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Enhancing physiological processes and reducing production costs associated with mating are key considerations for optimizing swine breeding herd management. Successful matings from either natural mating or artificial insemination, involve coordinating insemination with ovulation. Hand mating or pen mating takes advantage of the boar's innate ability to determine which females are in estrus and carry out the breeding process. However, as the swine industry has evolved, artificial insemination is emphasized as a way to capitalize on advantages beyond estrus detection.

Advantages of AI

Artificial insemination affords several advantages over hand mating and pen mating.

Allows more extensive use of older boars on lighter weight females. Very large boars that might otherwise injure a small replacement gilt during the breeding process may be used since only the semen from these boars will be used. Fighting and possible injury to the boar or the sow/gilt is eliminated as well.

Decreases the number of boars and time required for breeding when estrus is synchronized. Because boars are only used for estrus detection, the boar to sow ratio can be increased from 1:10 -- the normal ratio used for hand mating -- to 1:175.

Promotes development of a closed herd. Only semen is brought onto the farm and not the entire animal. The number one source of disease is through animal to animal contact. By not bringing new animals to the farm, the producer can potentially eliminate pathogens and or diseases a new animal may bring.

Allows introduction of new genetic material into a herd with minimum risk of disease. Changing genetics is much easier and faster with artificial insemination because of the wide choice of semen available from numerous boar studs. Purchasing semen from a reputable source also eliminates the quarantine period that would be required if live animals were to be brought in and introduced into the herd.

Allows semen to be examined for viability. Producers can choose whether or not to use the semen because they can visually inspect it under a microscope and determine whether it has adequate viability and morphology. Approximately one-third of the boars used for breeding are infertile or sub fertile at some time. In natural mating systems this decrease in reproductive efficiency is not observed until the females return to estrus or when a decrease in numbers born is noted in subsequent litters. This is especially a problem during periods of heat stress.

Increases safety for workers. Since fewer boars are kept and are only used for estrus detection, the danger associated with moving and working with boars is reduced. Boars that do become a problem can be removed quickly without the operation suffering a decrease in reproductive efficiency.

Disadvantages of AI

Artificial insemination is not without disadvantages that must be considered.

AI requires a higher level of management in order for it to be effective. Better records need to be kept regarding estrous cycles, breeding dates, synchronization of estrus, and availability of semen.

Risk of disease is of greater importance because a diseased boar could infect 15 to 20 females. This is especially true if the producer collects and extends semen from his own boars. It is very important that boars be free of diseases.

There is an increased margin of error brought about by the human factor that may lead to reduced reproductive performance. Because people cannot determine if the female is in estrus the way a boar can, errors can occur by breeding at the wrong time. Determining when the female is in estrus, even when using a boar, is a skill that needs to be learned.

Since successful AI depends on the coordination of having viable sperm fertilizing viable eggs, it is best to have viable sperm in the reproductive tract prior to ovulation. It will take the sperm approximately 6 to 10 hours to be capacitized and reach the point of fertilization. Sperm can live in the reproductive tract for 24 hours while the egg or ovum will only remain viable for 2 to 6 hours.

It is easy to become complacent when things are working well. This can lead to cutting corners and a subsequent decrease in reproductive performance. Things such as improper handling of breeding catheters and semen and improper storage of semen can all lead to a decrease in reproductive efficiency when using AI.

Estrus Detection

The single most important component of any AI program is proper estrus detection. Mistakes can be made in other facets of an AI program and the program can be somewhat forgiving, but errors at this step can be devastating because breeding is based upon when the female is first detected in estrus.

The onset of estrus and estrus behavior occurs gradually and individual females may respond differently. The primary sign of estrus in the female is standing to be mounted by a boar or another sow or gilt. Many sows and gilts will also stand for the "back pressure test" when applied by a stockman. However, a higher percentage of females will stand immobile for the stockman if a boar is present. This is partly due to the sight, sound, and odor of the boar. This odor is primarily caused by a steroid that the boar makes and secretes in the saliva, and is also one of the factors that contributes to "boar taint."

Some of the secondary signs of estrus include a red, swollen vulva (more so in gilts than sows), increased nervous activity, seeking the boar, loss of appetite, and mounting other females.

Length of estrus is variable and may last from 12 hours in gilts and up to 60 hours in sows. There can be considerable variation in the duration of standing estrus within a herd. Differences may also exist due to genetic makeup as well as from farm to farm. There is a tendency for sows with shorter wean-to-estrus intervals to have a longer duration of estrus and to ovulate later after the onset of estrus as compared to sows with longer wean-to estrus intervals that have a shorter duration of estrus and ovulate relatively sooner after the onset of estrus. Because it is very difficult to determine when the onset of estrus has begun it is advisable that the female receives two matings during estrus. This helps to insure that viable sperm are present at the time of ovulation.

There appears to be a constant with respect to the duration of estrus and the time of ovulation. Females tend to ovulate at a time which is approximately 2/3 of the period of standing estrus. For example, if a sow is in estrus for 50 hours, ovulation will likely occur approximately 33 hours after the onset of estrus.

Unfortunately, the length or duration of estrus is not known until it has already occurred, but over time and with experience within the farm, the breeding manager can use observed differences in wean-to-estrus intervals, parity, season, genetic lines, and other factors to accurately predict the approximate time of ovulation.

Estrus behavior is mainly under the influence of estradiol secreted from the growing ovarian follicles. Estradiol increases the blood flow to the reproductive tract and affects behavior centers in the brain that causes the female to seek the boar and stand to be mated. The onset of ovulation begins between 36 and 44 hours after the onset of estrus and lasts for 1 to 3 hours, with most of the eggs being released over a short period of time.

When the female is in estrus, she will stand to be mounted by the boar. She will often stand for the back pressure test as well and have an "ear popping" response. Using a boar in conjunction with the back pressure test is one of the most accurate methods of detecting females in estrus. The presence of the boar increases the chances of detecting all females in estrus by 30 to 40%.

Housing should facilitate boar exposure but restrict constant exposure to the boar stimulus since this leads to a decrease in responsiveness. Ideally the female should be kept in a pen where the boar can be allowed to have direct nose to nose contact while estrus detection is being performed.

Some individuals can detect females that are housed in crates with the boar by their head. While this method does work, it takes considerably more experience in detecting estrus females, because she does not have a chance to avoid the boar if she is not in standing estrus. Therefore, it is very easy to mistakenly breed the female when she is not in estrus.

Restrain the boar in front of a focus group of 4 to 5 females at a time, if walking him down an alley in front of the females, or allow him to have nose to nose contact with the female housed in an adjacent pen. Be very methodical during the process and provide tactile stimulation by rubbing her underline and/or flank.

The more frequently estrus detection is performed, the better the chances of inseminating at the correct time. But practicality also will dictate the frequency of estrus detection. It is much better to do a thorough job of estrus detection once per day than to do two hurried attempts during the day.

Using an old, smelly boar that produces large amounts of saliva is best. Nose to nose contact is essential because the boar produces a pheromone in the saliva that helps to initiate the standing reflex in the female.

The "standing reflex" involves prolonged contractions of the skeletal muscles. After 5 to 10 minutes the female becomes fatigued and becomes refractory to the boar stimulus or back pressure stimulus for a duration of 1 to 2 hours even though she is still in estrus. Keeping the females separated from the boar is necessary prior to estrus detection so they are not fatigued and refractory to the boar stimulus when estrus detection is performed.

Once it's determined which females are in estrus, remove the boar s and allow an hour to pass before re-introducing the boar for the insemination process.

When to Inseminate

Time inseminations to best insure that viable sperm is present in the female reproductive tract before ovulation. One of the most common errors made with artificial insemination is inseminating too early, which leads to decreased litter sizes. Table 1 provides guidelines for the appropriate time to breed sows based on twice daily estrus detections.

Table 1. When to breed sows in relation to post-weaning estrus with twice daily estrus detections.

Days Post Weaning	When to Inseminate
3 –4 days	Wait 24 hours after first detecting the sow in estrus to breed the first time. The second insemination should follow 12 hours after the first.
5 days	Wait 12 hours after first detecting the sow in estrus to breed the first time. The second insemination should follow 12 hours after the first.
6 –7 days	Inseminate immediately with the second insemination occurring 12 hours after the first.

If once-per-day estrus detection is performed, inseminate the female immediately upon detecting her in estrus. Continue inseminations every day that she is in estrus but no more than 3 times.

Double matings are superior to single matings in terms of litter size and conception rate. If gilts exhibit standing estrus for 2 days, then double matings increase both farrowing rate and litter size. The number of pigs born alive is more related to multiple matings than is farrowing rate.

Because gilts generally exhibit estrus for a much shorter period of time compared to sows, breed them 12 hours after first detecting them in estrus and again 12 hours later.

Sources of Semen

Semen can be purchased from a supplier or collected and extended from your own boars. Collecting and extending your own boar semen requires that you train the boars for collection, and dedicate an area as a semen processing laboratory. Equip the laboratory with a microscope, mixing containers, heated water bath, sperm counting device (hemocytometer or Sperm-A-Que), ultra pure water, warming cabinet, and semen cooler. The laboratory can be equipped with these instruments for $2,500 to $10,000.

Additionally, one or more individuals will need to trained on the proper techniques for semen collection and extension. The amount of semen needed on a regular basis and the amount of time spent by the technicians performing these duties will determine if collection and extension of your own boar semen is a worthwhile task.

Most producers are now buying boar semen from boar studs. Semen is collected and extended and shipped to the producer via UPS, Federal Express, or private courier. The cost of shipping can range from $20 to $40 for each shipment. Several kinds of semen are also available at varying costs.

Contract semen – The customer signs a contract with the semen supplier to use a specified amount of semen each week, e.g. 50+ doses/week. This can be cost effective for very large producers who breed a large number of gilts and sows each week.

Semen from a particular boar – Generally this is the most costly semen and can range from $20 to $60/dose. However, the cost of the boar himself could be as high as several thousand dollars. If semen is to be purchased from a particular boar that is very popular, delays of up to one year are not uncommon.

Special mixed semen – This is a mixture of semen from many different boars of the same breed. Because it is mixed it is not as expensive as semen from a particular boar. This could be used to generate the producers maternal line of gilts at a lower cost.

Mixed semen – This is a mixture of semen from many different boars of different breeds. This tends to be the one of the least expensive semens and could be used in generating the terminal line of commercial pigs.

Left-over semen – This is semen left over from a collection that has not been sold. This is then sold at a discounted price.

Store all semen in the dark at 62 - 65F. Semen in extender can last as long as 7 days; however, it is best to use it as soon as possible. Semen in extender should be gently rotated twice per day to ensure mixing of semen with extender.

Insemination Process

The following is a step by step guide to performing AI in the pig.

Move the boar to the female and enclose him in front of 2 to 3 estrus females for insemination. This can be done with females in individual stalls or gestation crates or housed in a pen next to a boar where they can have direct nose to nose contact. Make sure the female is exposed to the boar before beginning insemination.

Wash hands or wear vinyl (not latex) gloves and clean the vulva with a clean, dry, paper towel.

Part the lips of the vulva with one hand and gently insert the catheter into the vagina pushing forwards and upwards at a 30 angle for the first 6 to 8 inches. Then level off and advance the catheter until resistance is felt. If you are using the golden pig catheter, push the catheter into the cervix and with practice you will feel it actually "pop in." If using a spirette or other threaded-type catheter, turn it counterclockwise to enter the cervix. When this is locked into the cervix, it will flip back when twisted counterclockwise.

Get the semen from the storage container (leave the semen in the storage box until the last possible moment) and resuspend it by gently rotating the bottle or cochette.

Cut off the tip of the bottle or open cochette and place on the catheter. Lift the catheter and apply gentle pressure to the bottle or cochette to fill the catheter and begin insemination.

Begin laying over sows back and rubbing underline to stimulate uterine contractions. Normal service should take 5 – 10 minutes; gilts may take longer.

Continue to apply gentle pressure on the semen container and stimulate at the same time. Once the container is empty, it can be removed. Don't force air down the catheter. The catheter can be left in place for 5 minutes if you so desire to further stimulate uterine contractions. The catheter can be removed by clockwise rotation of the spirette or by gently pulling on the golden pig catheter.

Check the tip of the catheter for blood, and record if found.

In Summary

Artificial insemination can be as effective as natural mating in terms of getting sows and gilts bred. However, it does require more attention to detail if it is to be performed successfully and economically.

For more information about evaluating the suitability of adding artificial insemination to your swine herd management program, contact your local extension livestock educator.

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