COOPERATIVE EXTENSION SERVICE
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Management of Swine Mating

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Introduction

A high reproductive rate is essential to the success of most swine enterprises. When space in the nursery and growing-finishing facilities or farrowing crates are empty because of reproductive failure, the cost of that failure must be covered by those spaces that are occupied. Therefore, buildings must be occupied at 100% capacity for maximum return on investment.

Producers should identify and incorporate a breeding herd program (involving both males and females) to consistently achieve a conception rate, farrowing rate, and litter size that will ensure enough animals for all available space. This approach is especially important during times of low profit margins.

Pen-Mating vs. Individual-Mating Systems

Despite research which indicates that reproductive efficiency is generally higher with individual-mating systems (hand-mating or artificial insemination) as compared to pen-mating, it has been estimated that 75-80% of commercial producers utilize pen-mating. Many producers choose pen-mating as a labor-saving strategy for breeding herd management. However, when the potential loss in reproductive performance is considered, other mating strategies will pay for the increased time and labor.

When deciding on a mating system, producers should consider all of the factors that influence reproductive efficiency, not just the time and labor requirements. This publication will compare several of these factors as they relate to pen- and individual-mating systems, including the effect of mating systems on labor requirements and on the reproductive efficiency of both the sow and the boar.

The Effect on Labor Requirements

With pen-mating, the predominant routine activities that require labor are the rotation of boars between sow pens to help overcome unknown boar infertility problems and the rotation of boars from the sow pens to a separate pen for sexual rest. Routine activities associated with hand-mating include detection of estrus, movement of boars and sows to the breeding area, and supervision of the matings. With artificial insemination, routine jobs will include detection of estrus, collection, processing, and insemination of semen, and cleaning the insemination equipment.

The time and labor requirements for the movement of boars in a pen-mating system have not been documented, but are generally quite low and accepted to be less than the time required for hand-mating or artificial insemination. The amount of time required to perform some of the routine activities associated with hand-mating and artificial insemination is shown in Table 1. These data indicate that less time is required to hand-mate sows or gilts (approximately 22 minutes for sows and 28 minutes for gilts) than to breed them artificially (34 and 43 minutes for sows and gilts, respectively). However, as shown in Table 2, the time required to artificially breed decreases from approximately 35 minutes per animal when only one female is bred to about 17 minutes per animal when eight females are bred. On the other hand, the amount of time spent hand-mating is fairly constant (23 to 25 minutes per animal), regardless of the number of animals bred each day.

The reduced time required for artificial breeding results from spreading the time associated with the collection and processing of semen and equipment cleaning over an increased number of animals. Thus, when three or more females are bred on the same day, the time required for artificial insemination ($\leq$ 22 minutes per animal) is less than the time needed for hand-mating.

Effect on Reproductive Efficiency of the Sow

Farrowing rate has a large impact on non-productive sow days, making it an important measure of the reproductive efficiency of the sow herd. Also, as shown in Figure 1, a higher farrowing rate results in more pigs born alive per bred sow per year.

Table 1. Average time required for routine activities associated with hand-mating and artificial insemination

	Average time required (minutes/animal)	
Routine activity	**Sows**	**Gilts**
Hand-mating[a]		
Detection of estrus	9.7	12.1
Supervision of mating	12.3	16.1
Artificial insemination[b]		
Detection of estrus	9.2	11.4
Collection of semen	(11.3)	
Processing of semen	(6.7)	
Insemination	3.4	10.5
Equipment cleaning	(3.1)	

[a]Average time required for hand-matings based on observations from 393 and 255 natural matings performed on sows and gilts, respectively.
[b]Average time required for artificial insemination based on observations from 341 and 190 artificial matings performed on sows and gilts, respectively.
[J. Anim. Sci. 70:615 (1992)]

Table 2. Average time required for routine activities associated with hand-mating or artificial insemination based on the number of animals bred daily

	Average time required (minutes/animal)	
No. of animals bred/day	**Hand-mating[a]**	**Artificial insemination[b]**
1	23.4	34.6
2	24.4	25.7
3	24.7	21.7
4	24.1	19.8
5	23.4	18.9
6	23.9	18.0
7	22.9	17.6
8	22.8	17.3

[a]Routine activities for hand-mating include detection of estrus and supervision of mating.
[b]Routine activities for artificial insemination include detection of estrus; collection, processing, and insemination of semen; and cleaning of equipment.
[J. Anim. Sci. 70:615 (1992)]

Hand-mating as compared to pen-mating generally results in a higher rate of reproductive efficiency for sows bred during the first estrus period after weaning. The farrowing rate of hand-mated sows for the first estrus cycle following weaning is normally 85 to 88%, and that for pen- mated sows is 70 to 75%. It has generally been accepted that conception rates, and, therefore farrowing rates, are lower with sows bred artificially compared to sows bred naturally (pen- or hand-

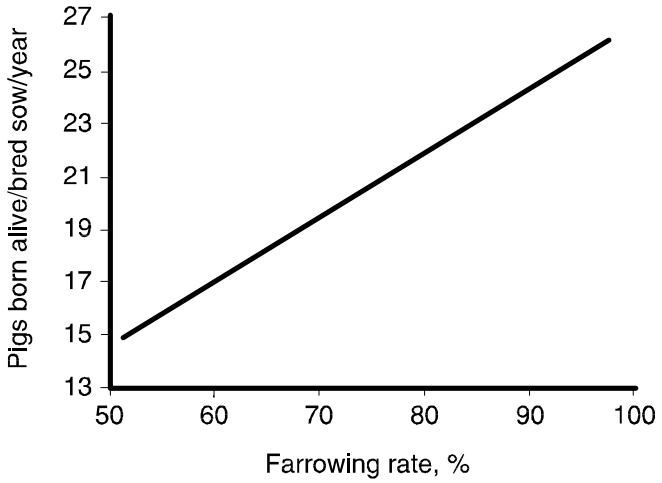

Figure 1. Relationship between farrowing rate and pigs born alive per bred sow per year.
[Vet. Clin. North Am. Food Anim. Pract. 8:517 (1992)]

mated). However, recent research indicates that farrowing rates for females bred artificially are typically about the same as those for females bred by hand-mating. The results of a study comparing hand-mating, artificial insemination, or a combination of these two breeding techniques are shown in Table 3. For gilts, two services by artificial insemination resulted in a higher farrowing rate than two hand-mating services (82 versus 72%). Conversely, sows serviced by two hand-matings had slightly higher farrowing rates than those bred artificially for both matings (87 versus 83%). Interestingly, gilts and sows that were hand-mated the first service and artificially inseminated the second service had higher farrowing rates than those hand-mated or artificially inseminated both services.

There has also been concern that litter size may be reduced when artificial insemination is used rather than some type of natural service. However, as shown in Table 3, there is no appreciable difference in the total number of pigs born or the number of pigs born alive or dead.

Improvement in Production Scheduling

One of the advantages for an individual-mating system over a pen-mating system is the improvement in production scheduling. With pen-mating, boars are turned in with a group of sows and allowed to remain for a certain period of time. This makes it impossible to know the specific date an individual animal was bred and would be expected to farrow. With hand-mating or artificial insemination, on the other hand, exact breeding dates for each animal are known, allowing farrowing dates to be more accurately estimated. Because the exact breeding dates are known, facilities and labor can be scheduled more precisely to accommodate sows and their offspring.

Knowing the exact breeding dates also provides the opportunity for synchronized farrowings (induced farrowings). If animals can be induced to farrow within a short time period, labor can be scheduled to be present at the time of farrowing without sacrificing large amounts of time needed for other

Table 3. Effects of mating combinations on the reproductive performance of gilts and sows

Trait	First service: Second service:	Gilts: Hand Hand	Gilts: Hand Artificial	Gilts: Artificial Artificial	Sows: Hand Hand	Sows: Hand Artificial	Sows: Artificial Artificial
Farrowing rate, %		71.7	88.9	82.3	87.3	93.2	82.5
Number of pigs born alive		9.8	9.5	9.3	10.3	10.2	9.8
Number of pigs born dead		1.1	1.4	1.2	1.0	1.0	0.9
Total number of pigs born		10.9	10.9	10.5	11.3	11.2	10.7

[Adapted from J. Anim. Sci. 70:615 (1992)]

aspects of the operation. Tighter farrowing groups will also help to schedule more precisely the flow of pigs through facilities and will make it easier to adopt all-in/all-out facility management in the farrowing house and nursery.

Effect on Reproductive Efficiency of the Boar

Many of the observed improvements in the reproductive efficiency of the sow herd from using an individual-mating system are related to inefficiencies of boars in a pen-mating system. In some cases, these inefficiencies are caused by poor management, while in other instances, the poor performance is the result of using boars with unknown problems.

Accumulation of Sows in Estrus

One of the pitfalls that can arise in a pen-mating system is the potential large number of sows that will be in estrus (standing heat) about the same time if the sows are group weaned. Figure 2 shows how the number of sows in heat accumulates on each day when 20 sows are weaned at the same time (in this example, the sows were all weaned on the preceding Thursday) and placed in one, two, or four breeding pens.

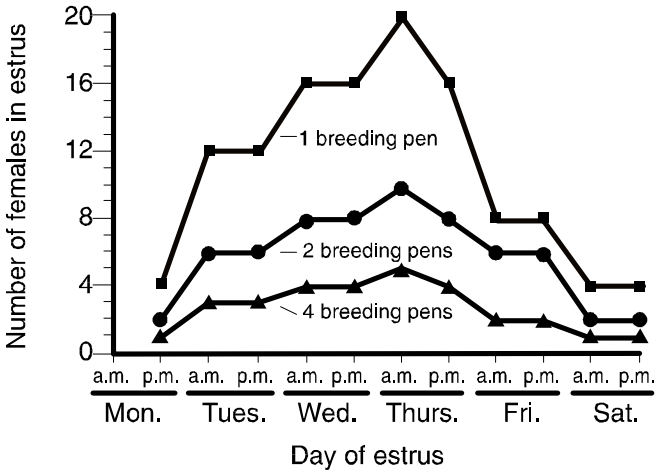

Figure 2. Number of sows in estrus on each day when pen-mated in one, two, or four breeding pens following weaning of 20 sows on the preceding Thursday.
[Univ. of Neb. Coop. Ext. EC89-212 (1989)]

Although the exact pattern may vary for each sow group weaned and from one farm to the next, the principle remains applicable. Most of the sows will begin cycling within four to seven days after weaning and may remain in standing estrus for 60 hours. Therefore, if all 20 sows are weaned into one breeding pen, it is likely that 20% of the sows (four head) will be in heat four days after weaning. This number of cycling sows should be adequately serviced by two boars. However, by the fifth day post-weaning, eight more sows (12 head total) will be coming into heat. Furthermore, by the sixth day post-weaning, an additional 20% (four head) will come into heat, meaning there will be 16 sows in estrus within the breeding pen.

To handle such a large number of cycling sows would require far more than a couple of boars. In fact, to adequately service this many sows would require one boar for every two sows. Unfortunately, very few producers using a pen-mating system will utilize such a high boar-to-sow ratio. This problem can be somewhat alleviated by weaning the sows into two or more breeding pens, but a larger boar pool will still be required to achieve good reproductive performance.

Boar Mating Frequency

In a pen-mating system, compared to hand-mating, the producer has no control over the mating frequency of the boar. Indeed, one of the major problems with pen-mating is that boars do not pace themselves. Thus, when the number of sows in estrus are allowed to accumulate, fertility becomes a problem due to overworked boars. Some overworked boars will have diminished sexual behavior (reduced sex drive) and will not breed very many sows, while more aggressive boars may continue breeding sows after their supply of sperm is significantly reduced or depleted. This is one of the likely reasons pen-mated sows have lower farrowing rates than individual-mated sows.

Figure 3 illustrates a boar's need for sexual rest after mating to allow sperm replenishment. The second time a boar mates on a 12- or 24-hour mating interval, he will ejaculate from 33 to 41% fewer motile sperm than were ejaculated at the first mating. The third time he mates there are from 59 to 66% less motile sperm. When boars are collected at 12- or 24-hour intervals, the amount of sperm per ejaculate usually stabilizes at low levels after the fifth or sixth collection.

Table 4 lists guidelines pertaining to boar-to-sow ratios for pen-mating systems and the number of services for boars used in individual-mating systems. However, as discussed previously, the number of boars needed in pen-mating systems is

highly dependent on the number of sows that will be in heat at the same time. If large numbers of sows are expected to begin cycling at the same time, one boar for every two sows may be needed.

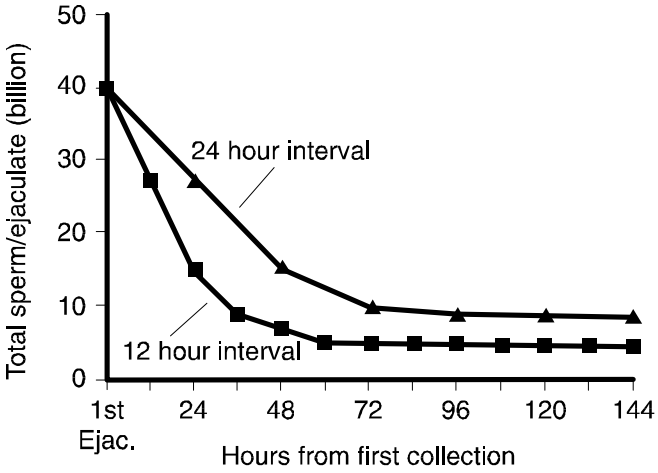

Figure 3. Sperm output for mature boars (12 months of age or older) at two collection intervals.
[Vet. Clin. North Am. Food Anim. Pract. 8:517 (1992)]

Sow Preference

Another area of concern with pen-mating is sows that do not get mated, even though boar numbers would seem to be adequate. Apparently, this problem results from the preference boars exhibit for certain sows. This behavior was demonstrated in a study conducted by University of Nebraska researchers (Table 5). In this trial, the mating behavior of nine boars was evaluated when they were placed individually in a pen with three sows (two sows were in heat and one sow was not in heat). The nine boars used in the study were known to have a moderate to high level of sexual behavior. The results showed that the number of matings per boar ranged from 0 to 9 (average of 4.4). However, only three of the nine boars mated both sows that were in heat. Five of the other boars did mate, but mated the same sow several times, and one of the boars failed to mate either of the sows in estrus. Overall, only 11 of the 18 sows in heat were mated (61%). Thus, just because an adequate number of boars is provided in a pen of sows that are in estrus, there is no guarantee all of the sows will get mated.

Timing of Mating

Mating should be timed so that the maximum number of active sperm cells comes in contact with the maximum number of viable ova (eggs) at the site of fertilization (upper half of the oviduct). Maximum ovulation in gilts occurs about 24 to 36 hours after the onset of standing heat and in sows approximately 36 to 48 hours after the start of standing heat. Due to the relatively short life-span of the eggs (six to eight hours following ovulation), they should be fertilized as soon as they reach the site of fertilization. Sperm can remain viable for about 24 hours in the reproductive tract of the female, but they require approximately two to three hours to undergo biochemical changes before they are capable of fertilizing eggs.

Because of the relationship between the time of ovulation, the life-span of the eggs, and the life-span of the sperm (Figure 4), the timing of mating is critical to the success of the breeding program. This is especially true if only one mating or insemination is used. However, just as the producer has no control over the mating frequency of boars in a pen-mating system, there is also no control over the timing of matings. If too many sows are in estrus within the same breeding pen, or if inadequate boars are provided in the pen, some females may be bred too early (Stage I), some may be bred too late (Stage III), and others may not be bred at all. The lower conception rates and litter sizes for animals bred in Stage I occur because the sperm cells have started to die before ovulation has occurred. The sharp decline in reproductive efficiency during Stage III results from the eggs dying before the sperm arrive. Rotating sexually rested boars among sow pens will increase the probability of sows being mated at the proper time. However, as discussed previously, this does not guarantee all sows in heat will be mated.

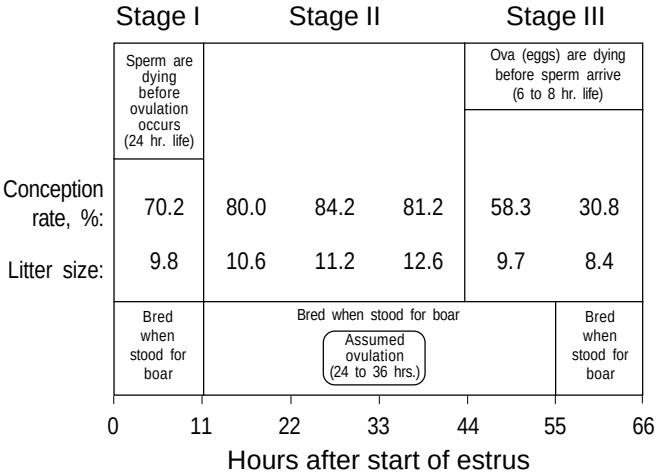

Figure 4. Relationship between the timing of a single mating and reproductive performance.
[Adapted from World Rev. Anim. Prod. 2:29 (1966)]

Table 4. Recommended number of services per boar for individual-mating systems and the boar-to-sow ratios for pen-mating

	Individual-mating system			Pen-mating system
Boar age (months)	**Daily services**	**Weekly services**	**Monthly services**	**(boar-to-sow ratio)**
Young (8 to 12 months)	1	5	20	1:2 to 4
Mature (> 12 months)	2	7	28[a]	1:3 to 5

[a]Mature boars should be given 2 to 3 days sexual rest per week.

Table 5. The number of matings per boar and the number of different estrus females mated by each boar during pen mating [a]

Boar No.	Number of times boar mated	Number of sows mated	Number of sows in heat	Percentage sows mated
1	9	2	2	100
2	4	1	2	50
3	5	1	2	50
4	4	2	2	100
5	1	1	2	50
6	5	1	2	50
7	0	0	2	0
8	7	2	2	100
9	5	1	2	50
Totals:	40	11	18	61

[a]Each boar was placed in a pen containing two sows in heat and one sow not in heat [Swine Res. Prog. Rept. No. 3:39 (1989)].

Although a single service at the optimum time (4 to 12 hours before ovulation) should be sufficient for achieving a high conception rate and litter size, two services per sow are recommended for optimum reproductive performance on the farm. To overcome inaccuracies in heat detection for individual-mated animals, gilts should be mated 12 and 24 hours after the onset of estrus, and for sows the matings should be 24 and 36 hours after the start of standing heat. In a pen-mating system, depending on the number and sexual activity of the boars, some females may be bred several times during standing heat. On the other hand, some may not get bred at all.

Boar Infertility or Inadequate Sexual Activity

In a pen-mating system, boars with a fertility problem or low sexual behavior can often go undetected. In fact, many producers will often provide an extra boar per breeding pen to cover downer boars. While this practice will help in minimizing the number of sows that do not get bred due to a boar inadequacy, the cost of purchasing and maintaining these non-productive boars is wasteful and unnecessary.

Individual-mating systems allow breeding records to be kept for each boar. This allows for rapid identification of boars with a fertility problem. The visual observation of mating also allows the identification of boars with low sexual activity. Even if boars are used in a pen-mating system, they should be frequently observed to evaluate their ability to pursue and mount a female, obtain an erection, gain entry into the vagina, and successfully copulate. Do not assume that an extra boar per breeding pen will mask boar reproductive deficiencies.

Summary

When choosing a mating system, producers should not base their choice strictly on the amount of time and labor that needs to be devoted to the system. Rather, each mating system should be evaluated in terms of what stands to be gained or lost in reproductive efficiency with the implementation of each mating program. For many, the inherent problems associated with pen-mating and the long-term improvements in reproductive performance that are attainable make switching from a pen-mating system to an individual-mating system well worth the added time. Table 6 highlights the benefits and limitations of an individual-mating system.

Table 6. Benefits and limitations of an individual-mating system[a]

Benefits

- Breeding dates for each female are known, allowing enhanced scheduling of facilities and labor and synchronized farrowings.
- Farrowing rate for the first cycle following weaning is higher compared to pen-mating.
- Boars can be penned and managed individually which will extend their useful life-span.
- Selective matings are possible.
- Mating frequency of boars can be controlled.
- Females can be double-mated to correspond more closely to the time of ovulation.
- A more detailed record system can be used, allowing reproductive success or failure to be detected at an earlier date.

Limitations

- Compared to pen-mating, more labor is required.
- Requires dependable, well-trained, and motivated labor.
- Specialized facilities are required and may be costly to build and operate.

[a]Adapted from Pork Industry Handbook (PIH-69).

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