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# Breeding Management in Pigs

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## Estrus:

Sows and gilts are nonseasonal and polyestrous, with the estrous cycle lasting 18–24 (average 21) days. Sows are behaviorally anestrous during pregnancy. Ovulatory estrus usually is not seen during lactation except under conditions of group rearing, high feed levels, or boar contact. Partial weaning or gonadotropin treatment can induce estrus during lactation, but the results are inconsistent and not economical. Normal uterine physiology is reestablished by 20–25 days postpartum. Most sows exhibit estrus 3–7 days after weaning. Estrus in gilts and postweaning anestrous sows can be initiated with exogenous hormones. However, these hormones circumvent natural selection for reproductive efficiency, and this should be kept in mind when they are used in breeding management programs. Exogenous hormones should not be used as a longterm solution to address reproductive inefficiency in a herd.

Estrus lasts ~36–48 hr in gilts and ≥48–72 hr in sows. Time to estrus after weaning and duration of estrus in sows can be influenced by length of lactation, nutrition, body condition, genetics, and other management practices (see Table: Factors Affecting Ovarian Activity of Pigs). Estrus is characterized by behavioral (eg, mounting, fence walking, vocalizing, tilted ears, kyphosis) and sometimes physical (eg, vulvar swelling, vaginal discharge) changes. Ovulation generally occurs in mid to late estrus. During ovulation, ~15–24 ova are released over a 1- to 4-hr period. Ovulation rate increases over the first four parities, so that the fourth to sixth litters tend to be the largest in number. Ovulation rate can decrease when gilts or sows are undernourished. Most gilts are on full feed, thereby averting the adverse affects of undernourishment on early reproductive performance. In countries in which gilts are not routinely provided full feed, increasing energy intake for 10 days before estrus (ie, “flushing”) is performed. This has optimized ovulation rate under these circumstances. To prevent undernourishment in recently weaned sows, an energy-dense diet should be fed until after estrus and breeding.

## Factors Affecting Ovarian Activity of Pigs

| | Stage of Breeding Affected | | |
|---|---|---|---|
| Proven or Suspected Factors | Puberty | After Weaning | After Service |
| Insufficient male stimulation | +[a] | + | –[b] |
| Housing and social environment | + | + | – |
| High ambient temperature | + | + | + |
| Season of year (summer/fall) | + | + | + |
| Photoperiod | + | ?[c] | – |
| Genotype | + | + | – |
| Nutrition | + | + | + |
| Short lactation | – | + | – |
| Large litter reared | – | + | – |

Adapted, with permission, from Meredith MJ, *Pig News and Information* 5, 1984, published by CAB International, Wallingford, Oxon, UK.

[a] Effect has been demonstrated

[b] No evidence for effect

[c] Effect uncertain

Behavioral changes are most pronounced when the sow or gilt is exposed directly to the sight, sound, odor, and attention (nuzzling and grunting) of a mature boar. A sow or gilt in standing heat normally assumes a rigid, immobile, receptive stance when exposed to a boar. Physical changes such as vulvar swelling and discharge are often unreliable; they do, however, appear to be more marked in gilts than sows and commonly develop 2–3 days before estrus. The ultimate criterion of estrus is either standing to the boar or a positive response to the “riding test” (an attendant applies pressure with the hands in the loin area, then gently sits on the pig’s back to elicit the standing reaction); this test is best conducted in the presence of a boar (eg, in an adjacent pen) or, as an alternative, after exposing the sow to a synthetic boar-odor aerosol or taint rag.

Anestrus is a common problem. Failure to detect estrus must be distinguished from true cases of ovarian inactivity. First-litter and early-weaned sows are particularly vulnerable to postweaning anestrus. The primiparous sow must support her own growth as well as maintenance and lactation demands, while her feed intake capacity is not yet fully developed. This problem can be avoided by breeding only gilts in good condition; not overfeeding during the first gestation; and encouraging energy intake during the first lactation by frequent feeding of high-density diets, wet feeding, and avoiding high temperatures in the farrowing rooms. Management practices such as segregated early weaning, modified medicated early weaning, and medicated early weaning recommend weaning as early as 10 days postpartum; postweaning anestrus is not an uncommon sequela of these management techniques. General guidelines to minimize the negative effect of early weaning on sow reproduction recommend weaning at no less than 14–16 days into lactation for primiparous sows, at no less than 12–14 days into lactation for sows on their second litter, and at no less than 9–11 days into lactation for sows on their third or subsequent litters.

# Hormonal Control of the Estrous Cycle:

Estrous synchronization may be achieved by synchronized weaning of lactating sows; estrus occurs 4–10 days later. Administration of a commercially available combination of 400 IU of equine chorionic gonadotropin (eCG) and 200 IU of human chorionic gonadotropin (hCG) per 5 mL dose given as a single IM injection within 12 hr after weaning tightens the synchronization, and estrus occurs 4–5 days after weaning. This eCG and hCG combination also induces estrus in gilts with

synchronization, and estrus occurs 4–5 days after weaning. This eCG and hCG combination also induces estrus in gilts with delayed puberty and in sows with postweaning anestrus.

Fixed-time insemination protocols continue to gain interest in the swine industry. Current recommendations call for the use of progestins to prime the gilt before administration of a GnRH analogue. With sows, a GnRH analogue is administered 83–96 hr after weaning. Breeding of both gilts and sows is then performed 20–33 hr after GnRH administration (depending on product and route of administration).

Exogenous prostaglandin induces luteolysis of the corpus luteum only after day 12 of the estrous cycle and, therefore, is not a practical agent for estrous cycle control; however, estrus may be synchronized by induction of abortion in sows pregnant >15 days by administration of $PGF_{2\alpha}$ (15 mg, IM, then 10 mg, IM, 12 hr later) or an equivalent analogue. Estrus may also be synchronized by feeding altrenogest (15–20 mg, PO, daily for 14–18 days), with estrus being observed 4–9 days after the last dose with appropriate boar exposure. Combination eCG and hCG may be given on the day of progestagen withdrawal to better synchronize estrus.

# Breeding:

The three methods of breeding are pen mating (boar run with females), hand mating (supervised natural mating), and artificial insemination (AI). Pen mating is generally found on smaller operations and works best in a pen of pigs in various stages of the estrous cycle. Pen mating with a group of recently weaned sows is less desirable, because their estrous cycles may occur close together and lead to overuse of the boar. In hand mating, the female is usually mated two or three times during estrus, with the first service on the first day of standing estrus, and subsequent matings at 24-hr intervals; confirmed matings should be recorded. Many commercial producers breed the sow or gilt once daily as long as she will accept the boar. The use of two different boars may increase the number of pigs per litter but may mask infertility in one of the boars.

In AI programs, heat detection is performed either twice or once per day. If heat detection is performed twice per day, gilts should be inseminated twice, 8–12 hr after the onset of standing heat and again 12–16 hr later. Sows should be inseminated 24 hr after onset of standing heat and again 18–24 hr later. If heat detection is performed once per day, gilts should be inseminated within 4 hr and sows within 12–16 hr from when they were first seen in standing heat. A second insemination should be performed as described above for those animals that remain in standing heat.

Timing of AI may need to be modified based on a particular farm's availability of labor, building design, or herd genetics. Some experienced users of AI obtain satisfactory results in gilts with a timed, single insemination; however, performing two inseminations is more common. Inseminations can be performed using either single-sire (sourced from one boar) or pooled (sourced from multiple [three to six] boar ejaculates) extended semen. In general, single-sire matings are performed when particular genetic (ie, breeding or show animals) offspring are desired, whereas matings with pooled semen are used as a means to produce market hog offspring. Minimum suggested values for extended semen used within 72 hr after collection are provided in ({blank} Minimum Suggested Values of Extended Porcine Semen for Use in an Artificial Insemination Program). Total sperm numbers in a dose of semen depend on quality and storage time of the semen.

### Minimum Suggested Values of Extended Porcine Semen for Use in an Artificial Insemination Program

| Semen Variable | Value |
|---|---|
| Gross sperm motility | ≥70% |
| Normal sperm morphology | ≥75% |
| Sperm concentration | 25 to 65 × $10^6$ sperm/mL |
| Dose volume (cervical deposition) | ≥70 mL |
| Microbial content | No significant aerobic growth |
| Arrival temperature | 15º–19ºC |

Boars should not be overused (see Table: Suggested Guidelines for Boar Usage Based on Breeding Program [a]). If sows are weaned in groups, a boar-to-sow ratio of 1:4 for mature boars and 1:2 for young boars is recommended. In hand mating, a mature boar should be used for ≤2 breedings/day. When using natural service, a boar-to-sow ratio of 1:15–1:25 (average 1:17 or 18) is usually needed. When using AI, the boar-to-sow ratio can be increased to 1:150–1:400.

### Suggested Guidelines for Boar Usage Based on Breeding Program [a]

| ----Artificial Insemination---- | | --------Natural Mating-------- | | |
|---|---|---|---|---|
| Boar Age (mo) | Semen Collection Frequency[a] | Matings/day | Matings/wk | Pen-breeding (females/mo) |
| 6–8 | 1 time/wk | 1 | 4 | <8 |
| 8–12 | 1–2 times/wk | 1 | 5–7 | 8–10 |
| >13 | ≥4 times/2 wk | 2 (spaced) | 8–10 | 10–12 |

Adapted from Althouse GC. *Animal Health and Production Compendium*, 2002, by CAB International, Wallingford, Oxon, UK.

[a] Depends on boar libido

## Pregnancy:

Sperm cells reach the oviducts within 30 min of mating, and fertilization can occur within 2–6 hr. Fertilization rates approach 100% in sows, but embryo mortality up to 30%–40% accounts for the usual litter size of 10–16 pigs. Embryos enter the uterus ~48–60 hr after ovulation. Embryos hatch from the zona pellucida and form blastocysts 144 hr after ovulation. Maternal recognition of pregnancy (embryos secreting estradiol) occurs by day 10–14 of gestation, with intrauterine migration and distribution of embryos. Embryo attachment begins by day 13–14, with implantation complete by day 40; a minimum of four embryos must be present at this time for pregnancy to continue. Skeletal mineralization develops by day 35, with fetuses immunocompetent by day 70–75. Fetal deaths that occur after day 35 can result in expulsion or retention of recognizable piglets. Retained dead fetuses in this sterile environment become mummified and are usually expelled at the time of farrowing. The average gestation length is 114 ± 2 days and is somewhat shortened in sows with large litters.

Embryos are at greatest risk of dying during the first 30 days, and efforts should be directed toward avoiding stresses to the sow (eg, overfeeding, heat, handling or moving, immunization) during this critical period. Pregnancies of <16 days are especially sensitive to heat stress. Avoiding exposure to outside animals reduces disease risk. Feed intake should be reduced to the limit feeding level of 4–5 lb (~2 kg) immediately after breeding to avoid embryo loss due to high energy intake. Farrowing less than five piglets is indicative of embryo death after the time of attachment.

To increase colostral antibodies, the gilt or sow should be immunized during the last 6 wk of gestation. An immunization program may include vaccination against *Escherichia coli*, atrophic rhinitis, and erysipelas, and provision of any other vaccines appropriate for the disease situation on the individual farm.

## Pregnancy Determination:

Several techniques are available for pregnancy determination (see Table: Common Tests for Detection of Pregnancy In Pigs). Pregnancy is most commonly diagnosed by noting that the female does not return to estrus in 18–25 days; this is 75%–85% accurate. Ultrasonography is another popular technique, and three types can be used: pulse echo (A-mode), Doppler, and real-time. Pulse echo or amplitude depth involves emitting ultrasonic waves from a hand-held transducer placed on the skin in the flank area. Reflected waves from a fluid-filled area (ie, developing conceptus or fetus) are picked up by the transducer and converted into either an audible or visual signal. Doppler ultrasonography detects changes in sound frequency (fluid movement) using an audible signal; movements indicative of pregnancy include blood flow in middle uterine or umbilical arteries, fetal heartbeat, and fetal movements. Real-time ultrasonography involves visualization of a 2-dimensional image of scanned tissues directly under the transducer. Ultrasonographic techniques are generally used at 22–75 days to determine pregnancy, with real-time ultrasonography being used as early as 18 days after breeding. Although uncommonly used for this purpose, rectal palpation can be performed to confirm pregnancy at >30 days gestation. The examiner palpates for fremitus, size, and position of the middle (medial) uterine artery in relation to the

external iliac artery. The tone and tension of the cervix and weight and contents of the uterus can also be used to help confirm pregnancy. Other techniques such as hormonal assays (eg, estrone glucuronide, progesterone, prostaglandin) and vaginal biopsy can be used but are not economically feasible.

### Common Tests for Detection of Pregnancy In Pigs

| Technique | Test Type | Application of Test After Breeding (Accuracy) |
|---|---|---|
| Estrus detection | Indirect | Daily testing 18–25 days (75%–85%) and through gestation (98%) |
| External physical signs | Indirect | >55 days (gilts); >84 days (sows) |
| Rectal palpation (sows) | Indirect | 30 days (94%), >60 days (100%) |
| Ultrasonography | | |
| A-mode | Indirect | 30–75 days (95%) |
| Doppler | Direct/Indirect | ≥35 days (>85%) |
| Real-time (B-mode) | Direct | ≥22 days (>95%) |

## Parturition:

The preparturient period involves restlessness and nest building the last 24 hr. Mammary glands become turgid, and the secretion changes from serous to milk as parturition approaches. Parturition is initiated by increased cortisol levels, which also stimulate release of prostaglandin (PG) $F_{2\alpha}$ from the uterus. $PGF_{2\alpha}$ causes luteolysis of the corpora lutea and release of relaxin, which causes relaxation of the birth canal and cervix. Oxytocin is released from the pituitary gland, which causes uterine contractions and onset of labor. Piglets are usually delivered at frequent intervals (10–15 min; 5–45 min range). Uterine horn evacuation is random.

The stillbirth rate usually is 5%–10%; intra-uterine deaths are due to infection, incorrect position in the uterine horn during delivery, or anoxia. Anoxia is seen when the umbilical cord ruptures or becomes constricted because of the extreme length of the uterine horn, or when there is a delay in transit along the birth canal. Stillborn and weak piglets also may be due to low temperatures in the farrowing house or low Hgb levels (<9 g/dL) in the sow. Any increase in the time interval between pigs born (eg, due to exhaustion, atony of the uterus, or dystocia) increases the chance of injury or death to the piglets still in the uterus. Piglets are born in both cranial (60%) and caudal (40%) presentation. Assistance can be provided in the form of oxytocin injections (10–30 IU) and manual removal of piglets. Walking the sow for a few moments also can be helpful. The number of pigs born alive can be increased by approximately one per sow if an attendant is present to assist delivery (see Preweaning Mortality). Passage of the fetal membranes should occur within 4 hr of delivering the last piglet.

Farrowing can be induced by IM injection of 10–15 mg of natural $PGF_{2\alpha}$ or equivalent dose of synthetic analogues. Farrowing generally occurs 18–36 hr later (most within 22–32 hr) in 80%–90% of sows when $PGF_{2\alpha}$ is given at or after 112–113 days gestation. Induction can be used so that most farrowings occur during normal working hours, avoiding evenings, weekends, and holidays. Good records are essential, and average days of gestation for the sow herd and individual breeding dates for each sow must be known. $PGF_{2\alpha}$ must be used within 72 hr of the expected farrowing date to prevent an increase in stillbirths. The slightly premature piglets require good environmental conditions, particularly in cold weather. Farrowings may be concentrated into an even shorter period by injecting 20 IU of oxytocin IM 15–24 hr after the $PGF_{2\alpha}$ injection. This shortens the interval to parturition but can be accompanied by an increase in dystocia. Successful farrowing can also be induced by giving a single vulvomucosal injection of 5–10 IU of oxytocin.

Incidence of dystocia is low (1%–2%) in sows. As with all polytocous species, uterine inertia accounts for most dystocia in swine. Other causes include fetal malposition, obstruction of the birth canal, deviation of the uterus, fetopelvic disproportion, and maternal excitement. A thorough digital examination of the birth canal is prerequisite to therapeutic intervention. Medical therapy for unobstructive dystocia may include use of an ecbolic agent (oxytocin at 20–30 IU every 30 min, up to three times). Administration of injectable calcium may be warranted if uterine inertia is suspected.

Lactation peaks at 3–4 wk postpartum. Sows that have been on an 8-wk lactation produce 400–700 lb of milk. Poor lactation is a significant cause of impaired productivity in pigs (see Postpartum Dysgalactia Syndrome and Mastitis in Sows).

## Preweaning Mortality:

## Preventing Mortality

Supervised farrowing alone can help to reduce piglet mortality, because it minimizes stillbirths, facilitates access of piglets to needed warmth, allows for observation of nursing activity, and prevents crushing and cannibalism. Other management techniques available to reduce piglet mortality include cross-fostering, split-suckling, well-designed farrowing crates and pens, prepartum vaccination of sows, appropriate feeding programs for lactating sows, and cleanliness.