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Estrus or Heat Detection

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Introduction

Detection of estrus or standing heat is one of the most critical components of a successful swine breeding program. Accurate and consistent detection of estrus is necessary to ensure insemination occurs near the time of ovulation and to identify open females. Errors in detection of estrus reduce reproductive performance and increase herd non-productive days. The widespread adoption of artificial insemination (AI) in the swine industry has shifted the responsibility of detecting estrus from boar to breeding technician. In AI mating systems, weaned and bred sows are typically housed in individual crates that limit the amount of physical contact with the boar and may make some of the signs of estrus less obvious to technicians.

Large sow inventories, high employee turnover, and limited swine experience among most new employees increases the chance of errors and makes training technicians to detect estrus an ongoing process. Since accurate heat checks are so vital, all individuals involved must know the typical signs that females approaching estrus exhibit and how to best use a boar to stimulate females to express the standing reflex.

Signs of Estrus

Estrus is defined as a period of sexual excitement and ovulation during which the female will accept the male and is capable of conceiving. The pubertal or first estrus usually occurs at about 170-210 days of age in gilts that receive boar stimulation. In mature sows, estrus normally begins 3-5 days postweaning. Estrus generally lasts 40 hours in gilts and 55 hours in sows, but variation among individuals can be substantial (range 12-84 hours). Ovulation typically occurs about two-thirds into an individual gilt or sow's estrus (usually 30-40 hours after onset of estrus). The estrous cycle, or interval from estrus-to-estrus, typically averages 21 days.

The ultimate sign that confirms a gilt or sow is in estrus is immobilization in response to back pressure from a boar, another sow, or a person. However, there are several behavioral and physical signs that may be observed hours or even days before the onset of standing estrus. These preliminary signs of estrus are not always exhibited, and their intensity often varies among different females, breeds, and herds. In addition, some signs of approaching estrus can vary in gilts versus sows and in individual (i.e., crate) versus group (i.e., pen) housing systems. The intensity of these signs of estrus and the order in which they typically occur is diagrammed in Figure 1. The descriptions of the signs of estrus that follow reference the numbered images in Table 1.

Swelling and reddening. Two to three days before onset of estrus, increasing estrogen levels from developing ovarian follicles stimulate increased blood flow and fluid retention in the reproductive tract and cause the vulva and clitoris to swell and turn red. This is commonly observed in gilts (1 and 2, center gilt) but it is usually only seen in sows if the vulva is parted to examine the interior (3). Estrogen also acts on sites in the brain to induce the behaviors associated with estrus. Vocalizations may increase or change, activity may increase, and feed intake may decrease as females approach estrus. Breeding technicians should make note of females exhibiting these behaviors, mark them, and examine them again at the next heat check. Mucous discharge. Clear, sticky mucus may drip and hang from the vulva in response to the increasing levels of estrogen (4 gilt, 5 sow). A small sample can be smeared on the thumb, even before a significant amount collects on the vulva, and then pressed and stretched repeatedly between fingertips to determine the degree of “stickiness” (6). This is commonly called “thumb checking,” and the theory behind it is that the mucus becomes increasingly sticky as the sow approaches estrus. Non-estrus females usually clamp their tail down when the vulva is examined but sows in estrus will sometimes raise their tail and it may begin to quiver.

Riding. Gilts and sows coming into or going out of estrus often mount and ride pen mates when group housed even though they themselves are not in heat (7). Most females will not tolerate being mounted and will vocalize loudly and make moves to escape. Females that stand immobilized when ridden (7) are in estrus and may develop rough hair and rub marks on their back from being repeatedly ridden. Females housed in crates cannot mount their neighbors but may make attempts to bite them (8) or climb on the crate when excited by exposure to a boar (9).

Seeking the boar. Most females will move toward a passing boar (10 pen and 11, 12 crates) whether in heat or not. However, females approaching estrus and in estrus will make increased effort to get close to the boar. This behavior has been used to develop an electronic estrus monitoring system that continuously records the frequency and duration of visits that group housed females make to a “viewing hole” on an adjacent solid-walled pen with a boar.

Standing response. Some females in estrus will exhibit the standing response without any direct physical stimulation when a boar passes nearby (13 pen and 14, 15 crates). The ears may spring into an erect position in some breeds and females often arch their back slightly and brace their legs through isometric muscle contractions, as if preparing to be mounted.

Back pressure test. Conversely, a few females in estrus will stand in response to pressure applied to their back without the presence of a boar. However, many gilts and sows in estrus will not exhibit the standing reflex when pressure is applied to their back unless a boar is present. When direct physical boar contact is not possible or practical, fence line exposure of females to a boar will work but it should be as close as possible and in a nose-to-nose orientation so females can smell as well as hear and see the boar (10, 11, 12). When allowed direct physical contact, boars often nudge the flank and underline of females to determine if they are receptive before making a mounting attempt. Stimulation of these same areas with firm hand strokes before applying pressure to the back by hand (16) or by riding (17, 18) facilitates expression of the standing reflex.

In the presence of the boar, females will generally stand when pressure is applied to their back about 6-10 hours before they will stand for the back pressure test without a boar. This is because the onset (and end) of estrus is a gradual transition that occurs over several hours. Even though estrus is measured as a definitive “yes” or “no” at each heat check, the amount of boar stimulation required to get a given female to stand decreases as she comes into estrus and then increases as she goes out of estrus. For this reason, intense periods of boar stimulation tend to lengthen the duration of estrus.

Gilts and sows can exhibit some or none of the preliminary signs of estrus and ovulate without exhibiting standing estrus, but the occurrence of such “silent heats” seems to be rare in most situations. It is much more common for estrus to be missed due to insufficient boar stimulation or technician error and the incorrect assumption made that females are anestrus.

Once females stand, they often do so for 10-15 minutes and then become unwilling to be mounted even though they are in estrus. This refractory state fades within a few hours and females will accept the boar again. This phenomenon may be related to muscle fatigue from the isometric contractions females exhibit during the standing response and/or fatigue of the behavioral center(s) stimulated in their brain.

Continuous stimulation of females through constant exposure to a boar can cause a reduction in the expression of estrous behaviors such as the standing response and this phenomenon is referred to as habituation. In other words, the excitement and novelty of a boar's presence can wear off if he is always there. The practical implications of habituation and the refractory state on boar housing and detection of estrus protocol are discussed below.

Heat Check Boar

The boar chosen for detection of estrus need not be genetically superior but should be structurally sound, mature, and have a high level of libido. Research has demonstrated that boars with a "high" versus "low" level of libido are more effective at stimulating onset of puberty (i.e., first estrus) in gilts. This also may apply to stimulation of return to estrus and expression of estrus during heat detection in weaned sows.

Younger boars are sometimes chosen because they are smaller, easier to handle and train, and less intimidating to breeding technicians. Boars less than 12 months of age provide a lower level of stimulation than older boars and can decrease estrous detection rate. The physical touch (i.e., tactile cues) and smell (i.e., olfactory stimuli) that a boar provides seem to be the two principal components of its ability to stimulate the onset and expression of estrus in females. Boars emit pheromones from their urine and saliva (3 α androstenol and 5 α androstenone) that may be involved in the olfactory component of their estrus stimulating ability. The portion of the salivary glands that produces these compounds does not begin to develop until 6 to 8 months of age. So the common philosophy that the bigger and "smellier" the boar, the more effective he will be at detecting estrus is essentially correct. A commercially available synthetic boar pheromone in an aerosol can or a piece of cloth soaked in boar preputial fluid and urine can be used as an estrous detection aid when a boar is not available, but cannot replace the other types of stimuli that a boar provides.

The heat check boar should be handled with patience and respect so that he will maintain a good working temperament as he matures. A mistreated boar can develop fear of humans and an uncooperative attitude. Any boar that becomes violent and dangerous to work with should be culled. It may be wise to have a veterinarian vasectomize or epididictomize boars that will have direct contact with females during heat check to avoid unwanted pregnancies since it can be difficult to separate females in estrus from the boar when they become immobilized during the standing reflex. Heat check boars need energy for maintenance and growth, but should not be overfed. The general consensus is that moderate restriction of feed intake helps keep boars from getting fat and lethargic, and may help them maintain high libido. Heat check boars often get extra feed during estrous detection by cleaning up the small amounts spilt on the aisle-way floors. This scavenging behavior aids in the transfer of stimuli because it puts the boar's head in close

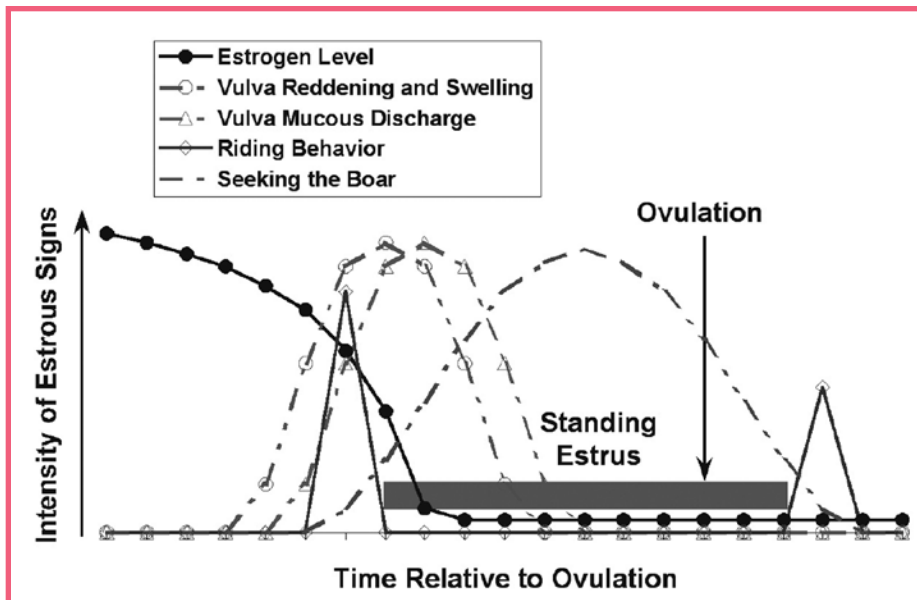


Figure 1. Level of estrogen and intensity of typical preliminary signs of estrus relative to ovulation in sows. Gilts usually display signs of estrus in a similar sequence but vulva reddening and swelling, mucous discharge, and riding behavior may begin to occur earlier and thus last longer than in sows.

Gilts	Begin boar exposure soon after gilts are introduced to breeding herd. Allow 10 to 15 minutes of direct physical contact with a boar daily. Avoid extremes of constant boar exposure and insufficient boar exposure. Early estrous signs may last longer and standing estrus is often shorter than in sows.
Weaned Sows	Begin boar exposure the day after weaning. Allow a few minutes of close nose-to-nose boar contact daily. Use firm strokes of the flank and underline followed by the back pressure test when the boar is focused on the sow to detect estrus. Recheck any sows that seemed close to standing or that should be in heat.
Mated Females	Check all mated females for estrus daily. Focus on those females mated 18 to 24 days ago. Look for signs that a female may soon return to estrus, such as an abnormal vaginal discharge or abortion.

Table 2. Estrous detection checklist for different types of breeding females.

contact with those of the females being examined, and it slows down the boar's movement. When not in use, house boars away from and downwind (tunnel-ventilated buildings) of females to avoid the potential refractory and habituation effects of constant boar exposure on expression of estrus.

Heat Check Protocol

A relatively short but intense period of direct physical contact with a mature boar is the most ideal form of boar exposure for gilts and sows because it allows the best transfer of tactile and olfactory stimuli. Due to the constraints of labor availability and(or) facility design, this type of contact is often not practical. The next best type of contact is nose-to-nose contact across a gate or fence line, which allows limited physical contact. The olfactory component of boar stimulation does not seem to travel well since estrous detection rate tends to decrease when females are separated from the boar by a distance greater than 3 feet. The length of time females should be exposed to the boar at each heat check depends on the intensity of the contact and the specific situation (see gilts, weaned sows and mated sows below).

The time of day that onset of estrus occurs in most females can vary between herds and within a herd across time (i.e., seasons). Based on detection of estrus every 6 hours in three different herds, the onset of estrus occurred between 8 p.m. and 8 a.m. in 70-90% of weaned sows (Belstra et al., unpublished data). Heat check is typically performed soon after morning feeding and this seems to be the best time of the day given that it is the coolest part of the work day, the breeding herd is up and active, and onset of estrus seems to occur during the early morning hours in most females. An additional afternoon heat check usually is not productive because few new females come into estrus after morning heat check and before the end of the workday.

During heat check, the boar is slowly walked up and down the aisle in front of the crates or pens by one technician while one or two other technicians examine the females and apply back pressure as the boar comes in close contact with them. Rubbing the flank and underline areas of each female with firm strokes before applying back pressure provides them with stimulation that encourages expression of the standing response. The technician(s) checking the females should set the rate of advancement along the crate or pen row, not the technician moving the boar. The technician handling the boar must watch the technician(s) checking the females and focus the boar where they need him. Some females may require extra stimulation to stand for the back pressure test, and it is a good idea to double check any individuals that were expected to be in heat but did not stand initially. Occasionally, when checking a row of crates or pens, a sow will exhibit the standing reflex soon after the boar has passed. For this reason it is a good practice to look back intermittently to read the body language of females that did not stand. If this occurs frequently, then the boar is passing too quickly and females are not getting enough boar stimulation to express estrus.

The popularity of harnesses or collars attached to a handheld lead to control the movement of the heat check boar has increased substantially. These devices can eliminate the need for setting up gates or using a push board to control boar movement, provided aiseways are narrow enough to prevent the boar from turning around and changing direction. Once a boar gets used to the lead, he can even be trained to back up. One company has taken this concept a step further and developed a crate on wheels that the heat check boar is loaded into and then moved up and down the aisles manually or by remote control. Another has developed a robot to tow a harnessed boar along the aisleway, eliminating the need of a technician to handle the boar. The goal of all these devices is to reduce the labor required for heat check and to allow technicians to better control the focus of the boar's stimuli on a specific female or group of females.

Gilts. Daily stimulation of gilts with a boar can begin a few days after they are introduced into the breeding herd, provided they are at least 130 days of age. A common practice in the swine industry is to house gilts in pens with continuous contact to a boar via an adjacent pen to stimulate the onset of puberty. Research suggests that regardless of housing type (crate or pen), gilts should not be housed directly adjacent to a boar for long periods because they can become habituated to the boar's presence as discussed above. This can result in a decrease in estrous detection rate and a decrease in the observed duration of estrus. Another method often used to stimulate puberty in gilts, which represents the opposite extreme, involves only a few minutes of fence line contact with the boar as he passes by during daily heat detection. The most ideal method to give gilts sufficient boar stimulation would be to move small groups to the boar's pen for at least 10 to 15 minutes of physical contact each day. It may be less labor intensive to simply move the boar from gilt pen to gilt pen but there is some evidence that suggests the effect of the boar on the onset of

puberty in gilts is more pronounced when the gilts are brought to the boar's pen. This may be due to the fact that the gilts would receive more boar "smell" when moved to the pen where the boar is usually housed than if he were brought to their pen. This also may be related to the stress associated with the temporary change of environment that the gilts experience when moved. The synchronization of estrus that occurs in some gilts approaching puberty after they are transported from a different barn or a different farm site is a good example of this phenomenon. Many farms have problems getting gilts cycling and mated and the two extremes of constant boar exposure or insufficient daily boar exposure may contribute to this problem.

Weaned sows. Housing sows adjacent to a boar so that they have continuous contact, while not recommended, does not seem to affect estrous detection rate. This type of constant exposure may result in shorter duration of estrus as compared to keeping the boar separated from the sows and then allowing close contact during heat check. There is no advantage to delaying exposure of weaned sows to a boar for a few days. Daily boar exposure should start the day after sows are weaned even though none should be in heat for 2 or 3 days, because boar exposure promotes the onset of estrus and reduces the incidence of anestrus.

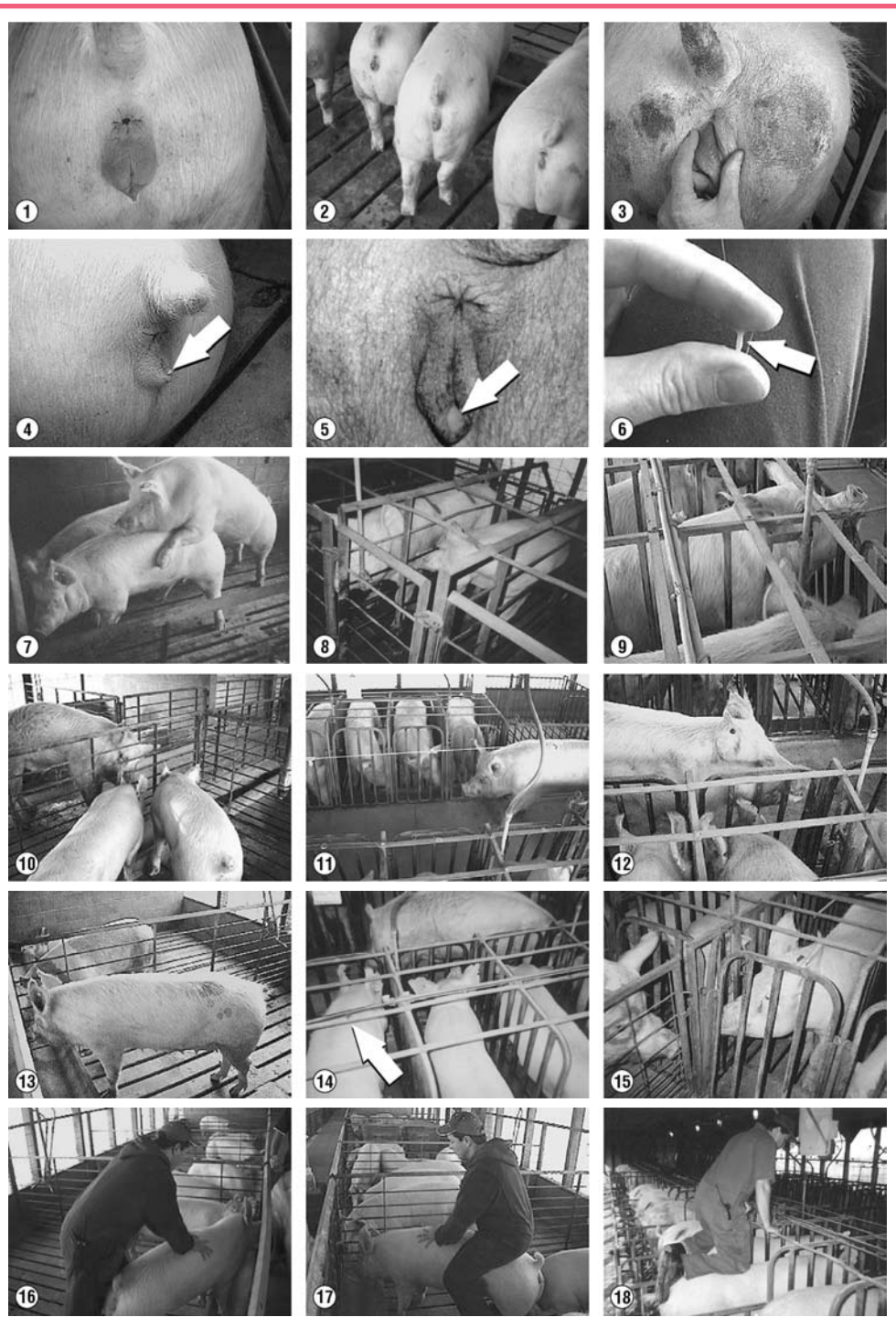


Table 1. Examples of behavioral and physical signs of approaching estrus (1-12) and standing estrus (13-18) in gilts versus sows and in individual (crates) versus group (pens) housing systems. Swelling and Reddening: The vulva swells and reddens significantly in gilts (1), center gilt (2) but only the interior tends to redden in sows (3). **Mucous Discharge:** Clear, sticky mucus collects on the vulva of a gilt (4) and sow (5). **Testing the "stickiness" of the mucus by "thumb checking"** (6). **Riding:** A sow coming in to or out of estrus mounts and rides a penmate (7) whereas crated sows attempt to bite (8) or climb (9) towards a neighbor. **Seeking the Boar:** Gilts in a pen (1) and sows in crates (2, 3) move forward to investigate a passing boar. **Standing Response:** Females in estrus stand motionless in response to boar exposure without back pressure in a pen (13) and in crates (14, 15). **Back Pressure Test:** Females in estrus standing motionless in response to boar exposure and back pressure applied by hand (16) or by riding (17, 18).

Mated females. Daily detection of estrus also is required to locate mated females that failed to conceive, were pseudopregnant, or lost their pregnancy for another reason such as severe prenatal mortality or abortion. Generally, “hot groups” or “hot breed weeks,” that consist of females mated approximately 18-24 and 39-45 days earlier, are given special attention because these two time periods are 1 and 2 estrous cycles post-mating and thus the most likely times for females to return to estrus. However, all mated females should be checked for estrus daily, even if they fail to return during this period, because they can lose their pregnancy at any time and begin to accumulate costly non-productive days. Failure to check mated females for estrus may even allow some non-pregnant individuals to remain undiscovered until they are moved to the farrowing barn.

Summary

Thorough and methodical heat checks can decrease herd non-productive days and increase reproductive efficiency by ensuring that gilts and sows are inseminated at the optimum time and by locating non-pregnant mated females. Detection of estrus is relatively simple but it is critical that all the individuals involved know the signs of approaching estrus in the females in their herd and how to effectively utilize a boar to maximize the expression of standing estrus so that errors can be avoided. Technicians who are particularly observant, patient, and consistent are likely to excel at detecting estrus.

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