



# pork industry handbook

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

## Managing Sows and Gilts for Efficient Reproduction

### Authors:

John R. Diehl, Clemson University  
James R. Danion, Auburn, University  
Leif H. Thompson, University of Illinois

### Reviewers:

Tro V. Bui, Cornell University  
Wray and Nancy Garrison, Lovell, Wyoming  
Gene and Bev Gentry, Farmington, Iowa  
Duane Miksch, University of Kentucky

Every producer should give the highest priority to management of females in the breeding herd to achieve maximum reproductive efficiency. Good reproductive management will pay dividends by increasing the number of live pigs farrowed. Similarly, good nutritional management can improve the size and viability of pigs at birth. The more live pigs farrowed, the greater the likelihood that there will be more at market weight. The purpose of this fact sheet is to identify important points of reference in the reproductive life of the sow which respond to good management by yielding additional live pigs at farrowing.

### Prebreeding Management

**Gilt Management.** Selection of females for replacement is only the start of managing for highest reproductive efficiency. Gilts should be selected from family lines that have superior mothering ability (refer to PIH-27). A good indication of the female's ability to function normally is whether she will start coming into heat at an early age. Gilts may start cycling as early as 5 months of age (Table 1). The general recommendation regarding age at first breeding has been to wait until the third heat to take advantage of any increase in ovulation rate. In swine units where the breeding groups are kept inside, gilts not bred at first heat may stop cycling. It is recommended that gilts not reaching puberty by 9 months of age be culled from the breeding herd. The decision to breed on first or third heat should be based on more factors than the possibility of increasing ovulation rate by one or two eggs. Fluctuating prices for feed, labor and facilities, salvage values of breeding stock, market expectations, etc. can create temporary situations that make it unprofitable to wait until 7 or 8 months of age before breeding gilts. But be aware that there will likely be fewer rebreeding and lactation failure problems if gilts are first bred at their second or third estrus.

**Table 1. Normal time for puberty, estrus and ovulation.**

Age at puberty	5-8 months
Weight at puberty	150-250 lb.
Duration of estrus	5 days (2 avg.)
Length of estrous cycle	18-24 days (20-21 avg.)
Weaning to estrus	3-8 days (5 avg.)
Time of ovulation	40 hours (from onset of estrus)

Mixing or regrouping gilts (with boar contact) at about 160 days of age can be beneficial and help to advance the date of first estrus, especially when they're not raised in dirt lots. Those not bred after 3 weeks of heat checking should be remixed to stimulate anestrus females. This may help synchronize the first heat and, to a lesser degree, the second heat.

Seasonal differences in age at first heat are a widespread problem. In general, research has indicated that fall-born gilts reach puberty at a lighter weight and at a younger age than spring-born gilts. Boar exposure decreased age and weight at puberty in spring gilts but not in fall-born gilts. In a Canadian report, an average of 9.7% of the gilts weighing 195-200 lb. that were slaughtered from June through September had reached puberty; whereas an average of 22.8% of gilts slaughtered from January through June had attained puberty.

Anestrus conditions (absence of standing heat) may be the result of a number of conditions:

1. Faulty heat detection
2. Hot weather stress
3. Silent heat (ovulation with no visible sign of heat)
4. Sickness
5. Nutrition (lack of protein and/or energy)
6. Social stress

**Heat Detection.** Good systematic heat detection is critical for achieving a high pregnancy rate and faulty detec-



tion is a major cause of problems. Heat is the time the female accepts the male for mating. A good method to detect heat is to bring a boar into a pen of females. The producer then should apply back pressure to each female in the presence of the boar. Nearly all females that are in "standing heat" will allow the man to sit on their back. Most sows or gilts will respond by standing solidly and attempting to stiffen their ears erect (called "popping-their-ears"). If females do not stand solidly and pop their ears, they are not in heat. Particularly in gilts, the vulva may be swollen and/or nervousness may be noticed before and after standing heat.

**Effect of High Temperature.** High temperature (above 85 F.) will delay or prevent the occurrence of heat, reduce ovulation rate and increase early embryonic deaths. Michigan studies showed that gilts exposed to 104 F. for 2 hours daily from 1-13 days postbreeding had reduced embryo survival by as much as 35-40%. Other studies at Illinois and Oklahoma show similar results from heat stress. Based on records of conception rates, the number of boars used and females kept in the breeding pool should be adjusted, especially in the hot months. See Table 2 for suggested adjustment factors. Animals also suffer similar stress from high body temperature when they get sick and have a fever. More variation in the length of standing heat can be expected due to hot weather. Not only does temperature have detrimental effects, but decreasing length of days and relative humidity can also interact to multiply the problems a producer may encounter during the summer months. An individual producer must do a good job of selecting replacement breeding stock that are reproductively efficient under his management system to minimize the effects of heat stress.

**Table 2. Suggested coefficients to determine the number of females to be bred each month.<sup>a</sup>**

Month	Coefficient
January	1.25
February	1.28
March	1.35
April	1.43
May	1.52
June	1.64
July	1.69
August	1.82
September	1.52
October	1.35
November	1.30
December	1.25

<sup>a</sup>Numbers to breed each month = (number of farrowing stalls) x (coefficient).

The effects of heat on the boar's reproductive capacity are decreased sex drive, lowered sperm output and lowered sperm fertility. If rectal temperature increases as little as 1 F. for 72 hours, sperm production is decreased by 70% or more. Once sperm production is affected, normal numbers of fertile sperm are not attained for at least 4-6 weeks. See Pork Industry Handbook Fact Sheet PIH-87, *Cooling Swine*.

Keep group sizes to 15 or fewer if possible to minimize peck-order fighting and help insure that all females receive their day's ration of feed. The use of individual stalls may prove to be economically feasible to cut down social stresses associated with the breeding herd.

**Sow Management.** Sows occasionally come into heat while their litter is still nursing, especially if lactation lasts

beyond 5-6 weeks. If a sow does express heat while she is nursing, she most likely will not return to heat within 3-7 days postweaning.

Selection for sows that do cycle within 7 days postweaning is very important to keep management schedules running smoothly. A number of producers use early return to heat as a prime consideration for retaining sows in the breeding herd. This criterion automatically selects a female capable of successfully contending with the stresses of living in a particular environment. If a sow fails to conceive within 28 days postweaning, she should be culled. This is enough time for her to have been in estrus twice. With each 21-day delay, the sow must produce one to two extra pigs just to pay for the extra labor and feed. Similarly, if cycling gilts do not conceive after three estrous cycles, they should be culled so as not to increase the number of "hard breeders" in future generations.

If adequate nursery facilities are available, weaning is recommended at 3-4 weeks of age so the sow can be returned to production as soon as possible. Results of one study conducted in England show a decrease of about three pigs per litter when sows were weaned and bred before 21 days of lactation. Weaning groups of sows at an average litter age of 3½ weeks is usually a good practice to follow.

If postweaning scours are a problem, postpone weaning for another week or more; then leave the litter in the farrowing area an additional week. This will extend scours protection provided by the sow's milk. An extra week will allow additional time for the pigs to get started eating dry feed. Sows in thin condition should be on a high plane of nutrition and in a weight-gaining status before breeding. This will assure maximum ovulation rate as far as nutrient intake is concerned.

Synchronization of heat in sows is a relatively simple matter when pigs are weaned from a group of sows at the same time. A high proportion of sows that are in good physical condition will begin to come into heat within 3-7 days postweaning. Adequate boar power is essential for synchronization of postweaning heat to be effective. If your sows do not respond, analyze your production system and try to determine the cause.

**Herd Health.** Abortions, mummified fetuses, stillbirths and irregular estrous cycles are indicative of potential disease problems. Pseudorabies, parvovirus and enterovirus may also be responsible for the occurrence of mummies. There are no treatments for any of the viral diseases. Consult with your swine veterinary practitioner for vaccines effective in preventing viral diseases. Leptospirosis and brucellosis continue to cause losses. Their symptoms can be inconsistent. Irregular cycles should raise suspicions regarding these infections and appropriate vaccination and blood testing can lead to their effective control. If there is any question about the health status of the breeding herd, consult with a swine veterinary practitioner and review your herd health program.

## Breeding Management

The all-important factor in achieving a high conception rate and good litter size is to get sperm into the female's reproductive tract at the time when pregnancy rate and litter size will be maximized. Regardless of the method of breeding (i.e., pen mating, hand mating or artificial insemination), an adequate number of live sperm must be in the tract a few hours before ovulation occurs or conception rate and litter size will be reduced. Figure 1 shows the effect on conception rate of breeding at various times in relation to time of ovulation. Notice that when heat lasts 48 hours a female will ovulate 8-12 hours before the end of



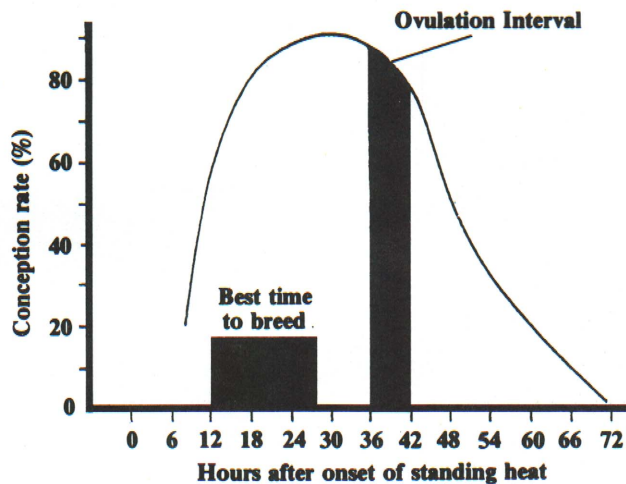


Figure 1. Effect of time of insemination on conception rate in swine.

standing heat (37-40 hours after the onset of standing heat). When mating occurs too early or too late, conception rate and litter size drop very rapidly.

The general recommendation for optimal breeding is based on the number of times per day a producer checks the females for signs of standing heat. With once-a-day heat detection, breed the females each day they will accept a boar. With twice-a-day detection, breed at 12 and 24 hours after they are first detected in heat. Heat detection should always be done in the presence of a boar to maximize the chances of detecting all possible females in heat. This applies specifically to producers using hand breeding or artificial insemination rather than pen breeding.

Abnormalities in the estrous cycle do occur. Gilts will sometimes have less than a two-day heat period. If this happens, they are most apt to ovulate shortly after going out of heat. If short heats are a problem, then gilts should be bred as soon as they are detected in heat and each succeeding 12 hours they will stand. When the period of male receptivity lasts longer than three days, chances are females may not conceive; so it is probably a waste of time and boar power to continue to breed her after the third day.

Producers using unobserved (pen) mating must have plenty of boar power available. For each 10 sows use one mature boar (over 1 year of age) per 21-day breeding period. Decrease that ratio to 4-6 sows for each young boar (less than 1 year). A sow-to-boar ratio of 4 to 1 for mature boars and 2 to 1 for young boars is recommended when sows are weaned in groups. When hand mating, the mature boar should not breed more than 2 females a day if he is to be used intensively for more than a couple of days, or the sperm reserve and/or sex drive will be decreased. Artificial insemination is extremely useful in this situation since it is possible to breed 10 or more sows with the sperm harvested from one ejaculate (see PIH-64). Using individual stalls during the first 30 days of gestation will significantly increase litter size, and possibly conception rate, during the late summer and early fall months. They help reduce social stresses encountered in group housing and insure access to feed. This is especially important for first litter sows and pubertal gilts.

An additional boost in conception rate and litter size can be obtained by using more than one boar on each female (double mating). This maximizes the chance that a highly fertile and compatible boar will be used on the

female. It is easiest to accomplish when using hand mating or artificial insemination. This can be done when pen breeding by rotating boars at least once every day from pen to pen. Sex drive can be enhanced in boars by frequent rotation.

The labor requirement is lowest for pen breeding. However, in most cases breeding dates are not known, so if one is to be present during farrowing, a greater amount of time spent in the farrowing house is required. Less is known about the mating performance of the males or females; therefore, problems such as origin of blood in semen, inability to couple properly and others are more likely to occur without being noticed. This makes it more difficult to keep accurate records of individual performance.

**Pregnancy Detection.** Electronic pregnancy diagnosis is a reality. With the ultrasonic detectors, a producer can find out with a 90-95% accuracy how many females have settled early in gestation. These machines are most accurate and give the best return per dollar invested when they are used between 30 to 45 days after breeding. The economic advantage and accuracy drops off rapidly after 45 days.

If bred females are observed for return to estrus at 18-25 days following mating, electronic heat detectors are not needed. Most producers do not remove open females from gestation pens before 90 days. Assuming feed costs amount to \$0.35-0.50/day for open or pregnant females, and that an average of 10% of all females bred will not conceive, it costs about \$30 to maintain an open female between days 30-90 postbreeding. Therefore, a pregnant sow must produce 3 extra pigs just to pay for each open female's feed cost. On this basis a producer farrowing 300 litters per year can pay for a pregnancy testing machine within two years.

**Nutrition.** It is important that brood sows and gilts get the proper amount of nutrients for successful reproduction. Feeding in excess is not only wasteful and costly but may increase embryonic mortality. A limit-feeding system using balanced, fortified diets is recommended. It insures that each sow gets her daily requirements of nutrients without consuming excess energy.

As a rule of thumb, 4 lb. of a balanced ration will provide adequate protein and energy. During cold weather, an additional pound or two of feed, depending on the type of housing, may prove beneficial, especially for bred gilts and thin sows. With limit-feeding it is extremely important that each sow gets her level of feed and no more. One of the following systems may be used to restrict energy intake of gestating females: daily individual limit feeding or interval feeding.

The daily feeding of a limited amount to each individual is the most popular system, and its success is based on having an adequate number of feeding stalls or space for individual animals. The individual stall is best because it prevents the "boss sows" from taking feed from slower-eating or timid sows. However, individual feeding takes more labor if it is not mechanized. Self-feeding for given intervals (1 day every 3rd day) takes less labor but is the least acceptable method for two reasons: (1) it costs more to maintain sows, and (2) it is very difficult to control feed intake. Constipation problems can be minimized by feeding a bulky ration for several days prior to the expected day of farrowing. Occasionally, a sow may need some exercise. Remove all feed the day of farrowing.

All animals are territorial and therefore like to have some space identifiable as their own. Use of individual stalls or maintaining small groups, especially during early gestation (through day 30), provides for this need. Some breeds appear to adapt better to stalls than others



(Yorkshire and Landrace) while the Hampshire breed is one considered best adapted to pen or even outside lots. If gestating females are group housed, keep them in as small a group as possible and separate gilts and first-litter gilts from older and fat sows. Comfort and contentment of bred females is important for efficient reproduction. The above factors should be considered to achieve maximum profitability to the breeding herd.

**Introducing New Breeding Stock.** Many producers bringing new breeding stock into their operation create situations that increase herd health problems. This is done when new animals are not properly quarantined. All new breeding stock should be totally isolated for 30 days. Retesting for certain diseases should be done in consultation with your veterinarian. Then during the next 30 days, start commingling by direct contact or reciprocal feeding of fecal material from the new livestock and open females only. In this way the new open females will be able to build an immunity to any new organisms they may encounter. If new boars or gilts have a new virus and it is transmitted to bred females, all the signs of infertility mentioned previously may show up. In addition, near the end of the initial 30-day isolation, test mate boars to females to be culled to observe breeding ability. Use cull females so that if new organisms are present the effect will not be costly. Commercial producers can purchase females or use their own farm-raised females for replacements and upgrade their herd by bringing in new boars or semen. Purebred females should come from a single source at any given time to minimize potential health problems.

### Farrowing Management

Be present when sows farrow, but do not offer any assistance unless necessary. Keep sows as comfortable as possible. The average interval between births is approximately 15-20 minutes unless a problem develops. Producers with more experience in handling farrowing problems may assist the sow in trouble (greater than 25-30 minutes between births). If help is unavailable, consult a veterinarian as soon as possible. Keep the pen clean, remove all afterbirth and supply supplemental heat for the baby pigs. Make sure sows have plenty of fresh water. Check them closely and be sure they remain in good health and properly care for their pigs. If breeding dates and the average length of gestation for sows and gilts is known, you may wish to consider inducing farrowing with Lutalyse® or other prostaglandins to shorten the time required for farrowing observation and facilitate crossfostering of large with small litters. Close observation is recommended to allow attention to be given when problems occur.

### Records

Records in swine production are essential. To keep accurate records, hogs must be identified. A good way to identify individuals is by ear notching at farrowing. See PIH-114 for ear notching numbering systems. Consider using ear tags in place of or in addition to notches for gilts and sows.

Records should be kept on each sow and litter. Figure 2 shows an example of a sow record card. Data from individual record cards can be recorded in a permanent record book and a summary prepared as a partial data base for future selection of breeding stock.

Additional records are desirable in many circumstances to utilize boar power more efficiently and identify breeding problems early. Keep records of the frequency of boar services and, if artificial insemination is used, the date and volume of each ejaculate collected. A record of the date

**Figure 2. Sow record.**

Sow number	_____
Sire number	_____
Breeding date	_____
Farrowing date	_____
Litter number	_____
Litter birth weight	_____
Number farrowed	_____
Live	_____
Dead	_____
Number transferred	_____
Weaning date	_____
Number weaned	_____
Weaning weight	_____
Farrowing problems	_____
Other	_____

and duration of heat is essential for predicting when females will next be in heat, calculating dates for return to heat if conception does not occur, pregnancy checking dates, and the day to bring them into the farrowing house. Computer programs are available for use in keeping, organizing and analyzing records.

### Summary

Commercial gilts should be selected from largest, healthiest litters (based on farrowing and weaning data) as replacements on the basis of their ability to come into heat at an early age and conceive within 3 heat periods after their first exposure to a boar. Sows should be retained on the basis of their ability to conceive within 7 days after weaning, or the earliest time that fits your management schedule. Use of a sow productivity index as developed by the National Swine Improvement Federation is recommended as an added selection tool.

No matter how sperm are placed in the female's reproductive tract, they must be there a few hours before ovulation to maximize the chance of getting the best pregnancy rate and litter size.

During gestation, gilts should be fed so they will gain about 75 lb. and sows should gain about 50 lb. Lactation should last 20-28 days to help insure that baby pigs get a good start and to insure a high rate of embryo implantation in the sow at the first postweaning heat. At farrowing, additional pigs will be saved if an attendant can be present. This also affords the opportunity to correct problems if they occur. Adequate records of individual performance during all phases of the reproductive cycle will be of benefit in upgrading the herd and making it more profitable.

### Related Publications

The following PIH fact sheets contain additional information related to swine production.

- PIH-1 Management of the Boar
- PIH-27 Guidelines for Choosing Replacement Females
- PIH-59 Infectious Swine Reproductive Diseases
- PIH-64 Artificial Insemination in Swine
- PIH-68 Guidelines for the Development of a Swine Herd Health Calendar
- PIH-74 Management of Developing Gilts and Boars for Efficient Reproduction
- PIH-87 Cooling Swine

**G** MSU is an affirmative-action, equal-opportunity institution. Cooperative Extension Service programs are open to all without regard to race, color, national origin, sex, or handicap. Issued in furtherance of Cooperative Extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. J. Ray Gillespie, Interim Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by the Cooperative Extension Service or bias against those not mentioned. This bulletin becomes public property upon publication and may be reprinted verbatim with credit to MSU. Reprinting cannot be used to endorse or advertise a commercial product or company.