understand the biological activity to best match the enzyme to your production system and watch for consistency and nutritive value issues with any enzyme or additive. Consider that these compounds may produce the largest return on your feed dollars invested if they produce even a small improvement in growth and/or efficiency in your rations. Now is the time to use all reasonably priced products that have a proven positive effect on feed efficiency. For more information on acidifiers, visit the Pork Checkoff's Web site for a copy of the document, "A Critical Review of Acidifiers" by C.M. Tung and J.E. Pettigrew or click here **http://www.pork.org/ResearchDetail/541/CriticalRevieHwofAcid.aspx.**

Explore possible alternative sources of fat

The advantages to added fat in the diet are well established. However, there may be lower cost alternative sources with similar performance or functional values. Examples include choice white grease, tallow, poultry fat, vegetable oils, restaurant grease, etc. Diets based on metabolizable energy added fat may be more expensive than those featuring lower fat inclusion levels or alternatives to typical fat sources.

Ensure correct evaluation of ingredients

Assays of ingredients should be done routinely for nutrient levels and digestibility values so that diet formulation is accurate. In addition, purchasing some ingredients from a single source can help to ensure consistency combined with routine evaluation will help provide more uniform diets for efficient production. Standard operating procedures for product handling will result in a more consistent feed product. Check with your local swine extension educator for a list of laboratories capable of performing feed analyses. An extension bulletin titled, "Swine herd monitoring: feed" is available at **http://www.ag.auburn.edu/~owslewf/extswine/monitor-feed.pdf.**

Review stocking densities in all phases of production

Optimal stocking densities will result in the greatest economic gain with the least negative impact on performance or animal behavior. Consider the end weight of the hogs at typical marketing times and adjust the number of pigs per pen accordingly. For more information, access the article titled, "Effect of stocking density on the welfare and performance of grow-finish pigs" at **http://www.pork.org/ResearchDetail/177/Effectofstockingdens.aspx.**

Identify and sell non-select replacement gilts by 260 lbs. body weight

Marketing females earlier will remove them before their growth curves change significantly resulting in lower feed efficiencies and more costly feed for the gain realized. Marketing these animals early also lowers the risk of injury or loss and prevents the gilt from reaching a market weight out of the ideal range for your packer.

Reduce mortality/ morbidity

Losses of pigs or sows at all stages of production are costly. Attempts should be made to address the most costly and most easily remedied losses. For instance, by increasing the number of pigs weaned per sow, the amount of sow feed needed to produce each pig is reduced. Sow death loss also figures into the total pigs per sow per year. Additionally, sows are costly to replace with gilts. Focus your attention on heavy pig management and care. Pig losses at market weight are costlier than losses in the nursery or during lactation.

Avoid changes which could affect safety and/or quality

Inadvertent contamination of feed as well as a sudden change in source could result in reduced performance or put pigs off-feed. Consideration also should be given to pork quality which may be compromised by changes in the type or source of feed ingredients or additives such as DDGS. Special considerations should be given to feed safety as it can impact product safety.

Maintain correct ambient temperature

Consideration should be given to providing an optimal room temperature for each stage of production. Colder pigs will consume more feed at a loss in feed efficiency in order to generate heat because their maintenance requirement is increased. This trade-off needs to be evaluated and decisions made accordingly. For a publication titled, "Effective environmental temperature", go to **http://www.aasv.org/shap/issues/v12n3/v12n3ptip.html.** Information on the thermoregulatory behavior of pigs and how to use it to determine the animals' thermal needs can be found in PQA Plus at **http://www.pork.org/Producers/PQA/PQAPlusEdBook.pdf.**

Reduce environmental stressors

Many factors can impact pig comfort and performance. Overcrowding of pigs, poor air quality (in terms of ammonia levels), poor ventilation or air flow, humidity and extreme ambient temperatures at the level of the pig can negatively impact pig comfort and performance. Information on ventilation control and its effect on animal well-being and performance can be found in PQA Plus at **http://www.pork.org/Producers/PQA/PQAPlusEdBook.pdf** and in the distance learning resource titled, "Ventilation management". The Pork Checkoff's distance learning resources are available from the Pork Store at no cost to U.S. pork producers. Visit **http://www.porkstore.pork.org/producer/default.aspx?p=viewcat&showpage=2&subcat=1** to find out what courses are available and how to obtain them.

Assure that employees have proper stockmanship skills

Ensure humane and effective handling of all animals in a production system to improve efficient pork production. Research has consistently shown that pig performance is improved through positive and humane handling of pigs. Refer to the Pork Checkoff's PQA Plus and Transport Quality Assurance (**http://www.pork.org/Producers/docs/TQA_08.pdf**) programs for more information. The Pork Checkoff's distance learning resources, "Effective handling of pigs" is available from the Pork Store. Visit **http://www.porkstore.pork.org/producer/default.aspx?p=viewcat&showpage=2&subcat=1** to find out how to obtain this course and to find out what other titles are available.

Train employees to identify normal behavior of sows

Injured animals, irregular open sows and sows with reproductive abnormalities are all costly occurrences. Sow barn employees can be a critical help in identifying these abnormal behaviors. Teach employees that work in breeding barns to be observant and to make daily observations part of their routine. This will help reduce some of these avoidable costs. Tips on daily animal observations, checklists and sample records can be found in PQA Plus at **http://www.pork.org/Producers/PQA/PQAPlusEdBook.pdf.**

Become certified in PQA Plus®

There are many advantages to becoming certified in the PQA Plus program. In addition to producing a safer product and being able to demonstrate the industry's commitment to animal care and well-being, improvements in efficiencies, performance and reductions in costs also are created through discussions and consultation with the PQA Plus Advisors.

Review the workload and responsibilities of employees

Improved labor efficiencies result in reduced costs and many times will result in improved production efficiencies due to closer involvement with the details of the operation. Training employees thoroughly and facilitating necessary support and continuing education for all employees will improve morale and loyalty while ensuring optimal performance and efficiency.

Understand your equipment and operate it efficiently

Make sure all equipment is running at maximum efficiency and is appropriate for the job. Make sure ventilation equipment and heating units are properly set and running efficiently. Ensure that curtain machines and ventilation fans are working correctly. Routinely clean fans because dirty ones do not run as efficiently, do not move the desired volume of air and consume more energy while running. Proper use and maintenance may produce large returns on your investment in labor and repairs. For more information on saving money by maximizing energy use efficiency in swine production, go to **http://www.thepigsite.com/articles/5/housing-and-environment/777/saving-money-by-maximizing-energy-use-efficiency-in-swine-production.**

Establish a vaccine compliance program

As part of a total herd health program, costs of unnecessary or incorrectly administered treatment or vaccination can be avoided. Vaccination mistakes can be very inefficient due to labor, vaccine, and health/performance costs that provide little benefit. Be sure to calibrate syringes to ensure proper dose administration. Using too much vaccine is a waste of money. Using too little vaccine will decreased efficacy and may not adequately protect the pig from disease.

Identify disease early to promote a quick response

One of the ways to have a better handle on the onset of disease in a pen or in the herd is through routine feed intake measurements. Often, the first sign of an emerging illness or onset of disease is that pigs will go off feed. Know what diseases may be present in your area and may pose challenges in the future. Closely monitor sow herds for early signs of disease, such as feed refusal, spontaneous abortions, irregular returns to estrus, etc. Early identification and response to emerging infections will improve efficiency of the production unit. Additionally, monitor water use with accurate meters in your nursery and grow-finish facilities. Decreased water usage also may be a sign of an emerging disease.

Control disease in the nursery and grow-finish areas

Morbidity and mortality during the grow-finish period can cause huge economic losses. Controlling or eradicating some of these prevalent diseases through implementation of a herd health plan can help reduce pig losses and economic costs. This herd health plan should include an evaluation of the vaccination and medication programs and revisions as needed. Consideration should also be given to the cost to the packer of carcasses affected by pig diseases due to trim losses or condemnations. Tips on what to include in a herd health plan are available in the Pork Checkoff PQA Plus program. Contact you local veterinarian to design a comprehensive herd health plan specific for your operation.

Practice timely euthanasia and sort pigs aggressively

Poor performing pigs may show little or no improvement after treatment and result in ongoing losses to the operation if a decision to market or euthanize them is not timely. Poor performing pigs should be removed from each nursery and grow-finish pen. Humanely euthanize these pigs early or market them in a lower weight channel. A standard operating procedure that prescribes the conditions under which pigs should be sorted or euthanized so as to cut losses and improve herd performance and economic returns should be described in every operation. Sort out nursery pigs aggressively before moving them to the finishing building. The National Pork Board/American Association of Swine Veterinarian publication, "On-Farm Euthanasia of Swine – Options for the Producer" is available at **http://www.pork.org/filelibrary/Factsheets/Well-Being/FINAL%20-%20EuthanasiabookletSINGLES.pdf .**

Reduce transport losses and the incidence of fatigued pigs during transport

There are many management techniques that will reduce the incidence of fatigued pigs or losses in transport. Most relate to pig handling and stressors immediately before, during and after transport and may include equipment issues, handling facilities and transport vehicle issues. However, most of the immediate relief can be achieved through gentler pig handling to reduce the level of blood lactates caused by stress and fatigue. Mortality and quality issues associated with the fatigued pigs cost the industry a significant amount of money each year. A little prevention in this area will produce large returns on your investment. The Pork Checkoff's Transport Quality Assurance (TQA) program has a good overview of some of the factors and techniques that can help reduce the incidence of fatigued pigs and transport losses. Information is available online at **http://www.pork.org/Producers/TQA/TQA.aspx.** For a fact sheet titled, "Welfare of pigs during transport", go to **http://www.pork.org/filelibrary/Factsheets/Well-Being/SWINE%20WELFAREFACTSHT-trans.pdf.** An extension publication titled, "Effect of environmental factors on the frequency of fatigued pigs and mortality rates at a commercial abattoir" is available at **http://www.ans.iastate.edu/report/air/2008pdf/R2346.pdf .**

MARKETING

Communicate weaned pig acceptance standards

Effective standards for health status, performance and carcass quality of pigs purchased as weaners should be clear and understood as purchase specifications.

Optimize market weights and consider the "marketing grid" when evaluating changes in feed and production programs

Check your packer's buying grid and consider marketing weights that will avoid excessive feed costs during a time when the growth curve of the pig is changing toward lower efficiency of feed conversion. It is important to spread more pounds of pork over each reproductive unit, but the point of diminishing returns has become lower with rising feed costs. Consider that the optimum end weight depends on your packer and on your specific genotype. Be sure to carefully consider all options to add value at heavier weights against the cost of the additional feed, including your packer's grid and the genetic potential of your genotypes. Give attention to the grid value at specific weights and lean percent levels. Positive changes from a cost standpoint may result in deleterious impacts on returns from marketing. The optimal combination will include an evaluation of production costs as well as throughput and market value.

Revisit input ingredient hedging and contracting mechanisms and strategies

Economic risk management through the use of the futures market for pork and feed ingredient inputs can help mitigate some of the wild swings in ingredient pricing and can help producers lock in prices and lower risk. For additional information on hedging, contracting and options go to **http://www.extension.iastate.edu/agdm/homepage.html** and search for publications B2-50, B2-51 or B2-52. This Web site also includes additional information on livestock pricing, marketing and basis determination.

Purchase heavier weaned pigs

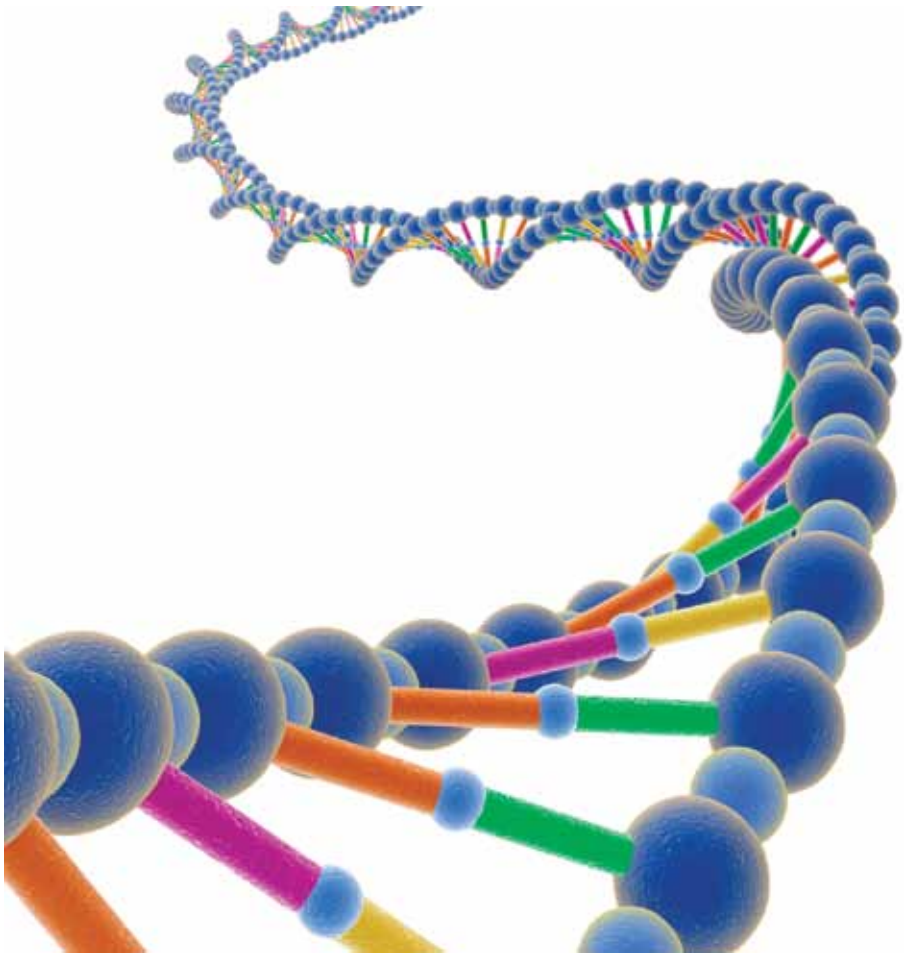
Heavier weight pigs at weaning can get off to a more rapid start and are less fragile, increasing performance and lowering risk. Search for sources that can consistently supply these pigs.

Evaluate genetic influence on feed conversion

Feed conversion efficiency is only of medium heritability, but with rising feed costs, genetic progress can still result in substantial savings. In addition, large differences may exist between commercially available terminal lines. Seek out breeding stock that maximizes performance for feed conversion while ensuring adequate performance for all other economically important traits of interest. Producers that select their own replacements should revise selection indices accordingly to ensure that potential replacements are evaluated with accurate economic weights for each trait of interest. There are several new commercial DNA markers for feed efficiency and lean deposition available to all interested producers.

Improve lean gain feed efficiency

Review genetic programs with consideration given not only to feed efficiency in terms of pounds of feed per pound of gain but also in terms of lean gain. These carcass traits are highly heritable and when coupled with performance in a selection program can result in significant progress toward producing a hog the packer wants at economic value for the producer. Selecting for increased live weight growth or adopting faster growing genetic lines tends to improve overall feed efficiency as well.



SECTION 2: PORK CHECKOFF-FUNDED RESEARCH

FEED MANAGEMENT

(05-052) How does drinking behavior influence feed intake and the development of behavior problems in newly weaned piglets?

http://www.pork.org/ResearchDetail/491/Howdoesdrinkingbehav.aspx

Drinker style affects multiple aspects of production and behavior of the newly weaned piglet. Nipple drinkers contribute to high levels of water wastage, regardless of weaning age. Float bowl drinkers limit water consumption due to soiled water, and result in higher levels of behavioral problems such as belly nosing. The push-lever drinker keeps water wastage in check while still ensuring that piglets consume adequate amounts of water. This style of drinker also appears to benefit younger weaned piglets through their initial feeding behavior and overall growth.

(97-2001) The effect of feed withdrawal on pork quality & the incidence of gastric ulcers at slaughter

http://www.pork.org/ResearchDetail/436/TheEffectofFeedWithd.aspx

To help producers decide whether they should withdraw feed prior to slaughter, we designed a study that examined the effect of feed withdrawal on the proportion of gastrointestinal tract lacerations, prevalence of *Salmonella spp.* in cecal contents at slaughter, prevalence and severity of gastric ulcers, and meat quality as measured by ultimate pH, color, and water holding capacity. Excluding meat quality differences, one time feed withdrawal had slightly positive but statistically insignificant effects on net returns from hogs in the first marketing group. Repeated feed withdrawal (twice and three times) reduced net returns from hogs in the second and third marketing groups. It appeared that the animals that had feed withdrawn repeatedly had significantly lower carcass weights than controls in the same marketing groups.

FEED FORMULATION

(09-044) Effects of rapid introduction and removal of high and low digestibility corn distillers dried grains from the diet, and dietary inclusion rates on growth performance and carcass characteristics of growing-finishing pigs

http://www.pork.org/ResearchDetail/1439/Effectsofrapidintrod.aspx

Our research group conducted an experiment to determine whether relatively high dietary levels of high digestible AA DDGS can be fed throughout the grower-finisher phase to achieve acceptable performance and carcass quality. Additionally, we sought to determine if intermittent inclusion of DDGS of different estimated AA digestibilities into diets can be achieved without affecting feed intake and carcass composition. Results from this study suggest that pigs continuously fed a 40% low digestible AA DDGS based diet formulated on a Standardized Ileal Digestible (SID) AA basis, experience lower ADG, reduced ADFI, lighter HCW and smaller LMA than pigs continuously consuming a corn-soybean meal based diet.

(08-174) Development of equations to predict the metabolizable energy content of distillers dried grains with solubles (DDGS) samples from a wide variety of sources

http://www.pork.org/ResearchDetail/1421/Developmentofequatio.aspx

The objective of this study was to develop regression equations to predict the metabolizable energy (ME) content of DDGS based on chemical composition. The study used DDGS samples obtained from 17 sources (Midwestern ethanol plants) that were chosen to represent the variation in nutrient content currently available to the industry. Equations were developed for the chemical components other than proximate analysis; for these, the 3-variable equation that explained the greatest variation in the ME content of DDGS was based on ADF, NDF, and GE for both laboratories.

(08-115) Ileal and total tract apparent and true digestibility of fat in distillers dried grains with solubles and other corn oil products fed to growing pigs

http://www.pork.org/ResearchDetail/1319/IlealandtotaltractapAspx

The objective of this research was to test the hypothesis that oil in distillers dried grains with solubles (DDGS) and other co-products from the ethanol industry, such as high protein distillers dried grains (HP DDG) and corn germ, have different nutritional properties in swine diets than liquid extracted corn oil and intact oil in corn. Results showed that the digestibility of fat was greater in extracted corn oil and full fat soybeans than in the other ingredients. However, HP DDG and DDGS had greater digestibility of fat than high oil corn and corn germ, which indicates that the fermentation process in the ethanol plants increases fat digestibility. It is concluded that the digestibility of fat varies greatly among feed ingredients. As a result, it is not possible to predict the impact of a specific feed ingredient on quality of pork fat just by measuring the concentration of fat in that ingredient. Instead, it is necessary to formulate diets based on the digestible concentration of fat in the diets.

(08-094) Characteristics and eating quality of bacon and sausage from finishing pigs fed medium and high levels of distillers dried grains with solubles (DDGS) from ethanol production

http://www.pork.org/ResearchDetail/1396/CharacteristicsandEa.aspx

An experiment involving 60 crossbred pigs was conducted at the University of Kentucky to assess the effects of feeding high levels of corn distillers dried grains with solubles (DDGS) on performance of growing-finishing pigs from 76 to 265 pounds of body weight, and on carcass and belly firmness, fatty acid composition of the fat, slicing efficiency of cured bacon, and eating quality of bacon slices, bratwurst sausage, and loin chops. The results of this study showed that rather high levels of DDGS (up to 45% DDGS in the diet) can be fed to growing-finishing pigs without having much of an effect on growth rate; however, the amount of feed required per unit of gain was increased with increasing amounts of DDGS in the diet. Carcass leanness was not greatly affected by level of DDGS; however, the high levels of DDGS in the diet resulted in higher proportions of unsaturated fatty acids in the body fat, higher iodine values in the backfat and belly fat, and softer, more flexible bellies.

(08-093) Sulfur concentration in distiller's dried grains with soluble (DDGS) and its impact on palatability and pig performance

http://www.pork.org/ResearchDetail/1378/SulfurConcentrationi.aspx

This study has provided a comprehensive investigation on whether or not increasing concentrations of sulfur in distillers dried grains with solubles (DDGS) can impact the palatability and performance of weanling and grow-finish pigs. Based on the results of this experiment, the level of sulfur that is commonly present in DDGS is not a concern for swine palatability and performance with 20 to 30 % DDGS included in the diets. Additional research is currently being conducted to investigate the impact of sulfur in DDGS on tissue levels of sulfur in pigs.

(07-240) Development of an allergenicity model in swine

http://www.pork.org/ResearchDetail/1259/DevelopmentofanAller.aspx

The objectives of this project are to genetically select a pig population that reproducibly exhibits hypersensitivity to soy products, to produce antibodies that specifically recognize swine IgE, and to demonstrate a quantitative assay for allergenic response using swine IgE. We have completed the second year of this 3-year project, and more useful information will be coming forth during the next few months. Establishment of a credible model for evaluation of hypersensitivity to soy is a necessary step toward the development of strategies that will help sustain domestic swine production and protect long-term demand for U.S. soy meal.

(07-173) Critical review of literature on feeding biofuels co-products to pigs

http://www.pork.org/ResearchDetail/1273/Criticalreviewoflite.aspx

The digestibility of nutrients in distillers co-products vary among sources. The variability is of the same magnitude as that of other co-products. If corn DDGS of average or above average quality is used, approximately 30% can be included in diets fed to lactating sows, weanling pigs, and growing-finishing pigs, whereas 50% can be included in diets fed to gestating sows.

(07-172) Net energy of three sources of distillers dried grains with solubles fed to growing and finishing pigs

http://www.pork.org/ResearchDetail/1290/Netenergyofthreesour.aspx

It has been suggested that profits from pig production in North America would be improved by $2 to 3 per pig if diets were formulated based on a NE system rather than a DE or ME system. There are, however, no NE values for co-products from the dry grind ethanol industry such as distillers dried grains with solubles (DDGS) and high protein distillers dried grains with solubles (HP-DDG). The current research was, therefore, conducted to measure NE values in two sources of DDGS and in HP-DDG. In conclusion, results of this research suggest that the NE for DDGS-CV, DDGS-BPX, and HP DDG is 1,665, 1,596, and 1,783 kcal/kg, respectively, for growing pigs, and 2,718, 2,065, and 2,291 kcal/kg, respectively, for finishing pigs.

(07-170) Digestibility of dietary fiber from distillers co-products fed to growing pigs

http://www.pork.org/ResearchDetail/1269/Digestibilityofdieta.aspx

The objective of these experiments was to measure the digestibility of dietary fiber in DDGS by growing pigs and to measure the difference in fermentation capacity among different sources of DDGS. The apparent ileal (AID) and apparent total tract digestibility (ATTD) was measured and the fermentation of dietary fiber in DDGS was calculated by subtracting values for AID from values for ATTD. The data from these experiments suggested that the digestibility and fermentation of the dietary fiber in DDGS is less than 50%.

(07-165) Evaluation of crude glycerin in swine

http://www.pork.org/ResearchDetail/1281/Evaluationofcrudegly.aspx

The objective of the proposed research was to determine the variation in metabolizable energy (ME) content of crude glycerin samples from several biodiesel production facilities using different feedstock sources (soybean oil, animal fat, and used restaurant grease). Overall, data presented herein showed that the concentration of glycerin, fatty acids, and methanol affect the GE and ME of crude glycerin, and because crude glycerin is easily digested and metabolized, it can be used as a viable source of energy in growing pigs.

(07-152) Assessment of corn distillers dried grains with solubles (DDGS) from ethanol production on performance and carcass quality of growing-finishing swine

http://www.pork.org/ResearchDetail/1293/AssessmentofCornDist.aspx

A large collaborative experiment involving 560 crossbred pigs was conducted at nine experiment stations to assess the effects of feeding high levels of corn distillers dried grains with solubles (DDGS) on performance of grow-finish pigs from 71 to 265 lb body weight and on carcass and belly firmness. In summary, the results show that rather high levels of DDGS (up to 45% DDGS in the diet) can be fed to growing-finishing pigs without having much of an effect on growth performance or carcass leanness. However, these high levels do result in a higher proportion of polyunsaturated fatty acids in the backfat, higher iodine values in the backfat, and softer, more flexible bellies.

(07-148) Influence of dietary DDGS and glycerol on pork loin and bacon quality

http://www.pork.org/ResearchDetail/1370/InfluenceofdietaryDD.aspx

The goals of this study were to determine the impact of 0 and 20% DDGS and the inclusion of glycerol at levels of 0, 2.5, and 5% in grow-finishing rations on loin and bacon quality, and determine the relationship between belly firmness and slicing yield for commercially produced bacon. In summary, feeding DDGS and glycerol in combination or singularly at the levels tested did not practically impact loin quality traits. Feeding 20% DDGS did decrease belly firmness, although, not to a degree that would affect any processing characteristics. Furthermore, our results suggest that the addition of 20% DDGS to finishing swine diets will not be detrimental to sensory components in bacon.

(07-144) Influence of rapid introduction and removal of dietary DDGS on pig performance and carcass characteristics

http://www.pork.org/ResearchDetail/1284/InfluenceofRapidIntr.aspx

Our research group conducted an experiment to determine the effects of switching between corn-soybean meal and corn-soybean meal-DDGS diets on pig performance and carcass quality of finishing pigs. Results of this study suggest that the frequent inclusion and removal of 20% DDGS from diets for finishing pigs will not adversely affect pig performance or carcass characteristics. We plan to conduct a similar experiment to determine if consistent responses are observed with lighter pigs. It appears that alternating 40% DDGS in and out of the diet may reduce feed intake and hot carcass weight of finishing pigs.

(07-143) Energy and amino acid digestibility of corn distillers syrup by-products in growing pigs

http://www.pork.org/ResearchDetail/1398/Energyandaminoaciddi.aspx

The purpose of this study was to determine the energy, amino acid, nitrogen and phosphorus digestibility of thin stillage, condensed distillers soluble, ground and intact syrup balls, and DDGS when fed to growing pigs. In conclusion, feeding DDGS with ground or intact syrup balls has little impact on the nutritional value of DDGS for growing swine. The presence of syrup balls does not decrease amino acid digestibility of DDGS.

(07-011) North American Swine Energy System, 2nd year

http://www.pork.org/ResearchDetail/1264/NorthAmericanSwineEn.aspx

Energy is the most expensive dietary essential in pig diets, but it receives much less attention in North America than is deserved by its importance. The digestible energy (DE) and metabolizable energy (ME) systems widely used in North America share important shortcomings: they systematically overvalue fibrous or high-protein feedstuffs and they systematically undervalue fats. More sophisticated energy systems have been developed in Europe to overcome these shortcomings, but they have not been widely adopted in North America. We conducted this study to evaluate the European systems under North American conditions, as a first step in moving our industry to more accurate diet formulations and more profitable feeding programs. Comparison of results for growing versus finishing pigs suggests there is value for an energy system to consider the animal's use of nutrients (for protein versus fat gain) as well as the supply of those nutrients. Our NE values for diets and ingredients are all substantially lower than values predicted by the European systems, perhaps because of different measurement methods. Stated differently, these data strongly suggest that the European systems overestimate the energy value of diets and ingredients for growth in pigs. Our data will eventually provide further guidance concerning the practical usefulness of those systems in North American pig production, and that will guide us to the most effective energy system to control diet costs while achieving high productive performance.

(06-142) Corn distillers dried grains (DDGS) for growing-finishing swine

http://www.pork.org/ResearchDetail/617/Corndistillersdriedg.aspx

A nutrition study was conducted to investigate the feeding value of DDGS for growing-finishing swine. Specifically, growing-finishing diets were developed that contain 0 (control), 5, 10, and 15% DDGS. Overall, growth performance decreased as dietary DDGS inclusion increased from 0 to 15%. This reduction in performance may have been partially explained or exacerbated by the elevated fiber concentration detected in the source of DDGS used in this study. Dressing percentage, chemical composition, color and sensory characteristics of the LM did not change due to the inclusion of dietary DDGS up to 15%. These results suggest that the inclusion of increasing levels of DDGS in diets of finishing pigs from the University of Nebraska-Lincoln (UNL) nutrition line did not affect carcass characteristics; however, as DDGS inclusion increased HCW was reduced.

(06-117) Alternative feedstuffs for reducing ammonia and odor emissions in pork production systems and improving the pig's gut health

http://www.pork.org/ResearchDetail/1265/Alternativefeedstuff.aspx

The overall objective of the project was to evaluate alternative feedstuffs for their potential impact on the character of the manure excreted, on the formation of odor-causing compounds and on the gut health of the pig. An experiment carried out on pigs confirmed that the fermentation of the soluble fiber in the gut led to an increased production of lactic acid, to a lower pH value in the colon (which means a more acidic content) and to a modification of the microbial diversity and of composition of the intestinal bacteria. This important finding shows that prebiotic effects (i.e. development of health-promoting bacteria in the gut by adding favorable substrates in the diet) can be obtained by a judicious selection of feed ingredients rather than by the addition of antibiotics, of probiotics (living bacteria) or of prebiotics (purified carbohydrates used by bacteria as a substrate). In other terms, it is possible to improve the pig gut health through feed formulation and not only with additives.

(06-103) Understanding the relationship between immune response, intestinal microbial ecology and growth performance in nursery pigs fed diets with, or without in-feed antibiotics or a combination of beta-glucan and vitamin C

http://www.pork.org/ResearchDetail/1298/Understandingtherela.aspx

This research project was developed to understand the effect(s) of two commonly used in-feed antibiotics (carbadox and tylosin), and a dietary combination of beta-glucan and vitamin C on the immune system and intestinal bacteria of nursery pigs. Although the use of tylosin in nursery diets did not improve growth performance, it was most favorable to the pig's immune system by protecting the pig from an increase in intestinal pathogens and insuring the health of the animals. Administration of beta-glucan and vitamin C may be an attractive alternative to antibiotics, but additional research needs to be conducted.

(06-097) Evaluation of dietary butyrate as a growth promotant and on the response to lipopolysaccharide (LPS) in weanling pigs

http://www.pork.org/ResearchDetail/596/Evaluationofdietaryb.aspx

Producers are looking for alternatives to dietary antibiotics. Data obtained in this research indicate that sodium butyrate did not increase growth efficiency in weanling pigs, but did regulate the physiological response to inflammation. The research results described in this report provides pork producers, researchers at universities, feed companies, and allied industries, data showing that feeding sodium butyrate to weanling pigs does not increase growth performance, but may alter the inflammatory response.

(05-195) Impacts of growth promoting antibiotics on growth performance, economics, and the development and persistence of antibiotic resistance in nursery and finishing pigs

http://www.pork.org/ResearchDetail/551/Impactsofgrowthpromo.aspx

A 20-week study was conducted using gilts from a commercial source (n=200; initial BW = 6.2 ± 0.003 kg) to determine the effects of growth-promoting levels of antibiotics on growth performance of nursery and finishing pigs, as well as development and persistence of antibiotic resistant *E. coli* and *Enterococcus* isolated from fecal samples and groundwater samples after a simulated rainfall. Economic analysis based on weight gain, mortality, and feed consumption during the trials showed that relatively small differences in performance can produce economically important differences in cost of production.

(06-001) Oxygen consumption and energy digestibility of soybean meal and corn or corn co-product diets fed to grow-finish swine

http://www.pork.org/ResearchDetail/575/Oxygenconsumptionand.aspx

Diets containing corn or corn co-products were fed to swine over 6 feeding phases, starting at 18 kg bodyweight and concluding at market weight. The corn co-product diets contained increasing levels of the co-product; from 5 to 30% over the course of six feeding phases. Co-products used included distillers dried grains with solubles (DDGS), corn germ meal (CGM), and dehulled, degermed corn (DDC). Findings demonstrated no differences in animal growth or feed intake. However; pigs fed DDC diets had better utilization of diet energy and pigs fed the DDGS diets produced more heat, suggesting that there may have been some compensatory factors that allowed for similar growth to occur across diets.

(05-169) Critical review of acidifiers

http://www.pork.org/ResearchDetail/541/CriticalReviewofAcid.aspx

The inclusion of various organic acids or their salts to diets improves the growth performance of pigs and helps in preventing scouring and high mortality post-weaning. The beneficial effects of organic acids on growth performance are evident within the first few weeks of weaning, and the influence gradually decreases as the pig grows old. Diet acidification significantly reduces the diet pH, but does not affect the gastrointestinal pH. The use of acids in diets for pigs enhances the nutrient digestibility and dissimilarly affects the microbial populations in different parts of the digestive tract.

(05-134) Aspects of yeast-based products in enhancing animal production

http://www.pork.org/ResearchDetail/505/Aspectsofyeast-based.aspx

A literature review on yeast and yeast-based products as potential alternative feed additives to enhance animal production was conducted. This manuscript may serve as a valuable reference material for swine producers interested in understanding the potential role of yeast and yeast-based products in enhancing swine production and as a starting point for basic and applied swine research studies. Understanding and determining possible options to further process an existing yeast product or develop other potential yeast-based products will allow swine nutritionists to better position these products and optimize their use in the feed industry.

(04-097) A comparison of administration routes of direct-fed microbials to nursery pigs, and the effects on growth performance and gut health

http://www.pork.org/ResearchDetail/168/Acomparisonofadminis.aspx

Direct fed microbials (DFM) have been investigated as a potential replacement for sub-therapeutic antibiotics in swine diets with mixed results being reported. Our results, found no overall significant effect of DFM or their mode of administration on growth rate. However, we also did not observe an effect of carbadox on overall growth rate, although ADG was improved during phase 3 when carbadox was added to the diet. A few small improvements in intestinal morphology and indicators of cellular migration and proliferation rate within the gastrointestinal tract were observed when antibiotics were included in the diet.

(04-143) Carbohydrate and bacterial non-antibiotic production enhancers

http://www.pork.org/ResearchDetail/525/CarbohydrateandBacte.aspx

Although there is a relatively small data set on specific probiotic or prebiotic treatments, especially when the experiments also have an antibiotic treatment as a positive control, there is an increase in data being published and we should have a large enough data set to statistically analyze for treatment effects. In the meantime, probiotics and prebiotics show promise as alternatives to growth promotant antibiotics.

(04-142) Critical review of functional animal proteins

http://www.pork.org/ResearchDetail/524/CriticalReviewofFunc.aspx

Spray-dried plasma and immune egg products provide dramatic benefits when added to diets of young weaned pigs. Spray-dried plasma increases growth rate and resistance to enteric infection, while properly-targeted immune egg products markedly improve resistance to disease. Whey proteins provide modest benefits in growth rate. The benefits of dried porcine solubles and of conventional egg products remain unclear.

(04-021) Comparison of cereal grains in diets for nursery pigs: microbiology, health and performance

http://www.pork.org/ResearchDetail/198/ComparisonofCerealGr.aspx

There are competing concepts of how dietary cereals may influence resistance to enteric disease, but we have surprisingly little information upon which to base decisions on so important a factor. Our results are not sufficient basis for recommending that producers use rice or barley instead of corn in early nursery diets, but they confirm that the issue is an important one that deserves further study. We found suggestions in three experiments, two intensive experiments in disease-containment chambers and a feeding trial on a commercial farm that changing from corn to another cereal may improve health of newly weaned pigs.

(03-075) Evaluation of antimicrobial alternatives to reduce the development of antibiotic resistance

http://www.pork.org/ResearchDetail/94/Evaluationofantimicr.aspx

The oregano oil product evaluated did not enhance nursery pig performance or influence the development of antimicrobial resistance to the panel of antibiotics used to screen resistance. While a high level of multiple antimicrobial resistances was apparent at the beginning of the study, decreases in the level of resistance to several of the antibiotics was an attribute of all the dietary treatments. Therefore, the oregano oil product demonstrated no apparent benefit over carbadox or the control diet in modulating antimicrobial resistance. The less than superb performance obtained from feeding the oregano oil product appears to be a function of depressed feed intake based on the intake and feed efficiency data. The strongly aromatic nature of the oregano oil product most likely discouraged consumption of the diet resulting in the poor pig performance.

(01-156) Comparison of grain sources (barley, white corn, and yellow corn) for swine diets and their effects on meat quality and production traits

http://www.pork.org/ResearchDetail/564/ComparisonofGrainSou.aspx

Animals fed diets differing in energy source did not express a difference in average daily gain, average daily feed intake, feed-to-gain ratio, backfat depth or percent fat free lean. However barley-fed pigs did have a smaller loin muscle area than pigs fed corn-based diets. Results of this trial suggest that barley does not have an advantage in meat quality traits when compared to traditional corn-based diets. Barley does however have a significant impact on the hardness of pork fat, but does not have a significant effect on subjective color values.

(98-101) Evaluation of the impact of distillers dried grains with solubles on swine manure odor

http://www.pork.org/ResearchDetail/420/EvaluationoftheImpac.aspx

Finishing pigs were fed distillers dried grains with solubles (DDGS) to evaluate the effects on pig performance, manure characteristics, and odorous emissions. Three isocaloric, isonitrogenous diets containing 0, 5, or 10% DDGS were fed during six 4-week feeding periods. Animal performance differences were not observed, consistent with feeding diets of similar nutrient content.

DISEASE CHALLENGE

(08-075) Effects of dietary aflatoxin on hepatic gene expression in swine

http://www.pork.org/ResearchDetail/1419/EffectsofDietaryAfla.aspx

Aflatoxins, especially aflatoxin B1 (AFB1), can be high in dried distillers grains with solubles (DDGS) when concentrated during the ethanol production process. The objectives of this study were to determine the effects of AFB1 on 1) the health, performance, and serum profiles and 2) the hepatic gene expression of growing barrows. Both ADFI and ADG were negatively affected by AFB1 treatment. Liver samples were fixed and stained for detection of cellular damage and inflammation. No statistical differences in liver health as assessed by histological grading were observed among the 70-day treatment groups. These results demonstrate that performance and blood parameters in young growing barrows are affected by consumption of an aflatoxin-contaminated diet, especially when the concentration of aflatoxin is high (≥ 500 ppb); however, even lower concentrations (250 ppb) are detrimental to performance when administered for a more chronic period.

(02-208) Effects of a commercial probiotic supplement on intestinal *E. coli* and growth in the weaned pig

http://www.pork.org/ResearchDetail/92/Effectsofacommercial.aspx

There are many products on the market sold as probiotics with label claims to enhance growth and production. Regulations governing the licensure, sale, and addition of these products to animal feeds require only that the product be safe, without regard to product usefulness. How probiotics act to modulate the ecology of the gastrointestinal tract is poorly understood. The addition of some probiotics, especially lactic acid-producing bacteria such as the ones included in this probiotic mixture have been shown to provide beneficial effects such as enhanced weigh gain and feed conversion and protection from infection in pigs and other animals. One the other hand, other researchers have tried to identify beneficial effects of other probiotic bacteria without success. In order to consistently select and predict the potential beneficial effects of a particular probiotic treatment, the mechanism of action must first be established.

(02-204) On-farm evaluation of diet acidification

http://www.pork.org/ResearchDetail/91/On-FarmEvaluationofD.aspx

Under the conditions of these experiments, lactic acid added to complex nursery diets does not improve growth performance and (or) health in weaned pigs in large groups on a commercial farm, in the presence or absence of dietary lactose.

(02-197) Effect of probiotics in the health and performance of nursery pigs raised in conventional or antibiotic/growth promoter free farms

http://www.pork.org/ResearchDetail/45/Effectofprobioticsin.aspx

We compared the health and performance of weaned pigs in a high health herd between groups receiving low level antibiotics in the feed to groups receiving probiotic in the feed and no antibiotics. Performance and health were similar between the two treatments. This study indicates that some high health status nurseries may be able to reduce antibiotic use and reserve them for disease challenges of more significance.

(02-104) Analysis of a more restricted antimicrobial access policy in pork production

http://www.pork.org/ResearchDetail/562/AnalysisofaMoreRestr.aspx

Our conclusion is that a U.S. ban at the finishing stage would create very few animal health concerns, but it would lead to a slight reduction in feed efficiency and increase the weight spread of finished animals. A ban at the weaning stage would create some serious animal health concerns and lead to a significant increase in mortality. Our best estimate is that costs would increase by approximately $4.50 per animal in year one. The estimated cost increase includes an increase in costs at the finishing stage of $1.05 per animal; an increase in costs at the weaning stage of $1.25 per animal; an additional veterinary cost of $0.25 per animal; a vaccine cost of $0.75 per animal; an increase in sort loss of $0.65 per animal; and a capital cost of about $0.55 per animal.

(02-094) Productivity and economic impacts on feed grade antibiotic use in pork production

http://www.pork.org/ResearchDetail/68/ProductivityandEcono.aspx

An economic and statistical analysis of the 2000 NAHMS National Swine Survey data reveals that efficient use of antibiotics for growth promotion and disease prevention purposes is associated with improved levels of herd productivity measures, such as ADG and FCR. A farm budget analysis, conducted for a 1,020 head finishing barn, illustrates a significant contribution of antibiotic use to profits. When antibiotics for growth promotion and disease prevention purposes are carefully applied at optimal levels, our farm budget analysis indicates that producers gain $4,146 for each 1,020 head barn compared to no antibiotic use.

(02-084) Evaluation of antimicrobial alternatives to reduce the development of antibiotic resistance

http://www.pork.org/ResearchDetail/41/Evaluationofantimicr.aspx

A 35-day growth assay was conducted to assess the effect of inorganic minerals and probiotic feed additives on growth performance and development of antibiotic resistance in nursery pigs. With regards to performance, results of the present study concur with results of other studies where growth responses to non-antimicrobial feed additives tend to be variable, with improvements in feed intake and feed efficiency being observed more commonly.

GENERAL MANAGEMENT

(05-173) Management guide for reduced usage of antibiotics in swine production

http://www.pork.org/ResearchDetail/543/Managementguideforre.aspx

A summary of research conducted to investigate possibilities for reducing the negative impact of discontinuing the use of antibiotic growth promoters has documented that many management tools are available for producers. The most important of these tools are the following: • Increase weaning age to between 21 and 28 days • Use all-in all-out production systems. Wean to off-site facilities if possible • Regardless of the weaning system, provide pigs with a clean, draft-free environment. Provide room temperatures around 28°C during the initial weeks post-weaning. Control of flies and rodents and strict biosecurity is required • Feed diets in a liquid form if possible – preferably as fermented liquid feed. If liquid feed cannot be used, then feed diets in a pelleted form after grains have been ground to an average particle size around 600 microns. • Restrict feed intake to approximately 75% of ad libitum intake during the initial 2 weeks post-weaning • Formulate diets based on barley, naked oats, or oats. Avoid corn and soybean meal in the early weaning diets. Use diets that contain less than 18% crude protein during the initial 2 weeks post weaning – sometimes crude protein levels need to be as low as 15%. Use acidifiers, probiotics, and pharmacological levels of zinc and copper in the diets. Using these management strategies, producers will be able to wean pigs without encountering increased problems with intestinal diseases and the use of therapeutic antibiotics will not increase. In many cases, producers will also be able to obtain pig performance at the same level as is obtained in systems that use antibiotic growth promoters. However, due to increased costs of production, profits may be reduced if no antibiotic growth promoters are used.

(04-093) Effect of stocking density on the welfare and performance of grow-finish pigs

http://www.pork.org/ResearchDetail/177/Effectofstockingdens.aspx

Welfare and performance of grow-finisher pigs were evaluated in groups of 19 barrows, in 2 levels of group weight composition, uniform (pigs of body weight above 25 and below 75 percentiles) or varying body weights (pigs of body weight below 25 and above 75 percentiles) and at 4 levels of floor space allowances calculated allometrically for a final slaughter weight of 116 kg by using 'k' values of 0.027, 0.031, 0.034, and 0.037. The four space allowances were 0.64 m^2/pig (SA0.64), 0.74m^2/pig (SA0.74), 0.81m^2/pig (SA0.81), and 0.88 m^2/pig (SA0.88). The performance and welfare of pigs in 0.81m^2/pig and 0.88m^2/pig were comparable at market weight of 116kg. Allotting grow-finishers according to uniformity or variation in body weight may not provide any differential benefit in ADG or overall welfare. Although, a beneficial effect was observed in terms of ADG, injury scores, aggression and lying behavior by increasing space allowance, an increase in space allowance from 0.64 to 0.74m^2/pig did not result in significant benefit. Similarly reducing space allowance from 0.81 to 0.74 m^2/pig also did not cause further disadvantages in terms of ADG, lying behavior, injuries and aggression.

(04-086) Floor space requirements for grow/finish pigs in large groups

http://www.pork.org/ResearchDetail/173/FloorSpaceRequiremen.aspx

The effects of group size and floor space allowance on productivity, health and welfare were tested on 1728 grow-finish pigs (barrows) of PIC genetics. Group sizes were 18 (small) and 108 (large) pigs per pen, and space allowances were 0.52 m^2/pig (crowded) and 0.78 m^2/pig (uncrowded), creating four experimental treatments: small crowded, small uncrowded, large crowded, and large uncrowded. Pigs housed in crowded groups had poorer performance than uncrowded pigs. Overall, average daily gain (ADG) was 4.2 % lower for crowded pigs than uncrowded pigs. During the final week of the trial, when the pigs were most crowded, the difference was 9.8 %. Final body weights differed by 2.1 %. Although crowded pigs spent less time at the feeder, had fewer meals, and had longer latencies between their meals than uncrowded pigs, average daily feed intake (ADFI) values did not differ. Overall feed efficiency was reduced by 6.6 % in the crowded treatment pigs.

(02-194) Zone heating for wean-to-finish facilities: A performance comparison

http://www.pork.org/ResearchDetail/16/ZoneHeatingforWean-t.aspx

The University of Nebraska conducted on-farm research trials in 2003 and 2004 to determine the impacts of zone-heating options for wean-to-finish operations. Without an advantage in pig performance, the gas-fired brooders are at an economic disadvantage due to higher equipment costs and low electricity prices in Nebraska (about 6.5 cents per kWh) compared to moderate gas prices (around 90 cents per gallon of LP), even though annual operating costs should be lower. Gas-fired heaters may have an advantage in regions where electricity prices are higher relative to natural or LP gas prices.

(02-163) Effect of weaning age and commingling after the nursery phase on humoral and behavioral indicators on humeral and behavioral indicators of well-being and on growth performance

http://www.pork.org/ResearchDetail/37/Effectofweaningagean.aspx

Age at weaning impacts growth performance as well as behavioral and immunological responses to management stressors, such as weaning and commingling after the nursery phase. A study conducted at the University of Arkansas evaluating the effects of weaning age and commingling after the nursery phase in wean-to-finish facilities on growth performance, immunological measurements, and behavioral observations, reported that older pigs were heavier throughout the nursery period. Body weight difference between younger and older pigs increased from 4.4 to 13.2 lb. at the start and end of the nursery period, respectively. Younger pigs seemed to be more active (standing or walking vs. lying recumbent) than older pigs, and less immunologically developed, as evidenced by the increase in mortality rate observed for younger pigs during the nursery phase. However, pigs weaned at 14 d of age grew faster during the growing/finishing period and reached a common body weight (230 lb.) four days sooner than pigs weaned at 21 days of age. It is unclear why the pigs weaned at 14 days of age that survived the nursery phase responded so robustly in the subsequent growing/finishing phase, although differences in immune system development may be the cause.

(01-128) The effect of air quality in swine finishing facilities upon animal performance and environmental pollution potential

http://www.pork.org/ResearchDetail/236/TheEffectofAirQualit.aspx

This project was conducted with 96 finishing pigs in 4 identical rooms under closely controlled ventilation and temperature. The objectives of the project were to determine if air quality impacted pig performance, to identify and quantify the gasses emitted and to determine emission rates of those gasses, and to compare gasses, dust, and performance as influenced by three different levels of ozonation in the facility. The emission rates were calculated and tabulated. The gasses detected were too numerous to detail here but are detailed in the dissertation produced in conjunction with this project (Kim-Yang, 2002). Overall, performance of the pigs was not affected although feed intake and gain were reduced in the early stages at the highest ozone level. The differences were overcome by later compensatory gain and there was no difference in the end.

(00-065) Impact of odor and dust on pig performance

http://www.pork.org/ResearchDetail/297/ImpactofOdorandDusto.aspx

A research project to determine whether ozonation of air in a swine nursery has impact on dust, odor, and pig performance was undertaken at the Michigan State University swine research facility. The average daily gain and feed efficiency was better in the ozonated treatment than in the control, but there was inadequate replication to state that the differences were statistically significant.

(98-092) Effect of prenatal androgenization on growth rate, feed efficiency and carcass quality of swine

http://www.pork.org/ResearchDetail/387/EffectofPrenatalAndr.aspx

This study was conducted to determine if the prenatal administration of testosterone, prenatal androgenization, would enhance the growth rate of pigs as has been reported in ruminants. Fifteen gilts or sows were administered testosterone via an intravaginal controlled release insert on days 21-26 of gestation. Pregnancy was terminated in six of the 15 (40%) females administered the intravaginal testosterone insert. Although the live offspring were normal at birth and equal in weight to the non-prenatally androgenized pigs, there were fewer live offspring. Litters that had been prenatally androgenized had a higher incidence of stillborns and mummified fetuses. Therefore, prenatal androgenization, as done in this study, increased the incidence of pregnancy termination and increased embryonic and fetal mortality. Also, in contrast to our results in cattle, prenatally androgenization appeared to have no effect on the growth rate or on the gain to feed ratio.

FEED PROCESSING AND MANUFACTURING

(07-151) Utilizing glycerol in swine diets: Feed manufacturing considerations and nutritional strategies to reduce dietary costs

http://www.pork.org/ResearchDetail/1295/UtilizingGlycerolinS.aspx

Consequently, experiments sponsored by the National Pork Board, were carried-out to evaluate the effects of glycerol on feed characteristics, the pelleting process, and nursery pig growth performance. Thus, based on the results, adding glycerol to diets prior to pelleting tends to improve pellet quality and decreases energy cost. However, it does not appear glycerol can replace lactose in weanling pig diets.

(02-046) Corn particle size and pelleting influence on fecal shedding and enteric colonization of *Salmonella typhimurium*

http://www.pork.org/ResearchDetail/66/CornParticlesSizeand.aspx

Grinding corn to a finer particle size has been shown to have beneficial effects on growth, feed efficiency, and digestibility. The trial demonstrated improvements in growth and efficiency. However, in contrast to previous research, pelleting did not result in an improvement in growth and feed efficiency. Using this model, we were unable to detect influences of feed processing on fecal shedding and colonization of mesenteric lymph nodes with salmonella. Therefore, it appears that the increased risk of finer grinding and pelleting of feeds associated with salmonella shedding reported in other studies may be due to factors other than those confined to the intestinal tract environment.

FEEDER MANAGEMENT

(04-179) Effect of feeding system failures on grow-finish performance and welfare

http://www.pork.org/ResearchDetail/184/EffectofFeedingSyste.aspx

Results of these 2 experiments document the impact of repeated out-of-feed events on grower-finisher pig performance. In production units that must sell pigs by a certain date, these data will allow producers to examine whether the improvement in feed conversion efficiency from finely ground diets overcomes the loss in weight gain from out-of-feed events due to increased bridging often associated with finely ground diets.

SOW MANAGEMENT

(08-256) Economic analysis of the University of Nebraska-Lincoln gilt development project

http://www.pork.org/ResearchDetail/1407/EconomicAnalysisofth.aspx

Restricting energy intake during gilt development lowered costs associated with gilt development and increased subsequent productivity of these females. The study modeled costs and value of market pigs through four parities from production data of 631 gilts that were fed on an ad libitum basis until breeding or were restricted to 75% of ad libitum energy intake from 123 days of age until breeding (approximately 230 days of age). Gilts developed with energy-restriction had a greater probability of reproductive success than those developed with ad libitum feeding. The budget showed that progeny of both LWxLR and L45X gilts developed with energy-restriction generated greater profits than progeny from their littermates developed with ad libitum feeding.

(05-060) Investigation into the effects of feeding schedule on body condition, aggressiveness and reproductive failure in group housed sows

http://www.pork.org/ResearchDetail/493/Investigationintothe.aspx

In this project, we increased the feeding frequency from two to six times per day and spaced the feedings at a designed interval in an attempt to induce the sense of satiety of the boss sows and reduce variation in sow weight gain within each pen. Increasing feeding frequency did not improve overall weight gain, weight variation, reproductive performance, or overall removal rate of group housed gestating sows or gilts. There was a small reduction in skin and vulva lesions and structural scores, but an increase in vocalization for sows fed six times per day. In summary, increasing the feeding frequency from two to six times per day does not appear to have a dramatic negative or positive impact on performance or welfare of group housed gilts and sows.

(05-172) Development of condition scoring guide – using live animals

http://www.pork.org/ResearchDetail/542/DevelopmentofConditi.aspx

The objectives of the study were to develop educational materials to assist pork producers and animal caretakers in the evaluation of sow body condition, to estimate the amount of feed and associated costs that are necessary to add weight to cull sows, and finally to estimate the cost / benefit of adding weight to cull sows that are from a modern – lean genetic line. New tools were developed to assist pork producers in the evaluation of body condition of breeding herd females.

SWINE HEALTH

(02-192) Effect of sow dietary glutamine intake on subsequent nursery pig growth after an intestinal disease challenge

http://www.pork.org/ResearchDetail/21/EffectofSowDietaryGl.aspx

The data from this experiment suggest that increased sow consumption of glutamine does not improve the immune response of endotoxin-treated progeny following weaning. However, it appears that duodenum villus height may be maintained in pigs challenged with endotoxin if they previously consumed milk with greater concentrations of free glutamine due to increased sow glutamine intake.

(02-191) Genetic resistance to Porcine Reproductive Respiratory Syndrome Virus (PRRSV)

http://www.pork.org/ResearchDetail/17/GeneticResistancetoP.aspx

In the experiment pigs of two distinctly different populations were challenged with PRRS virus. The lines differed in physiological responses to virus (body temperature, weight gain, ability to replicate virus, and lung lesions), indicating that genetic variation exists. This suggests that breeders could select directly for resistance to PRRSV. However, such selection is very difficult to implement, would be very expensive, and is certainly not practical. It would require continuous challenge of all pigs to PRRSV and then selection of those with the optimum response as measured by the physiological traits. A much more practical procedure would be to genotype animals for genes conferring resistance and select directly for these genes.

(00-063) Growth and immunomodulatory effects of the seaweed ascophyllum nodosum in Salmonella-infected pigs

http://www.pork.org/ResearchDetail/386/GrowthandImmunomodul.aspx

Our overall hypothesis was that the dietary inclusion of A. nodosum extract (ANE) would enhance growth and immune function in disease-challenged pigs and that ANE would directly modulate the function of pig immune cells. Thus, taken together, the data fail to support our original hypothesis and do not provide adequate justification for incorporation of ANE in diets for weaned pigs.

GENETICS

(08-190) Large scale SNP association analyses of feed efficiency and longevity

http://www.pork.org/ResearchDetail/1366/LargescaleSNPassocia.aspx

The objectives of this study were to: 1) use the newly developed porcine SNP chip to genotype animals from the National Pork Board funded feed efficiency and longevity trials; 2) complete association analyses to determine which markers are associated with the traits of interest; and 3) inform producers of how to utilize this genetic information in selection programs. Many well-known and newly discovered regions of significance were identified throughout the pig genome during analyses for each of these traits. An example of a well-known gene is MC4R which was again found to be associated with ADFI, ADG, and BF in the current study. Hundreds of new regions of significance were also identified which will require more in-depth research to confirm their effects. More detailed results are given in the final reports on National Pork Board grants #08-011 and #08-012. Overall, the findings from this study look very promising. Validation of these results may prove that utilization of some of these markers in MAS can decrease production costs by several dollars per pig in the near future.

(08-011) Large-scale association analyses of candidate genes for feed efficiency traits in pig

http://www.pork.org/ResearchDetail/1364/Large-ScaleAssociati.aspx

This study was conducted with the objectives of identifying genes which impact feed efficiency in pigs, quantifying those effects, and informing producers of how to utilize this information in selection programs. The purpose of this research was to identify markers that can be used in marker-assisted selection (MAS) to improve feed efficiency. Results of this research look very promising for producers. Statistical analyses showed that a genetic marker on chromosome 2 had the largest marker effect for residual feed intake (RFI); markers on chromosomes 3, 10, and 15 also had significant effects on RFI, and many smaller effects were also identified throughout the genome.

(07-139) Identification of biological factors responsible for differences in feed efficiency between selection lines for residual feed intake- NPB 07-161, Selection lines to enhance genetic selection for feed efficiency

http://www.pork.org/ResearchDetail/1339/Identificationofbiol.aspx

Thus, with the ultimate aim to develop genetic tests or indicator traits to select for feed efficiency without the expense of feed intake recording, the objective of this research project was to identify the main biological factors that contribute to differences in residual feed intake (RFI). Results from the experiments that were conducted demonstrated that, compared to the control line, pigs from the efficient line: 1) had different feeding behavior as the Select pigs ate faster and less often, 2) tended to be slightly less active, 3) did not differ much in other behaviors that were studied, 4) were more efficient under both ad libitum and restricted feeding, 5) required less feed to maintain a constant weight, 6) tended to have lower internal organ weights, 7) had a lower fat content of the carcass, 8) had greater dressing percentage, 9) had better carcass composition with limited effects on selected measures of meat quality such as pH and water holding capacity, 10) had decreased carcass lipid content and postmortem protein degradation, 11) had physiological parameters that indicated less protein turnover and energy expenditure in muscle. In conclusion, although a substantial part of differences in feed efficiency as measured by RFI are related to differences in body composition, part of the differences appear related to pen and feeding behavior and to lower maintenance requirements and energy expenditures.

For more information visit pork.org or call (800) 456-7675.

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