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## "Organic Better Than Conventionally Raised Pork?"

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The Pork Industry continues to evolve into multiple pork chains with each chain having different specifications to meet the needs of the consumers for which that particular chain services. A growing market segment is the market for organically grown products. This market has continued to grow at a rate of 20% each year. Part of the appeal for organically grown products is that the consumer is assured that products that are sold with the "organic" label have been produced following strict guidelines involving feeds, feed additives, housing and animal care. In addition there have been claims that these products also have better eating qualities as well.

A recent report from Sweden[a] evaluated pigs that were grown under conventional or organic standards. The Swedish Organic standards were those approved for Sweden following the International Federation of Organic Agriculture Movement (IFOAM) guidelines. Pigs were produced from Large White-Landrace $F_1$ sows and sired by Hampshire boars. The Swedish standards require that pigs reared for the Organic market must be from parents that were raised and maintained on farms following the Organic Standards. Therefore pigs raised following the organic standards were from Organic livestock farms while pigs raised under the conventional system were from conventional farms.

Both barrows and gilts were used in this study. Pigs weighed approximately 60 lb at the beginning of the study and weighed approximately 238 lb at completion. Pigs raised by Organic Standards were housed in large pastures and fed diets according to the regimen required by the Organic Standards. Conventionally raised pigs were housed indoors in pens of 8 with normal square footage allocations and diets. After slaughter, carcass data and meat quality measures were recorded. Hampshire boars sired all pigs within this study. Therefore there were pigs that were carriers for the Napole gene as well as normal pigs. Pigs that are Napole gene carriers have been shown to have paler meat, with more drip loss. This was accounted for in the data analysis.

Pigs from organic farms and raised following Organic Standards grew 0.14 lb/day faster than pigs raised under the conventional system. However, pigs raised following the Organic Standards had 0.15 in. more backfat than pigs conventionally raised and had 2% less percent lean.

Upon evaluation of meat quality traits, pigs raised following Organic Standards did not perform as well as pigs raised under conventional standards. Organically produced pigs had less marbling than pigs produced under conventional methods, even though they were fatter. There was a production system by Napole gene status interaction for percent moisture loss and shear force, an indicator of toughness. Organically raised pigs, that did not carry the Napole gene, lost 3% more moisture than conventionally raised pigs that did not carry the Napole gene. Pigs that were Napole gene carriers had similar moisture loss regardless of production system. The same was true for shear force. Organically raised pigs, that did not carry the Napole gene, had higher shear force values, and

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*What's Inside ...*



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potentially tougher meat, than conventionally raised pigs that did not carry the Napole gene. Pigs that were Napole gene carriers were similar for shear force values regardless of the production system. Furthermore, in a consumer taste panel, consumers could not discriminate between pork raised following Organic Standards or raised conventionally.

This study is one of several that have evaluated organic versus conventionally raised products. These studies do not always agree which suggests that is still much variability in meat products and the production system can but not always modify their acceptability to consumers.

However, persons purchasing organic products have more concerns that just the eating quality of the product. Their interests lie in knowing more about the care and handling of the animals, the feed the animals consume during their life and what the feed contains along with typical consumer concerns of safety. Persons purchasing organic products are purchasing a guarantee of sorts that match their sense of what is the appropriate way that animals should be raised for human consumption, above what is provided for by the federal government within their requirements and inspection guidelines.

Organically raised pork is one of many pork-marketing chains that have developed over the last decade. Though small, it has had steady growth among consumers wanting more assurance about the products they consume. Producers raising Organic Pork must be able to follow and document specific production guidelines that meet the federal organic guidelines within a given country. When purchasing organic products, consumers can be assured that these products have been produced by the guidelines stated within the Organic Standards; however, the eating quality of the product may be no different than conventionally raised pork.

[a]*Olsson, V., K. Andersson, I. Hansson and K. Lundstrom. 2003. Differences in meat quality between organically and conventionally raised pigs. Meat Science. 64:387-297.*

## "Do You Pollute? Development and Utilization of Michigan State University Continuous Emissions Monitoring System "

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The Environmental Protection Agency has indicted agriculture as a primary source of environmental pollution in the United States (EPA 833-F-00-016). Production animal agriculture is increasingly being scrutinized due to its perceived detrimental effects on the environment and the reduction of the quality of life in rural Michigan. Public concerns include: atmospheric nitrification, ecosystem degradation, odor pollution, global warming, acid rain, human health impacts, etc.

The environmental pollution potential of the livestock industry and resulting deleterious impacts upon residents of rural Michigan are primarily determined by the emissions of noxious gases and aerial contaminants developed within livestock production and manure handling facilities.

For animal agriculture to survive and prosper in Michigan it must develop and implement production systems which are sustainable, economically profitable, and environmentally sensitive while ensuring an abundant, wholesome, safe food supply for the consumer.

Development and implementation of production systems meeting these criteria is the responsibility of all Michigan livestock producers. However, it is not the producer's alone, Michigan State University, as a Land Grant Institution, has the duty to provide the leadership, research and education required to ensure the success and sustainability of Michigan's livestock industry.

**Development of the MSUCEM:**

An important first step in controlling the environmental impact of livestock is understanding the composition of gases and aerial contaminants produced from them. Therefore the MSU Waste Management Research Laboratory undertook the task of integrating state of the art environmental monitoring equipment and techniques into the agricultural sector.

The Michigan State University Continuous Emissions Monitoring System (MSUCEM) was designed and developed following an eighteen month review of current research and environmental regulations, discussions with

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industry and academic leaders, and multiple visits to environmental monitoring facilities to assess equipment and observe laboratory procedures.

The MSUCEM system was designed to meet or exceed the American Society of Quality Control national standards, the Environmental Protection Agency quality assurance program for air pollution measurement systems, and the requirements to ensure the quality and accuracy of environmental data as outlined by industry and academic experts (Hartung, 2002). All monitoring sensors and evaluation hardware utilized in the MSUCEM system are certified ISO 9001.

The MSUCEM is very portable and highly flexible in design, allowing for evaluation under both laboratory and in-field conditions. It integrates the most advanced photoacoustic infrared and chemiluminescent technologies available for air quality evaluation and emission rate quantification. The system is designed to allow multi-point, continuous evaluation of temperature, relative humidity, ammonia, methane, nitrous oxide, nitrogen oxides, carbon dioxide, carbon monoxide, hydrogen sulfide and particulate contamination (dust). The accuracy of these measurements is ensured by an integrated calibration system and the unit's ability to compensate for temperature and pressure fluctuation, water-vapor interference, and interactions from other gases present in the sampling environment.

The MSUCEM is expandable and adaptable to meet the specialized needs of future research, with the capability to measure over 250 different gases with minor reconfiguration and minimal expense. The system, as currently configured, utilizes less than half of its data acquisition and control capabilities, thereby providing the opportunity to integrate with complimentary research and management technologies (i.e.: electronic feeding, automatic sorting systems, video analysis for behavior evaluation, etc.).

The CI Technologies Plant2Business[1] family of software provides integrated computer control and data acquisition allowing real time data analysis, rolling averages, historical trending, system diagnostic capabilities and system emergency notification. The MSUCEM is directly linked by satellite to the Michigan State Computer System; this provides four levels of data redundancy (2 onsite, 2 offsite) and allows access to researchers of the information without jeopardizing the security of the MSUCEM unit.

A public website providing real-time data and additional details on the system is currently in design and development.

**Equipment Utilization:**
Multitudes of research utilizing this equipment have been proposed in conjunction with the Departments of Animal Science, Food Science and Human Nutrition and Agricultural Engineering. Examples of these projects include: Quantification of Emissions and Odors from Michigan Livestock Production Enterprises, Dietary Manipulations for the Reduction of Nitrogenous Pollution, The Effect of Air Quality on Meat Attributes and Consumer Acceptability, The Effect of Air Quality on Animal Behavior and Well-being, and the Evaluation of Manure and Composting System Design and Management Strategies.

**Financial Support:**
The development of this new tool was made possible through funding from the Michigan Agricultural Experiment Station, the Michigan Animal Industries Coalition, the EPA Six-States Consortium, and the USDA National Center for Manure and Animal Waste Management.

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[1] Mention of trade names is for information purposes only.

## "Seminal Plasma Repairs Cooling Induced Membrane Changes in Boar Semen "

*Melissa Vandais, Large Animal Clinical Sciences, Michigan State University*

The use of frozen-thawed (FT) semen for artificial insemination within the swine industry results in low fertility rates. This effect on fertility is a consequence of sperm undergoing a capacitation-like reaction during the freezing and thawing process (Green and Watson 2001). Once sperm have undergone the process of capacitation they are capable of fertilizing oocytes; however, if an oocyte is unavailable the sperm die shortly after capacitation. Therefore FT semen has a short duration of time to meet and fertilize an oocyte prior to death.

Green and Watson (2001) demonstrated that the capacitation-like reaction is caused by the cooling of boar sperm to 5 C and is expressed once rewarmed to 39 C. The addition of boar seminal plasma (SP) reduces the percent of capacitated boar sperm incubated in a capacitation-supporting media at 39 C (Harayama et al. 1999). The addition of 20% (v/v) boar SP demonstrated protection in boar sperm cooled to 5 C (Kaneto et al. 2002). It has also been recognized that cold shocked-induced membrane damage in ram sperm was restored following incubation with a solution containing proteins separated from ram SP (Barrios et al. 2000). The aim of this study was to demonstrate the effect of adding SP to boar sperm on this capacitation-like reaction.

Ejaculates from three Yorkshire boars were used for this study. Semen was collected at the Swine Research Facility at Michigan State University and transported back to the lab in a 37 C water bath. Upon arrival to the lab, a 5ml sample of the ejaculate was centrifuged at 23 C for 10 minutes at 600 x g. The semen pellet was then resuspended in 5ml of a capacitating-supporting medium (mM199), both the media and semen were at 37 C. The semen suspension was then cooled to 5 C over 100 minutes or incubated at 39 C for 100 minutes. At the end of the 100 minutes, each sample was centrifuged for 10 minutes at 600 x g in a refrigerated centrifuge held at 5 C or 23 C depending on cooling or incubation respectively. The pellet was then resuspended in 5ml of mM199 at 5 C or 39 C depending on cooling or incubation respectively. The semen suspension was immediately placed in the incubator at 39 C for 10 minutes; after which, it remained in the incubator until after the time of the last slide reading. Seminal plasma (20% (v/v)) was added to the semen suspension not at all, after cooling or incubation, at Hour 2, or before cooling.

Slides were prepared for analysis using Chlortetracycline (CTC) staining directly before and after the 100 minute incubation or cooling period; directly after the 10 minute incubation period (called Hour 0); and at 1, 2, 4, 6, 7, 8 hours after Hour 0. Two slides were prepared for each sample, and 100 sperm cells were counted on each slide. The average of both slides was taken. CTC staining was used to analysis the membrane changes in boar spermatozoa. Four fluorescent patterns were used to demonstrate the progress of sperm capacitation and the acrosome reaction. Fresh (F) spermatozoa (uncapacitated) were characterized by a bright anterior region with a bright acrosome cap, a relatively faint posterior region, and a dark half circle at the equatorial region or by equally bright anterior and equatorial regions and a less bright posterior region. Capacitated (C) spermatozoa were consistent with a faint anterior region, a bright equatorial region, and a faint posterior region. Acrosome reacted (AR) spermatozoa were characterized by a very faint anterior region, a slightly bright equatorial region, and a faint posterior region.

A total of seven separate experiments were preformed with each of the three Yorkshire boars. Three experiments were completed where the semen suspension was incubated at 39 C for 100 minutes: Experiment 1 no SP was added, Experiment 2 SP was added after incubation, Experiment 3 SP was added at Hour 2. Four experiments were performed where the semen suspension was cooled to 5 C over 100 minutes: Experiment 4 no SP was added, Experiment 5 SP was added after cooling, Experiment 6 SP was added at Hour 2, Experiment 7 SP was added before cooling. Experiment 1 established the F, C, AR pattern that was a result of incubation at 39 C. As F spermatozoa declined, C spermatozoa increased, and eventually AR spermatozoa rose as C spermatozoa declined. Experiment 2 showed that SP repaired the capacitation-like reaction within 10 minutes of introduction incubated at 39 C. Experiment 3 demonstrated that there

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was repairing of the capacitation-like reaction. Experiment 4 recognized the F, C, AR pattern with spermatozoa cooled to 5 C. It was also noted that the damage became visible only after rewarming to 39 C. Experiment 5 established that the addition of 20% SP repaired the capacitation-like reaction that occurred during cooling and became visible after rewarming. Experiment 6 illustrated that the capacitation-like reaction was repaired after cooling and rewarming. Experiment 7 demonstrated that 20% SP offered the protection needed to prevent the capacitation-like reaction.

In conclusion, it has been shown that SP is able to repair not only the capacitation-like reaction that occurs when boar semen is cooled to 5 C but also the capacitation process that occurs in a controlled capacitation-supporting environment. The fact that the capacitation-like reaction caused by cooling the sperm to 5 C is not revealed until the spermatozoa are rewarmed to 39 C suggests a possible enzyme related response. The long-term goals of this study are to improve the fertility of sows inseminated with FT semen.

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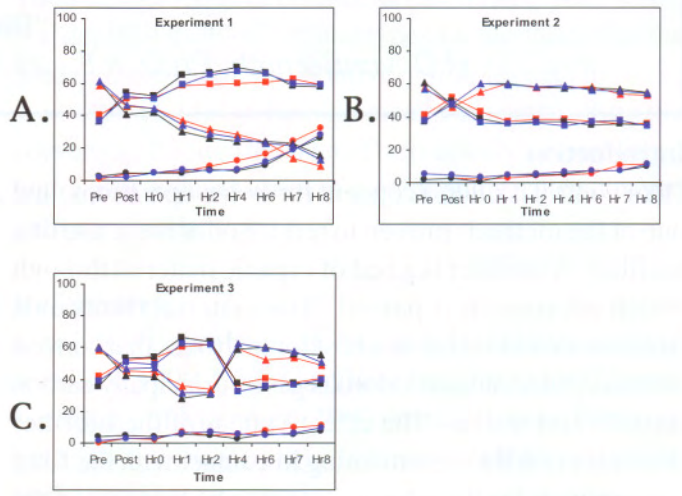


**Figure 1.** Florescent patterns of boar spermatozoa. **A.** Incubation in mM199 with no SP added. **B.** Incubation in mM199 with SP added after initial 100 minute incubation at 39 C. **C.** Incubation in mM199 with SP added at Hr2. The vertical axis represents the percent of sperm population. All three boars (black, red, blue) are included on each graph. Each boar's F, C, AR count at each time point on the horizontal axis sums 100 percent. Time point 'Pre' represents the slide reading prior to the 100 minute incubation. Time point 'Post' represents the slide reading after the 100 minute incubation. ?, ?, ?, represent the Fresh spermatozoa for all three boars. n, n, n, represent the Capacitated spermatozoa for all three boars. ?, ?, ?, represent the Acrosome Reacted spermatozoa for all three boars.

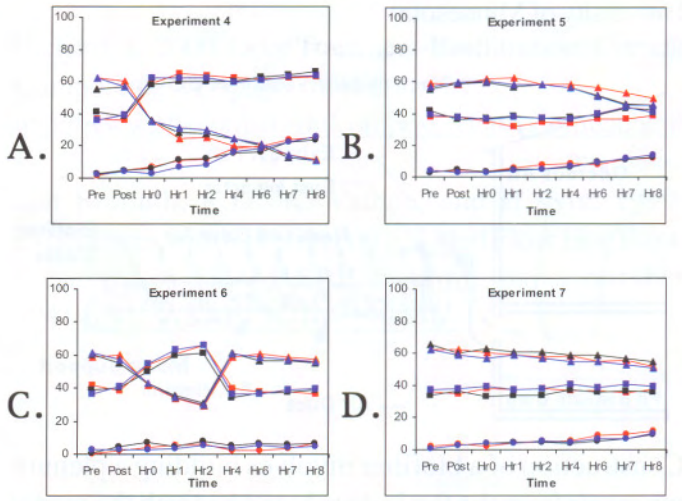


**Figure 2.** Florescent patterns of boar spermatozoa. **A.** Cooled to 5 C in mM199 with no SP added. **B.** Cooled to 5 C in mM199 with SP added after cooling to 5 C over 100 minutes. **C.** Cooled to 5 C in mM199 with SP added at Hr2. **D.** Cooled to 5 C with SP and mM199 then rewarmed in mM199 with no SP. The vertical axis represents the percent of sperm population. All three boars (black, red, blue) are included on each graph. Each boar's F, C, AR count at each time point on the horizontal axis sums 100 percent. Time point 'Pre' represents the slide reading prior to cooling to 5 C over 100 minutes. Time point 'Post' represents the slide reading after the 100 minute cooling period. ?, ?, ?, represent the Fresh spermatozoa for all three boars. n, n, n, represent the Capacitated spermatozoa for all three boars. ?, ?, ?, represent the Acrosome Reacted spermatozoa for all three boars.

## "Biofilters"

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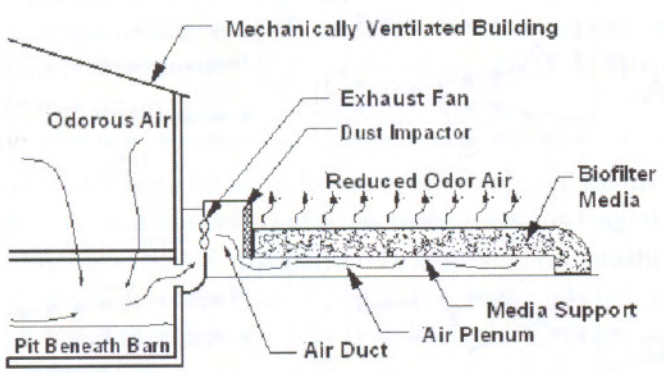
### Introduction

Odor control is often a concern for swine operations, and one of the methods proven to reduce odor is the use of a biofilter. A biofilter is a bed of organic material through which odorous air is passed. The material filters dust from the air and serves as a host for microbes that convert odorous gases into non-odorous gases, principally carbon dioxide and water. The effectiveness of the biofilter depends upon the air remaining in contact with the filter long enough for the odorous gases to be trapped on the medium microbes to break the gases down. Two gases typically found in air from swine facilities are hydrogen sulfide and ammonia, and properly operating biofilters can remove 80 to 95% of those gases.

### Installation

Figure 1 below shows a typical installation.

Figure 1. Typical biofilter installation (from Nicolai, Janni, and Schmidt; Frequently asked Questions about Biofilters; University of Minnesota)




Construction of a biofilter involves building a plenum where air from the fan is distributed beneath the media (usually a mixture of wood chips and compost, from 50 to 70% wood chips) placed upon a slatted floor. It has been found that used shipping pallets work very well as the media support if wire mesh is added on top to prevent the media from falling through the spaces in the pallets.

Biofilters can be installed on just the pit fans or on all the ventilation fans. Typically, the filter must be designed to handle the maximum air flow rate, and summer ventilation rates for swine facilities vary from 120 cfm per animal space (8 $ft^2$ per animal) to 500 cfm per animal space for farrowing.

### Costs

Researchers at the University of Minnesota have found that installation costs run from $100 to $150 per 1000 cfm of air to be treated. Operation and management costs run about $3.00 per 1000 cfm per year. Total costs for a 1,000 head finishing barn with all the ventilation air moving through the biofilter, a five-year life on the medium, and three turns per year are summarized below.

Installation (Fixed cost): Approximately $15,000
Annual operating costs: Approximately $360.

Fixed cost per pig: $15,000/15,000 pigs = $1.00 per pig
Operating cost per pig: $360/3000 = $0.12 per pig
Total cost per pig: $1.12 per pig

### Design

Biofilter design requires the use of mechanical ventilation. An alternative to forcing all of the ventilation air through the biofilter is to run just the pit ventilation air through the biofilter. This will substantially reduce the cost and will reduce odor about 50%.

Typically the exhaust fans in a barn will not develop sufficient pressure to push the air through the biofilter and will have to be replaced. However, if the barn is designed with a biofilter from the beginning, the additional cost is minimal.

In the summer it is important to keep the media moist so that an ideal environment exists for the microbes. In the winter additional moisture isn't necessary, and the warm air from the building will melt any snow that falls on the media.

The design of a biofilter is a tradeoff between cost and effectiveness. Thicker or deeper biofilters are generally more effective but they require more power to push the

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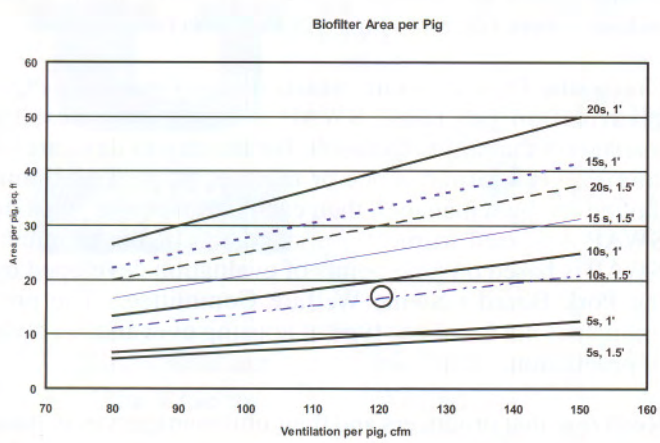
air through. Biofilter thicknesses of one to 1.5 feet are usually most economical, and the contact time required to remove most of the odorous gases should be between five seconds and 15 seconds. The University of Minnesota guideline (Janni, et. al., 1999) recommends 5 seconds. Experience at Michigan State University (von Bernuth, et.al., 1999) would suggest 10 seconds is a better choice. A larger biofilter takes less power but more space and involves somewhat higher installation costs. Figure 2 shows the tradeoff between ventilation and contact time as it impacts the biofilter area per pig. The circled spot on the chart is for 10 seconds of contact time and a 1.5 foot deep filter with a ventilation rate of 120 cfm per pig. This requires 16.7 square feet of biofilter per pig making the biofilter roughly twice the occupied floor area of the finishing barn. If the contact time is reduced to five seconds, the area can be roughly the same as the occupied floor area of the barn if the filter is 1.2 feet thick. I would not recommend contact times less than five seconds. Nicolai, et. al., 2002, give design details. Further information can be found in Richard, 2000.

Figure 2. Biofilter Area per Pig as Influenced by Contact Time and Filter Thickness. (Lines are denoted by contact time and thickness, e.g., [20s, 1'])

## Conclusions

Biofilters can be an effective means of reducing odor from swine operations, and have been accepted by Michigan Department of Agriculture as an odor mitigation technique.




Their design requires consideration of fan capacity, size and depth of the biofilter, and type of material used in the media. Construction is relatively simple, with the most significant addition being a means of transmitting the odorous air through the filter. The is usually accomplished with a plenum and a series of used shipping pallets covered with wire mesh.

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## MSU Swine Team Prepares for SWAP

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The MSU Swine Team is preparing for the implementation of the National Pork Board's Swine Welfare Assessment Program (SWAP). During June's World Pork Expo three of the current Swine Team members traveled to Des Monies, Iowa for SWAP training. These three Team members will be training additional MSU Swine Extension Agents, as well as Veterinarians, who are interested in conducting on farm SWAP evaluations.

SWAP is a proactive response to the animal welfare concerns being addressed toward the swine industry by special interest groups. It is the Pork Board's desire that this producer initiated program be accepted by the National Council of Chain Restaurants and the Food Marketing Institute as their assurance program to address animal welfare concerns.

SWAP is a producer education program. Through SWAP farms are being assessed based on the best information available. Farms are not being welfare assured. Upon completion of a SWAP assessment the educator reviews the farm's strong points and short comings. Areas of concern are discussed along with possible solutions. All information collected during an assessment is left at the farm. The only information requested by the Pork Board is the farm name, location, number of animal assessed and the date of the assessment.

Realizing that SWAP may not be the answer, the second goal of the program is producer awareness. If packers are eventually forced by their customers to submit to special interest concerns by requiring third party welfare audits, how would an individual producer's farm fare? By having participated in SWAP, a producer will have prior knowledge of what a welfare assessment may include. Therefore SWAP participants will have the opportunity to make changes prior to submitting to a third party audit, if the industry were forced to move in that direction.

Unlike the PQA Program which requires only one PQA certification per farm, SWAP is based on assessing manager's that are responsible for the day to day care of animals. If a farm has one or more units, with each unit having its' own manager, then each unit manager must be SWAP Assessed to meet the standards of the program. SWAP is based on nine points of evaluation developed by the Pork Board's Swine Welfare Committee. The program does not favor one type of housing over another style of production.

Realizing that producers and their unit managers may have questions and concerns about the implementation of the program, the Swine Team will be offering educational meetings for farms interested in SWAP. For more information on SWAP contact Swine Team members Barb Straw (517) 353:9831, Ron Bates (517) 432:1387 or Jerry May (989) 875:5233.