MSU Pork Quarterly

Vol. 7, No. 4 "Information for an industry on the move!" 2002

"Manure Production Records to Meet "GAAMP" Guidelines and Assist with CNMP Development"

Gerald May, MSUE North Central Swine Agent, Ithaca

Livestock farms in Michigan with over 1,000 or more animal units will soon begin the Comprehensive Nutrient Management Plan (CNMP) process. Based on the agreement between the Michigan Department of Environmental Quality, Michigan Department of Agriculture, and the United States Environmental Protection Agency, Michigan's large animal feeding operations (those with over 1,000 animal units) will have until September 2005 to declare if they will participate in the Michigan Agriculture Environmental Assurance Program (MAEAP), or be covered under the State's general NPDES permit. Both programs will require the farm develop and implement a CNMP.

To facilitate farms preparing for the CNMP process the "Pork Quarterly" will publish articles intended to help farms prepare for developing and implementing a CNMP. While these articles will assist with CNMP development, they will be based on the minimum standards that all farms must follow to meet the *Michigan Right to Farm Act* "GAAMP's".

The first step for all farms is to implement a record keeping system that meets the guidelines of the Manure Management Systems Plan (MMSP) outlined in the "GAAMP's for Manure Management and Nutrient Utilization".

Soil test all fields that will receive manure applications. Michigan is a phosphorous based state. Fields available for manure applications, and the application rate, are determined by the phosphorous level of the field. Fields testing less than 150# P per acre may receive manure applications to meet the nitrogen needs of the crop to be grown. Fields testing between 150# P and 300# P may receive manure applications to meet the phosphorous uptake of the next four crop years, or the nitrogen needs of the crop to be grown, which ever is less. Soils testing over 300# P should not be used for manure applications until they test below 300#. Soil tests should be no more that three years old. Local agronomists will assist with soil testing, or MSU Extension Offices have for sale soil test boxes from the MSU Soil Testing Lab.

Estimated manure production from all sources should be recorded. Estimating manure production may include recording the loads of manure removed from a manure source during each manure removal. To increase the accuracy of this method an accurate estimate of the volume of each manure spreader or tanker must be obtained. Records of estimated manure production may be developed using book values obtained from the Mid West Plan Service 2002-18 "Manure Characteristics", but these estimates will be less reflective of manure production on individual farms.

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What's Inside ...

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A manure test from each source of manure production should be maintained as part of a farm's manure records. Just as soil tests help to determine the manure application rate, manure tests are needed to calculate the correct manure application rate to meet the expected needs of the crop to be grown. A listing of manure testing labs is available at http://www.MAEAP.org/ or http://web2.msue.msu.edu/manure/.

Manure applications need to be recorded to document that all applications meet the appropriate crop requirements and application safeguards. These application records need to include the source of the manure, which field the manure was applied on, the amount of manure applied, the date of application, when and if the manure was incorporated, weather conditions on the date of application, the application equipment, and the name of the equipment operator. These records are similar to fertilizer and pesticide application records that farms are now regularly recording. MAEAP along with interested producer groups, including Michigan Pork Producers Association, have developed a pocket notebook that facilitates this record keeping. These notebooks are available at local MSU Extension Offices.

Maintaining records that meet the requirements of a MMSP will document that a farm is environmentally sound, and assist farms with the CNMP planning process.

For more information on manure management and CNMP development visit the MAEAP web site at: http://MAEAP.org/ or the MSU Extension Manure Resources site at http://web2.msue.msu.edu/manure/.

"Pig Survival is Important!"

Ronald O. Bates, State Swine Specialist, Michigan State University

The title of this article is at a minimum overstating the obvious and probably bordering on ridiculous. However, much work and effort goes into managing gestating and lactating sows and nursing pigs to improve piglet viability at birth and maintaining low mortality rates through weaning and on to market.

However, there has been only sporadic work to look at the genetic and phenotypic relationships of survival to determine how best to improve piglet viability. It must be recognized that piglet survival is both influenced by the sow and the piglet itself. Recently[a] a comprehensive evaluation of a large data set (30,000 records) was completed where each piglet was weighed at birth and its outcome (survival and performance data) recorded.

This works confirms the notion that piglet birth weight does play a role in improving the odds of pig survival; however, only marginally. This relationship is more environmental than genetic in nature. What this suggests is that pigs while developing in the uterus before birth may get random assistance to be heavier birth, which improves their odds of survival. However, the genetic relationship, that is genes of the developing pig that influences its weight at birth, do not influence its ability to survive once its born.

It is true that the sow can influence pig birth weight and also piglet survival. The genetic relationship for the sow between birth weight of pigs in litters she farrows and survival rate is favorable. In other words, sows from families with a history of having heavier litters tend to have litters with a higher survival rate. However, the genetic makeup of the pigs in the litter are different than the genetic makeup of the sow. The result is that sows with heavier birth litters tend to have better litter survival rate but a pig by itself with a heavy birth weight does not necessarily have better survival odds.

There has been some preliminary work in estimating survival rate Estimated Progeny Deviations or EPDs to determine the genetic merit for survival rate. In this preliminary work, 107 sows with poor EPDs for survival rate were compared to 108 with favorable EPDs for survival rate. In their subsequent litters, the expected difference for piglet survival from birth to weaning, calculated from the EPDs, was 4.97% between the two groups (average of the favorable group minus the average of the poor group). The observed difference in piglet survival to weaning was 4.7%. There were differences between the litters of the favorable survival and poor survival groups. Pigs from sows with favorable survival

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EPDs had slightly smaller individual pig birth weights (.05 lb) but their total litter birth weight was heavier than litters from sows with poor EPDs for survival rate. Litters from sows with favorable survival rate EPDs also had less birth weight variation than litters from sows with poor EPDs for suvival rate, suggesting better uniformity in piglet birth weight, than litters from sows with poor EPDs for survival rate.

There has been a developing consensus that improved uniformity for litter birth weight does improve piglet survival rate. In addition, it appears that litters with more uniformity do also have somewhat lighter individual piglet birth weight. This suggests that litters with more uniform birth weights will probably have somewhat lower individual pig birth weights than litters that are less uniform. However, even though individual pig birth weight is slightly lower in the uniform litters, survival rate is typically improved.

If this is true and increased birth weights don't dramatically improve survival rate it becomes important to know what mechanisms may be involved in improving the odds for pig survival. There are many options and some of course are related to the sow as well as the pig. The management and care of the sow has a very important role in piglet survival. This includes feeding, housing, health status, season of the year along with the sow's genetic merit for taking care of litter, both while in the womb as well as during lactation. However, it also appears that both the energy reserve status of the pig at birth and its ability to thermoregulate body temperature once its born are important. It has been found that Meishan pigs have higher survival rate at a given birth weight, than pigs of typical breeds and lines, and more adeptly thermoregulate body temperature over a wider range of environmental temperatures. Meishan pigs are smaller at birth and have higher body energy stores at birth than commercially usable breeds and lines. This suggests that at a given birth weight pigs with higher energy stores (fatter) can better adjust to differing environmental temperatures and more adeptly survive than piglets with lower energy stores (leaner). This difference between pigs with good and poor odds for survival rate for thermoregulation and energy stores as nursing piglets may lead to the 0.5 genetic correlation that was determined for survival rate and backfat thickness. This indicates that pigs that are genetically fatter tend to have better odds for survival rate. Selection for improved lean content over the last 20 years, may have reduced the energy stores of a pig at birth and reduced its ability to thermoregulate its body temperature.

Knowing that both the sow and the pig itself influence a piglet's ability to survive impacts both selection programs and commercial pig management programs. Seedstock producers can start to implement a component for survival rate in their selection plans by knowing which families have higher survival rate odds. Commercial producers can be more diligent in managing the gestating and lactating sow so that litters have higher birth weights and sows are fed to milk as well as possible to help the nursing piglet improve energy stores after birth. In addition, commercial producers can evaluate and possibly improve nursing piglet environment so to decrease dramatic swings in environmental temperature from birth to weaning, since most pigs today are leaner and thus may have difficultly themoregulating their body temperature across a wide range of environmental temperatures.

[a]Knol, E.F., J.I. Leenhouwers and T. van der Lende. 2002. Genetic aspects of piglet survival. Livestock Production Science. 78:47-55.

"Sows Fertility to AI at a Gonadotropin-Induced Estrus and Ovulation"

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Fabio De Rensis, College of Veterinary Medicine, Michigan State University

Introduction

An important economic objective in pork production is to maximize the output of weaned pigs, which will depend on live pigs born per sow per year. A retrospective analysis of farm data has shown that for most farms, the most important factor influencing the variance in weaned pig output was the number of sows served per week (Dial et al., 1996). This emphasized the need to meet a farm's breeding target. The duration and variability in the wean-estrus interval can influence the ability to meet the breeding target.

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When less than 90% of weaned sows return to estrus by 7 days, hormonal induction of estrus may be warranted. In weaned sows, a common protocol for the induction of estrus and ovulation is the injection of a combination of 400 IU equine chorionic gonadotrophin (eCG) and 200 IU human chorionic gonadotrophin (hCG) (PG600®). However, while injection of gonadotrophins at weaning has proven efficacious for estrus induction, it does not permit an accurate timing of ovulation. Indeed, by inducing an earlier onset of estrus the interval between estrus onset and ovulation will increase, making the prediction of time of ovulation more difficult (Knox et al., 2001). A common protocol for timing the onset of ovulation is an injection of eCG. Ovulation will occur close to 40 hours after the hCG injection (Wiesak et al., 1990; Hunter et al., 1993). In the USA, eCG is not available for swine but PG600 will have the same effect.

Previous research has demonstrated that the efficacy of gonadotrophins for inducing a fertile estrus during lactation is influenced by day of lactation when treated (Hodson et al., 1981), with the best fertility obtained when sows were treated at 25 days post partum. To our knowledge, the efficacy of hormone treatment before weaning for minimizing the wean-estrus interval while maintaining subsequent farrowing rate has not been examined. The present studies were undertaken to examine the effect of injections of gonadotrophins before weaning on the wean-estrus interval and sow fertility.

Material and Methods

Experiment 1:

Two days before weaning during November and December, 2001, 228 parity one and parity two sows of Large White and Landrace breeding (Cotswold) were assigned to one of three treatments on the basis of parity and litter size nursed. Sows received an intramuscular (IM) injection of PG600® (Intervet) 2 days before weaning (n=75), or on the day of weaning (n=76). The third group received no injection and served as controls (n=77). The target lactation length was 18 days and sows were weaned into individual gestation stalls.

On the day of weaning, sows were exposed to a mature boar each morning to facilitate the onset and detection of estrus. Sows were artificially inseminated with 3×10^9 sperm at the detection of estrus and again 24 hours later. Semen doses were used within 72 hours from collection and sires were equally represented among treatments. Data recorded were pre-treatment litter size suckled, lactation length, wean-estrus intervals, whether the sow farrowed to the first service, and subsequent litter size.

Experiment 2:

During September and October, 2001, 228 Landrace x Large White multiparous sows on two commercial farms near Parma, Italy, were assigned to receive an IM injection of PG600® at 4 days before weaning (n=88) or to serve as untreated controls (n=140). The target lactation length was 24 days.

At weaning, PG600®-treated sows received an injection (IM) of either 750 IU hCG (Chorulon®, Intervet; n=45) or 10 μg GnRH (Receptal®, Intervet; n=43) and were transferred to individual gestation stalls. Twice daily, sows were exposed to a mature boar to detect the onset of estrus. Sows were artificially inseminated with 3×10^9 pooled sperm at the detection of estrus and then at 24-hour intervals while still exhibiting standing estrus. This also allowed an estimate of duration of estrus to be obtained. Sows were re-housed into groups of 4 or 5 at 21 days after insemination.

At the time of PG600 injection and on the day of weaning, 20 sows per treatment were subjected to transrectal real-time ultrasonography (RTU) using an Aloka SSD 210 DX with a 7.5 MHz linear array transducer. At each time, the size of a minimum of the 3 largest ovarian follicles was recorded. Other data recorded were wean-estrus interval, duration of estrus, whether the sow farrowed to the first service, and subsequent litter size.

Statistical Analysis

For the purposes of data analysis, only sows exhibiting estrus by 20 days after weaning were included, with other sows being designated as anestrus. This minimized the possibility of including data from sows having a missed first estrus and then being detected at their second post weaning estrus. Proportional data were compared using Chi square, while all other data were subjected to analysis of variance.

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Results and Discussion

In experiment 1, the injection of gonadotrophins at weaning resulted in more sows being detected in estrus by 7 days compared to controls (P<0.05, Table 1). The effect of injecting the gonadotrophin before weaning was intermediate (P<0.08). Compared to controls, the mean wean-estrus interval was shortest (P<0.001) for sows injected before weaning. The mean for sows injected at weaning was intermediate (P<0.02) (Table 1). However, it is interesting that compared to injection of PG600 at weaning, injection of PG600 at 2 days before weaning resulted in a further reduction in the wean-estrus interval of less than 1 day. The reason for this is that while many sows injected preweaning had wean-estrus intervals of 3 days, many also did not return until 4 to 5 days. In experiment 1, the farrowing rates and subsequent litter sizes were unaffected by treatment.

In experiment 2, gonadotrophin-treated sows had larger (P<0.001) ovarian follicles at the time of weaning than did the control sows (5.9±0.2 vs. <3 mm). These data confirm the ability of gonadotrophins to induce ovarian follicular development in lactating sows (Britt et al., 1985). However, more (P<0.02) control sows were detected in estrus by 20 days after weaning compared to gonadotrophin-treated sows. The etiology of this difference in response is unknown.

The wean-estrus interval was shorter (P<0.001) in sows receiving PG600 at 4 days before weaning (Table 2). Further, the very short mean wean-estrus interval (1.1 days) indicates a normal follicular response to gonadotrophin even though suckling was ongoing. The duration of the estrous period tended (P<0.1) to be longer for the gonadotrophin-treated sows (Table 2). These data are consistent with the established belief that a shorter wean-estrus interval is associated with a longer duration of estrus (Weitze et al., 1994; Steverink et al., 1999).

Table 1. Effect of injection of PG600 at 2 days before weaning on sow fertility (means± SE; experiment 1)

	Prewean PG600	Wean PG600	Control
Number of sows	75	76	77
Estrus by 7 days	61 (81.3%)[a]	63 (82.9%)[b]	53 (68.8%)
Estrus by 20 days	69 (92.0%)	65 (85.5%)	70 (90.9%)
Wean-estrus interval,[d]	4.5±0.2[d]	5.1±0.3[c]	6.1±0.3
Farrowing rate, %	62.7	77.0	65.8
Litter size total born	10.1	10.9	9.9

Values differ from control: a, P<0.08; b, P<0.05; c, P<0.02; d, P<0.001

There was no evident effect of treatment on subsequent litter size in experiment 2. However, gonadotrophin treatment was associated with a higher (P<0.003) farrowing rate (Table 2). Although speculative, it seems reasonable to suggest that the addition to the protocol of either GnRH or hCG to induce the ovulation was involved. The induction of a rapid return to estrus with an associated longer estrous period will result in a longer interval between estrus onset and ovulation. Under these conditions, the administration of hCG or GnRH will more reliably result in a predictable time of ovulation in sows. This would result in optimum timing of insemination relative to the time of ovulation and, in turn, would improve fertilization rates and the subsequent farrowing rate.

In conclusion, we have demonstrated that gonadotrophins can initiate final follicular development in lactation sows. When these sows are weaned at or following the expected

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Table 2. Effect of injection of PG600 at 4 days before weaning and GnRH or hCG at weaning, on sow fertility (means± SE; experiment 2)

	PG600	Control	P Value
Number of sows	88	140	
Estrus by 7 days	72 (81.8%)	122 (87.1%)	0.3
Estrus by 20 days	77 (87.5%)	135 (96.4%)	0.02
Wean-estrus interval, d	1.1±0.2	5.1±0.2	0.0001
Duration of estrus	2.6±0.07	2.5±0.05	0.1
Sows farrowing	73/77 (94.8%)	106/135 (78.5)	0.003
Litter size born alive	10.0±0.18	9.8±0.16	0.4

time of estrus onset, fertility is maintained. Further, if GnRH or hCG is employed to induce a predictable time of ovulation, the potential to improve the timing of insemination relative to the time of ovulation may enhance sow fertility.

Acknowledgements

This research was supported by short-term mobility (CNR) and FIL (MURST). We thank Dr's S. Sgoifo, Intervet Italy, and J. Jorgensen, Intervet Canada, for providing the hormones used in this study. The management and staff of Azienda La Badia, and Benedetti farms are gratefully acknowledged for allowing access to their facilities.

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BREEDING MANAGEMENT WORKSHOP
January 20, 2003

The objectives of this one-day course are to review the practices of estrous detection, breeding management, and pregnancy detection. At the end of the day, participants will have knowledge of the estrous cycle and its control, artificial insemination, and detection of pregnancy.

09:00-09:45 (lecture) – The Estrous Cycle and its Control
This discussion will outline the basics of the physiology and endocrinology of the estrous cycle. The control of estrus will encompass the use of the boar and exogenous hormones.

10:00-10:45 (lecture) – Gilt Housing and Feeding
This discussion will address best practices for housing and feeding management of gilts. The objective is to examine effects on fertility and longevity.

11:00-11:45 (lecture) – Artificial Insemination and Pregnancy Detection
This discussion will address how and when to perform an artificial insemination. Also covered will be early embryo development and detection of pregnancy using A-mode, Doppler and RTU.

12:00 LUNCH

1:00-end (Swine farm) - Estrous detection, artificial insemination, and detection of pregnancy (RK & RB).

NOTE: Persons participating in the on-farm portion of the program must be away from all other pigs for 48 hours and will have to shower at the Main Swine Farm and use the farm's clothes during the session. Morning session will be held at Pavilion for Agriculture and Livestock Education on the MSU campus with the afternoon program being held at the MSU Swine Farm.

FEE: $25.00 ***Registration form due by January 17, 2003***

Breeding Management Registration

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Remit payment to:

Dr. Ronald Bates
Department of Animal Science
1205 Anthony Hall
Michigan State University
Eat Lansing, MI 48824

FEE: $25.00
Make checks payable to Michigan State University

All participants will receive a letter acknowledging receipt of registration and a campus map.

1. **Jerry May, North Central Swine Agent**
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5. **Roy Kirkwood, Extenstion Swine Veterinarian**
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6. **Laura Cheney, Extension Livestock Economist**
Michigan State University
(517) 432-0089

7. **Roger Betz, Southwest District Farm Mgt.**
Finance, Cash Flow, Business Analysis
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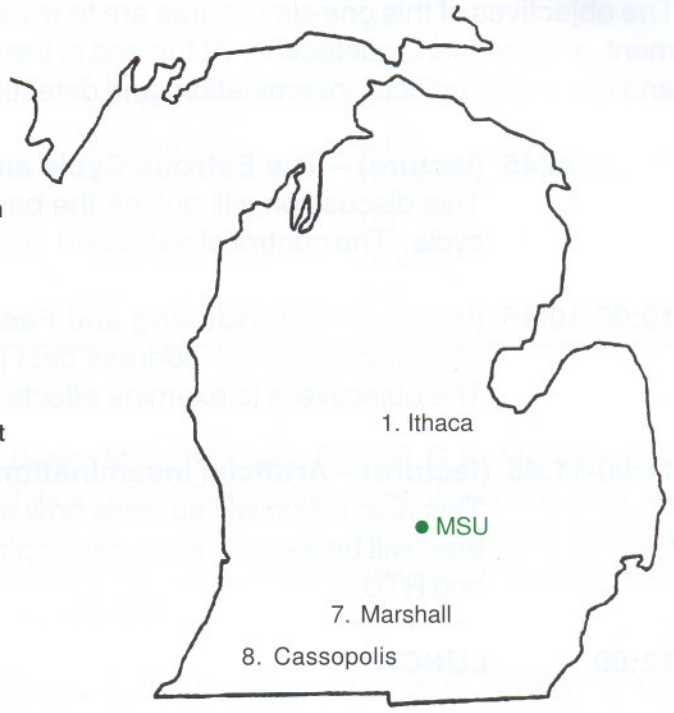
8. **Sarah Pion, Southwest Swine Agent**
Nutrition and Management
(616) 445-8661

All comments and suggestions should be directed to:

MICHIGAN STATE UNIVERSITY EXTENSION



UPCOMING BREEDING MANAGEMENT WORKSHOPS

Michigan State University Extension Swine AoE Team will host two workshops on breeding management in January and March of 2003. Both will be held at the Pavilion for Agriculture and Livestock Education on the MSU Campus, East Lansing. Each workshop will have a "hands on" component that will be held at the Main Swine Farm on the MSU Campus. Persons participating in the on-farm portion of the program must be away from all other pigs for 48 hours and will have to shower into the Main Swine and use the farm's clothes during the session. The following is an outline for the two workshops.

January 20, 2003
Breeding Management

Topics included will be:
1. Estrous Cycle and its control
2. Gilt housing and feeding
3. Artificial insemination and pregnancy detection
4. On-Farm Session: Estrous detection, artificial insemination and pregnancy detection.

March 3, 2003
Breeding Herd Management

Topics included will be:
1. Introduction of gilts into the herd
2. Boar semen collection and extension
3. Trouble shooting reproductive problems.
4. On-Farm Session: Semen collection, extension and evaluation.

Registration information will be in the next issue of the Pork Quarterly. For more information or to make your reservation contact: Roy Kirkwood (Ph:517-432-5198; email: kirkwood@cvm.msu.edu) or Ron Bates (Ph:517-432-1387; email: batesr@msu.edu) .