REPRODUCTIVE MANAGEMENT

BRIEF REVIEW OF REPRODUCTIVE PHYSIOLOGY

1. Boars

   In any breeding herd, boars are outnumbered by sows, but do not underestimate their contributions! They do contribute 50% of the genetic makeup of every pig sired. Thus, their levels of libido, mating ability, and fertility influence farrowing rate and litter size greatly.

   A. Testes - Have two primary functions: 1) to produce sperm (♂ germ cells) & 2) to produce testosterone (♂ sex hormone). The size of testes can be related to boar's sperm production capability, and testes for 7 to 8 month-old boar should be at least 6-7" in height & 6-6½" in width (paired testes).

   B. Scrotum - Supports and protects testes, and helps maintain testes at the optimum temperature for sperm production (generally, ≈ 4-5°F below the body temperature):

      1) Draw testes close to the body in the cold environment & relax muscles, ∴ fall away from the body, in the hot environment.

      2) Extreme temperatures [i.e., > 85°F or the low temperature that can cause frostbite/infection] can result in the low fertility rate because of inability to maintain the optimum body temperature!

   C. Epididymis - Exterior of testes and involved in: 1) sperm maturation, 2) sperm concentration, 3) sperm storage and 4) passing sperm (passageway).

   D. Vas deferens - Connects the epididymis to the urethra and acts as a passageway for spermatozoa.

   E. Accessory glands - Seminal vesicles secrete a large volume of fluid, prostate gland contributes to the fluid volume, and bulbourethral gland (Cowper's gland) secretes pelleted gel materials (referred to as a “cervical plug”).

   F. Penis conveys sperm to the sow's cervix.

   G. Ejaculation:

      1) Begins when the spiral tip of the glans penis becomes interlocked in the cervix.

      2) Consists of four fractions - a) pre-sperm (10-25 ml of clear accessory gland fluid), b) sperm-rich (30-60 ml; contains 80-90% of sperm), c) post-sperm (70-130 ml; clear, watery fluid), and d) gelatinous (secreted throughout the process, but a major portion at the end).

      3) Total volume ranges from under 100 to over 400 ml, and differences are due to age, breed, period of sexual rest, etc.

      4) The process usually takes 4 to 7 minutes.

2. Gilts and Sows

   A. Ovary - Primary organ of the ♀ (homologous to testes of the ♂, and has three functions: production of eggs or ova, secretion of estrogen, and secretion of progesterone.

      1) Ova: Produced in structures called “follicles” (usually 16-18 are produced, but not rare to produce 20), and released from ovaries upon ovulation. Usually fertilized
within the first 6 hr after ovulation, and greatly ↓ chance of fertilization and normal embryonic development if not fertilized < 12 hr.

2) Estrogen: The concentration is usually low except during the estrus period, and has several functions: a) causes the animal to come into heat (induces a “gonadotropin surge”), b) involved in the development of the genital system, and c) assists development of mammary glands.

3) Progesterone: Follicles begin formation of corpus luteum (CL) soon after ovulation, which produces progesterone, which ↓ during the 1st 14 or 15 days of the cycle & then ↓ within 2 days, and remains low for 4 or 5 days until the next ovulation.

B. FSH & LH (origin = pituitary):

1) FSH causes follicles to grow, and LH causes eggs to mature & triggers rupture of the follicle wall.
2) CL develops about 48 hr after ovulation:
   a) Progesterone “quiets” the reproductive system and maintains pregnancy.
   b) CL persists if conception has taken place, ↓ preventing ovulation.
   c) Progesterone levels ↓ up to about 14th day of the cycle, and ↓ if conception has not taken place.

C. Fallopian tubes or oviducts - Paired structures adjacent to each ovary. Ova are passed into infundibulum (a funnel-shaped membrane) & then into the oviduct. Fertilization takes place in the oviduct, and fertilized eggs then descend into the uterine horn.

D. Uterus - A muscular, membranous and glandular structure, which is made up of the body and two well-developed horns, and designed for reception of fertilized-eggs and provides nutrition and protection to the fetus.

E. Cervix - A thick-walled structure connecting the body of uterus and vagina, and semen is deposited primarily in the cervix in swine (vs vagina in most farm animals). Tightly closed during the pregnancy, ↓ protecting the uterus from “contamination!”

F. Vagina - The passage way that extends horizontally through the pelvic cavity, from the neck of the uterus to the vulva, and serves as a copulatory organ & a passage way for the fetus at the time of parturition.

G. Clitoris and vulva - Clitoris is ♂ homologue of the penis & vulva is the terminal part of ♀ genital tract.

3. Eggs and Sperm

A. Sperm can live for about 48 h after mating.

1) The number of viable sperm after mating ↓ rapidly within a few minutes, and can be as few as 1,000 within a few hours (out of 30-60 billion!).
2) Depending on the No. of viable sperm, the time from penetration of the 1st egg to last egg may be several hours!

B. Eggs can only live about 8 h after ovulation, and become incapable of being fertilized normally thereafter (> 8 hr)!

4. Pregnancy

1) Eggs are penetrated and developed to the 2-cell stage in about 24 h.
About 48 h after ovulation, eggs enter the uterus (embryos are now in the 4-cell stage). Embryos remain near the tip of each uterine horn until about 6th day. Uterine contractions distribute embryos throughout the length of the uterus. The first exchange of signals between embryos and dam at day 12. If all of the uterus is occupied, ♀ will stay pregnant, but will resorb embryos and return to heat if half the uterus is unoccupied! Once established pregnancy at day 12 & stayed pregnant for 20 to 30 days, additional losses usually do not interrupt pregnancy.

5. **Litter Size**

A. Litter size is limited by:

1) The number of eggs ovulated, which is influenced by the genetic potential, age, plane of nutrition, etc.
2) Fertilization? Most eggs are fertilized, but the development of embryo(s) may not be in “close synchrony” with constantly changing uterus environment.
3) Prenatal survival? About 25 to 30% of embryos are lost before day 30, and possible causes include abnormal fertilization, immunological incompatibility, genetics, hormone imbalance, diets, & toxins.
4) General recommendations? a) Restrict feed intake for the first 30 days, and b) no change in the diet or no exposure to chemicals or toxins!

B. Uterus has its limit:

1) The No. and size of pigs born are limited by the uterine space or length.
2) Each fetus requires ≥ 1 ft of the uterus - With inadequate space, fetuses would not survive & partially resorbed & less space can cause the formation of runt pigs.
3) With ≥ 14 fertilized eggs, the uterine length often limits the litter size.

C. Environmental effects:

1) The fertility of ♂ is affected by heat, and hot day(s) in early June will have adverse effects on the fertility in mid-July ( . . . takes about 6 or 7 weeks to produce mature sperm!) & consequently ↓ litter size during November and December
2) Adverse environmental effects on ♀ are usually restricted to first few weeks after breeding & last phase of gestation.

**THE BRIDE**

*They sent me away to be bred. I was afraid, going down the ramp from the truck to the strange barn. I tried to run for the farmyard . . . strangers shouted, they drove me inside.*

*In the barn, a beautiful, imperious boar dwelt in majesty.*

*They brought me to him, in the hot smell of him,*

*I who was delicate, Sylvia the pet, who smelled of acorns and the wind scoured pasture,*

*I, Sylvia the Dreamer was brought low, was brought into the depth of desire.*

*I steeped my soul in the sweet dirt, the stench of My Lord Boar!*

(“Pig Dreams” by Levertov, 1981)
1. **Pen Mating** - Simply turns a boar(s) into a pen to breed gilts/sows, thus, requires less labor!
   - This is the 1° reason for its popularity [see a table (unknown)], and advantages for the “hand mating” usually become disadvantages for the pen mating!

2. **Hand Mating** - Advantages include:
   - Known exact breeding dates for each ♀, & can induce farrowing because of that.
   - Can make sure sows are bred once or twice at a proper time.
   - Can control the use of boar, which allows more ♀ to be bred by a particular boar.
   - Can have more control over correct crossbreeding or purebred breeding programs.
   - Can control size differentials between σ & ♀.
   - Easy to identify σ with anatomical defects & reduced sexual behavior, or infertile σ.
   - Can prevent injuries to the penis.
   - Can optimize the utilization, thus increase the longevity of σ, and reduce the number of replacements needed.

### MANAGEMENT OF THE BOAR

1. **Introduction**
   - A boar has a very low degree of sexual capacity vs a ram or a bull.
     - For instance, a mature ram can be turned out with 40 or 50 ewes with reasonable assurance that most will conceive.
     - So, if a boar is used two times/day, he should be given a day of rest!
   - At 6-7 mo of age, usually capable of mating and ejaculating.
   - At 8 or 9 mo of age, a vigorous boar can be used on a limited basis.
   - To be used on a regular basis, the σ must: 1) be large enough to mate, 2) have sufficient sex drive to complete ejaculation in a reasonable period of time, and 3) produce adequate semen (quantity & quality) to ensure a high conception rate and normal litter size.

2. **Why Should Boars be Housed Individually?**
   - Can prevent injuries from fighting/riding, adjust feed intake to maintain a proper body condition, prevent homosexual activity, optimize sexual behavior, and simplify handling!
   - Thus, can optimize the utilization of boars, increasing the longevity & reduce the number of replacements needed!

3. **Lack of Sexual Activity**
   - Possible reasons include: high environmental temperatures (> 85°F), previous rearing environment (e.g., isolation), domination by other boars/sows or bad breeding experience, poor nutrition and/or body condition, lameness and sickness, hormonal deficiencies and/or inadequate stimuli, distraction in the breeding area, inexperience/age, & overuse.
4. Why Do Boars Need Sexual Rest?

   A. Sperm production - See a figure.

   1) Compared with the 1st, the 2nd ejaculate
      contains 33-41% less sperm & 3rd contains 59-
      66% less, and the number tends to be stabilized
      after 5 ejaculations.

   2) Question? “... Stabilized at what level of
      sperm output... fertile, sub-fertile or
      infertile?” Not exactly sure!

   3) Generally assumed that 3 to 6 billion motile
      sperm are needed, but there are some variations
      among boars.

   The bottom line? The 1° reason for a sexual rest is to ensure adequate No. of normal
      sperm!

   B. How much rest?

   Effect of the number of ejaculations: (Levis and
   Brumm, 1980)

<table>
<thead>
<tr>
<th>Item</th>
<th>No. of ejac. in previous 6 d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1</td>
</tr>
<tr>
<td>No. of litter</td>
<td>547</td>
</tr>
<tr>
<td>No. born alive</td>
<td>10.1</td>
</tr>
<tr>
<td>No. stillborn</td>
<td>9</td>
</tr>
<tr>
<td>Return rate, %</td>
<td>15</td>
</tr>
</tbody>
</table>

   Effect of the rest period: (Levis and Brumm, 1980)

<table>
<thead>
<tr>
<th>Item</th>
<th>No. of wk unused before mating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-2</td>
</tr>
<tr>
<td>No. of litter</td>
<td>854</td>
</tr>
<tr>
<td>No. born alive</td>
<td>10.5</td>
</tr>
<tr>
<td>No. stillborn</td>
<td>7</td>
</tr>
<tr>
<td>Return rate, %</td>
<td>10</td>
</tr>
</tbody>
</table>

   The bottom line? Over use can ↓ litter size, but too much rest (> 4 wk) can also have
   adverse effects!


<table>
<thead>
<tr>
<th>Age (mo)</th>
<th>Hand-mating (# service)</th>
<th>Pen-mating (# sows)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day</td>
<td>Week</td>
</tr>
<tr>
<td>Young (8½ - 12)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Mature (&gt; 12)</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

6. Should Boars be Assisted?

   A. Possible advantages of assisting:

   1) Speeds up the breeding process.

   2) Prevents boars and sows from getting “over-heated.”

   3) Prevents anal ejaculations.

   4) Helps prevent penile injuries.

   B. Beneficial? According to Levis (1986), assisting boars during
   their first 2-3 matings does not make a young boar a better breeder, so ...?!
7. Management of Boars in the Pen-Mating System

A. Keep them in a small group (2-3 per pen) - Well-established dominant and subordinate relationships among boars can prevent stress, and also can provide some flexibility because easier to replace two or three boars than trying to add one or two boars to a large group!
B. Divide weaned sows into groups of 10-15 & rotate two groups of boars every 12-24 hours, which may prevent multiple mating!
C. Unable to give a rest, then rotating group(s) of boars between sow pens may stimulate their sexual behavior. (Behavior may decrease, but how about the No. of sperm?)
D. Observation of boars frequently for signs of injuries, illness, etc. is must!

8. Effect of Heat Stress

A. Effects of high temperatures (boars were exposed to 92°F for 72 hours):

1) Summary:
   a) A short-term temperature stress has detrimental effects on semen (No. & quality), thus on fertility! (Also, ↑ body temperatures due to sickness has the same effects!)
   b) Adverse effects are not immediate, but 3 to 5 wk after the exposure.
   c) Gradually return to near normal values by ± 9 wk after the exposure.

2) The bottom line? Maintain boars in a cool environment (< 85°F) 24 h a day and 7 days a week!
B. During the summer? Try to use boars during a cooler period of the day (↑ heat production + high environmental temperatures - ↑ body temperature!), and also should not overuse aggressive boars!
9. **Feeding Boars?**

A. When to feed? - Boars should be fed before being used in the hand mating system because they have a tendency to stop and eat spilled feed in the alley, possibly to miss sows in a “standing reaction” because of the delay!

B. How much?

1) Before the breeding period (within 2 weeks) - Feed 5-6 lb of a well-balanced 14% CP diet to young boars, and feed 4-5 lb to older boars in a good body condition.

2) During the breeding period - Depends on the work load, but generally 8 lb of a well-balanced 14% CP diet should be sufficient.

3) After the breeding period - Depends on a body condition and idle period, but generally 4 lb of a well-balanced 14% CP diet should be sufficient.

10. **Type of Records to Keep on Boars?**

A. Because of large impacts they have on reproductive efficiency, important to keep records on boars!

B. To keep “meaningful” records on the boar, cannot use a different boar on the 2nd service, i.e., use the same boar when servicing twice!

C. Important records to keep in the hand-mating system - 1) Litter size, 2) farrowing rate, & 3) percentage of litters farrowed with 8 or less pigs.

**MANAGEMENT OF THE FEMALE**

1. **Introduction**

   - Because about one-third of total costs of pork production is the maintenance of the breeding herd, it is essential that all females return to estrus after weaning and conceive promptly!

2. **Failure to Return to Estrus**

A. Failure to recycle is greatest in sows weaning their first litter (vs 85% for multiparous sows) because:

   1) Have a limited appetite, and their feed intake is inadequate for maintenance, growth and milk production, the consequence being excessive weight loss during the lactation phase!

   2) Excessive weight loss is the main contributing factor in a failure to return to estrus after weaning!

B. Can expect ≈ 20 to 30% reduction in “early return to estrus” (i.e., within 7-10 days) during the summer.

   1) This varies from year to year, and also with parity, housing systems, etc.

   2) Thus, usually need a greater number of replacement gilts during those months.

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### Percentage of primiparous sows bred < 9 Days: (Levis, 1980)

<table>
<thead>
<tr>
<th>Month</th>
<th>Sows weaned</th>
<th>% Bred</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>46</td>
<td>57.6</td>
</tr>
<tr>
<td>May</td>
<td>56</td>
<td>56.3</td>
</tr>
<tr>
<td>June</td>
<td>58</td>
<td>56.0</td>
</tr>
<tr>
<td>July</td>
<td>39</td>
<td>54.2</td>
</tr>
<tr>
<td>August</td>
<td>23</td>
<td>34.1</td>
</tr>
</tbody>
</table>

### Season & pregnancy (Levis, 1980)

<table>
<thead>
<tr>
<th>Month</th>
<th>Anestrus (%)</th>
<th>Pregnancy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan - June</td>
<td>0 - 9</td>
<td>85 - 100</td>
</tr>
<tr>
<td><strong>July - Oct</strong></td>
<td><strong>15 - 36</strong></td>
<td><strong>33 - 50</strong></td>
</tr>
<tr>
<td>Nov - Dec</td>
<td>0 - 5</td>
<td>86 - 95</td>
</tr>
</tbody>
</table>

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3. **Failure to Detect Estrus**

A. General - Detection of estrus in gilts is more difficult vs sows. Many ♀ might be actually cycling with normal ovaries!

B. Reasons for missing cycling sows? See a figure (Levis et al. NE Swine Repro. Mgt.)

4. **Effect of Factors on Return to Estrus**

A. Nutrition during lactation:

1) **Effect of energy intake:** (e.g., Reese et al., 1982. JAS 55:590)

<table>
<thead>
<tr>
<th>Intake change, kg</th>
<th>7 d</th>
<th>14 d</th>
<th>21 d</th>
<th>70 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Mcal</td>
<td>50.0</td>
<td>63.9</td>
<td>63.9</td>
<td>86.1</td>
</tr>
<tr>
<td>16 Mcal</td>
<td>94.3</td>
<td>94.3</td>
<td>97.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* The 1988 NRC requirement = 17 Mcal/day.

Sows must consume adequate energy for early return to estrus!

2) **Protein intake:** (e.g., Brendemuhl et al., 1987. JAS 64:1060)

<table>
<thead>
<tr>
<th>Protein intake</th>
<th>Wt Δ, kg</th>
<th>7 d</th>
<th>14 d</th>
<th>35 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>380 g/d</td>
<td>-23</td>
<td>63.1</td>
<td>75.7</td>
<td>85.4</td>
</tr>
<tr>
<td>760 g/d</td>
<td>-12</td>
<td>82.3</td>
<td>87.5</td>
<td>93.6</td>
</tr>
</tbody>
</table>

* The 1988 NRC requirement = 689 g/day.

Sows must consume adequate protein for early return to estrus!

B. Modifying suckling inhibition:

1) See an example (Unknown Source) - ↓ suckling intensity before weaning may have beneficial effects in terms of early return to estrus & others!

2) Practical application? Perhaps, weaning heavier pigs 2-3 days before scheduled weaning day:

   a) ↓ suckling intensity & weight loss of the sow.
   b) Also, beneficial to the remaining smaller pigs!?

C. Estrus during lactation?

1) Can be induced by, e.g., the use of hormones (estrogen, GnRH and gonadotropins), separation of pigs, and(or) exposure to other sows and(or) boar.
2) Usefulness? May not be practical, and benefits would be minimal if weaning < 28 days after weaning!

D. Effect of hormones after weaning:

1) In one study, treated sows with 400 IU, Pregnant Mare Serum Gonadotropin (PMSG) and 200 IU Human Chorionic Gonadotropin (HCG) - See the results (Bates & Day, 1988).
2) The bottom line?
   a) Recommended if experiencing a high incidence of anestrus, and the timing of ovulation is important (e.g., when using the AI program).
   b) Generally not recommended because of the availability & costs. Besides, weaning (+ boar exposure) is the most effective stimulus!

5. Flushing After Weaning?

A. Flushing or high energy feeding 7-10 days before breeding (↑ feed intake by 50-100%) is commonly used to ↑ ovulation rate in gilts.
B. Effect on primiparous sows - See the data (Levis, 1980).
C. Effect of age and body condition of sows - See the data (Levis, 1986).

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Days to estrus</td>
<td>22</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>% mated</td>
<td>66</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Pigs born (next farrowing)</td>
<td>9.4</td>
<td>10.1</td>
<td>11.6</td>
</tr>
</tbody>
</table>

Effect of flushing on younger & older sows: (Levis, 1986)

Effect of flushing on sows in very good, normal or poor condition (Levis, 1986):

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<thead>
<tr>
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<tbody>
<tr>
<td>Return to estrus (day):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parity 1</td>
<td>7.6</td>
<td>6.4</td>
<td>+1.2</td>
</tr>
<tr>
<td>Parity 2-5</td>
<td>5.6</td>
<td>5.2</td>
<td>+.4</td>
</tr>
<tr>
<td>Parity 5+</td>
<td>5.5</td>
<td>5.3</td>
<td>+.2</td>
</tr>
<tr>
<td>Return to estrus (day):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V. good</td>
<td>6.2</td>
<td>5.5</td>
<td>+.7</td>
</tr>
<tr>
<td>Good</td>
<td>6.4</td>
<td>5.8</td>
<td>+.6</td>
</tr>
<tr>
<td>Poor</td>
<td>7.6</td>
<td>6.7</td>
<td>+.9</td>
</tr>
<tr>
<td>Return to estrus (day):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V. good</td>
<td>10.8</td>
<td>10.6</td>
<td>-.2</td>
</tr>
<tr>
<td>Good</td>
<td>10.6</td>
<td>10.9</td>
<td>+.3</td>
</tr>
<tr>
<td>Poor</td>
<td>10.4</td>
<td>11.2</td>
<td>+.8</td>
</tr>
</tbody>
</table>

The Bottom Line:

1) Primiparous sows respond to flushing, but not sows in a good body condition. (If sows are returning to estrus 4-8 days after weaning, probably insufficient time to show response in the ovulation rate.)
2) Feeding extra feed to very thin sows or to primiparous sows may be justified because of benefits in return to estrus and ovulation rate!
3) Older sows weaned in a good body condition, feeding 4 lb/day is adequate!

6. Antibiotics at Breeding Time? For the herd with history of breeding problems (& causes unknown), antibiotics may improve breeding performance, but should discontinue their use within two or three weeks after breeding.

7. To Avoid Failure to Recycle After Weaning
A. Some considerations: (Mostly for the 1st litter sows)

1) Breed gilts that are in a good body condition.
2) During the gestation phase, feed gilts so that they are still gaining weight (i.e., net body weight gain, not including the conceptus!).
3) Feed a high energy diet during the first lactation.
4) Avoid high farrowing house temperatures (> 80°F).
5) Reduce suckling intensity on thin sows by weaning heavier pigs 2-3 days before scheduled weaning date.
6) Do not reduce sow feed on thin sows before weaning.
7) Feed thin sows about 8 lb daily after weaning (especially first litter sows).
8) Check “adequacy” of feeding program by weighing sows at the mating time, end of the gestation phase and weaning time.

B. Weight gain of sows: [See a figure (Levis et al. NE Swine Repro. Mgt.)]

1) Sows continue to mature until about the fifth litter.
2) If sows are gaining about 22 to 33 pounds (from weaning to weaning) during each of 4 to 5 cycles, they are probably in a proper body condition!

**MANAGEMENT OF SOWS AND BOARS AT BREEDING TIME**

1. Estrus in Gilts/Sows

A. Signs include: Restlessness, loss of appetite, color change & swelling of vulva, frequent sniffing of genitals of pen mates, often emitting a peculiar growling or roaring sound like boar, cloudy mucous discharge from vulva, adopting male-like sexual behavior such as pursuing, nosing flanks, mounting other females, etc., an arched back, rigid, immovable receptive stance, and “ear popping (ears in an erect position).”

B. Signs of estrus & time:

1) Difficult to determine the onset of estrus!
2) Duration of estrus?
   a) Usually, shorter in gilts than in sows.
   b) Considerable variations, and varies from 12 to 96 hr.

2. Need the Boar for Estrus Detection?
A. Signs of estrus alone are unreliable because they merely indicate that a female is coming into, is already in or has been in estrus!

B. Also without a boar, many estrous females may not stand for the back pressure test - 20% sows and 40-50% gilts are not responsive.

C. The bottom line:

For the effective heat detection, need an aggressive, mature boar its behavior such as head-to-head contact, champing & salivating, nosing the flank, chanting, genital sniffing, and mounting on side & rear. (Also need a facility that allows him to undergo his courtship rituals!)

3. Estrous Detection

A. Estrus is characterized by the immobilization response (standing reaction), and it is usually not maintained for more than 10 min in sows & 7 min in gilts!

B. The key to detect estrus quickly and efficiently is “not to provide boar stimuli” 1-2 hours before heat detection. Then, can expect more intense and immediate response when exposed to the boar!

C. Estrus detection procedures: (Levis, 1989)

1) Step 1 - Provide a continuous boar contact after weaning (optional) by placing a boar in the adjacent pen or in alleyway for several hours/day.

2) Step 2 - Separate sows and boars for at least 1-2 h before actual heat checking time (by the wall or distance of at least 50 feet).

3) Step 3 - Estrus detection and(or) mating:

   a) Take weaned sows to the heat checking/breeding area.

   b) NEVER take the boar to the area where weaned sows are housed!

   Why? - May stimulate all estrous sows into the mating stance & some sows may not stand for the 2nd boar 10 to 15 min later!

   Frequency of heat checking & service:

   a) Checking once a day - Heat check & service!

   b) Twice a day - Heat check only!
4. Optimum Time to Service?

- See “Effect of time of a single service on pregnancy rate & litter size (Levis, UNL).”
  
  a) Optimum time - 4-12 hr before ovulation for a high conception rate & litter size!
  
  b) But, rather difficult to determine the exact time of ovulation!

5. How Many Times & When?

A. Again, difficult to detect the “onset” of estrus accurately,
B. Effect of the number of service on pregnancy rate? - See one example.

Rather difficult to obtain a high conception rate and litter size with a single service, thus servicing more than once can ↓ conception rate!

C. When to service?

a) Once-a-day heat detection - Breed once on each of the first 2-3 consecutive days!
b) Twice-a-day heat detection - Breed at 12 & 24 or 36 h after estrus detection!

c) Estrus in ♀ lasts only 12 to 24 hours (often occurs in gilts)? Breed others in the group as soon as they show standing heat & again 12 hours later if they are still in heat, and for gilts, probably should check for estrus more than once a day!

6. Number of Sows in Estrus After Weaning?

B. To avoid “overload” for boars, it is important to even out the number of sows in estrus after weaning! (This is especially important for the pen mating system!)

7. How Many Boars Do We Need?

A. Inadequate “boar power” can result in a low conception rate & suboptimal litter size!
B. Too much boar power means inefficient use of resources & costly!
C. The right No. of boars depends on many factors - e.g., Breeding period, No. of ♀ in estrus at a given time (i.e., distribution of estrous ♀ after weaning), No. of gilts to be bred and(or) No. of gilts in estrus, No. of services per female etc.

\[
\text{NoFar ÷ PerFar} \times \text{MatFem} \div \text{MatBoar} \times \%\text{Active}
\]

The number of service & pregnancy rate (%):

<table>
<thead>
<tr>
<th>Item</th>
<th>Gilts</th>
<th>Sows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once</td>
<td>70-72</td>
<td>76-78</td>
</tr>
<tr>
<td>Twice</td>
<td>83-85</td>
<td>85-88</td>
</tr>
</tbody>
</table>

where: NoFar = desired No. of farrowings/unit time, PerFar = % farrowing (farrowing rate), MatFem = desired No. of matings or services for ♀, MatBoar = desired No. of matings/unit time for ♂, %Active = avg. percent ♀ being used at one time.
8. How Many Additional Females?

- For a 100% occupation of the farrowing unit, must adjust the No. of ♀ to be serviced based on the expected farrowing rate!

A. Use previous records on the monthly farrowing rate to make a decision.

B. No records? Use the estimates based on the general farrowing rate trend, and corresponding monthly breeding factor (MBF). See a table.

1) MBF - Vary from one farm to the next because of differences in management practices, environment, etc.!

2) For replacement gilts, should not expect greater than 60% farrowing rate! (But, many producers achieve a higher rate!)

C. For a 100% occupation rate of the farrowing unit:

1) An adequate number of gilts must be maintained in the “Gilt Pool!”

2) Gilts must be managed properly to fit into the production or breeding schedule!

FACILITIES FOR SWINE ROMANCE?

- Depending on many factors (e.g., how to utilize facilities & handle animals), many types can be used successfully!

1. Hand Mating System or Artificial Insemination

- Regardless of the type of housing, five components must be designed correctly (Levis, 1989):

1) Housing area for newly weaned sows.

2) Temporary housing area for females after first service or heat checking (for those housed as a group).

3) Housing area for replacement gilts.

4) Housing area for boars.

5) Non-slick floors for breeding pens.

2. “Levis System” for Hand Mating/Artificial Insemination


3. Other Types
A. Dirt-lot (pen breeding) - Similar to the grower-finisher unit described previously, but has boar pens in addition to sow pens. (See Levis, 1989)
B. Open-front shed & outside concrete lot (pen breeding) - Similar layout to the dirt-lot, but shelters are replaced with the permanent structure (& concrete floors). (See Levis, 1989)
C. Post-weaning stalls and the boar pens behind (see PIH-69).
D. Weaned sows and boars separated by a buffer zone - Gestating sow pens are used to separate boars and recently weaned sows (or gilts) to avoid a continuous boar exposure. (See Levis, 1986)
E. Housing only boars, and contains breeding pens - Can use various types of housing for weaned sows/gilts (i.e., confinement, semi-confinement, dirt-lot, etc.). (See Levis, 1989)

**ARTIFICIAL INSEMINATION (AI)**


1. **Advantages**
   
   A. Fewer boars will be required - Undiluted semen can service 3 to 4 females & diluted semen can service 6 to 8 females/ejaculate.
   
   B. Can determine genetic capability of the boar more quickly, thus can improve the herd performance more quickly.
   
   C. To some extent, diseases can be controlled.

   - Diseases that can be potentially transmitted through semen but can be prevented by periodic testing of boars include: a) Leptospirosis, b) Brucellosis, c) Tuberculosis, and d) Pseudorabies.

   D. Older, heavier boars can be used for gilts without danger of injury.
   
   E. With estrus synchronization, a large No. of females can be bred at the same time.
   
   F. With the use of frozen semen:
   
      1) Less investment for boars in the cross breeding system.
      2) Increase the use of genetically superior sires - Both between and within the herd.
      3) Lower costs of using an outstanding boar vs keeping a boar.
      4) Because of a regular semen examination, infertile boars are likely to be detected sooner.

2. **Limitations**

   A. Fresh, undiluted semen has a short life (≈ 2 hr).
   
   B. Diluted, cooled boar semen stored under farm conditions usually lasts < 48 hr. (Depends on the type of extender used, but can be up to 6-7 days though!)
   
   C. Frozen semen (commercially available) is rather expensive (+ costs of equipment & techniques of using the AI), and should expect substantially lower farrowing rate and litter size.
   
   D. A higher level of management is essential - Must be thorough and pay close attention to details in all phases of the program (techniques, estrus detection, sanitation, etc.).

3. **Breeding Costs for a 250-Sow Herd**
A. Example [NHF 38(8):20 (1993)]

- Assumptions: 250 sows bred for 2.47 litters/yr (2.1 litters/sow/yr & 85% farrowing rate). 618 sow matings/yr x 2 breedings/sow = 1,236 breedings/yr.

Breeding requirements & costs ($) for a 250-sow herd:

<table>
<thead>
<tr>
<th>Item</th>
<th>NS/NS</th>
<th>NS/AI</th>
<th>AI/AI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of boars required</td>
<td>14</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Boar costs at:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$500/boar</td>
<td>10,360</td>
<td>5,920</td>
<td>740</td>
</tr>
<tr>
<td>$1,000/boar</td>
<td>17,360</td>
<td>9,920</td>
<td>1,240</td>
</tr>
<tr>
<td>$2,000/boar</td>
<td>31,360</td>
<td>17,920</td>
<td>2,240</td>
</tr>
<tr>
<td>AI cost/yr</td>
<td>0</td>
<td>1,206</td>
<td>1,740</td>
</tr>
<tr>
<td>Labor/yr, hr</td>
<td>466</td>
<td>390</td>
<td>315</td>
</tr>
<tr>
<td>Labor cost/yr ($10/hr)</td>
<td>4,656</td>
<td>3,904</td>
<td>3,152</td>
</tr>
<tr>
<td>Total cost of breeding:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$500/boar</td>
<td>21,016</td>
<td>12,029</td>
<td>5,632</td>
</tr>
<tr>
<td>$1,000/boar</td>
<td>22,016</td>
<td>15,029</td>
<td>6,132</td>
</tr>
<tr>
<td>$2,000/boar</td>
<td>36,016</td>
<td>23,029</td>
<td>7,132</td>
</tr>
</tbody>
</table>

\[\text{NS = natural service & AI = artificial insemination.}\]

B. Equipment costs for a basic lab (e.g.): [NHF 38(8):20 (1993)]

- Boar collection dummy, $250; microscope, $290; spectrophotometer for sperm density determination, $2,314; electronic balance, $195; water bath, $965; semen storage unit, $333... Total = $4,697. Average depreciation/yr (7 yr) = $671 & supplies/collection for 12 doses = $10.3.

4. **AI & Natural Service**

- May want to consider using both the AI & natural service during the transition period - See an example [1993. NHF 38(7):26]
  - Farm 1 & 3 used a combination ("natural service" first & then AI for subsequent matings) for 5 mo before shifting exclusively to AI.
  - Farm 2 & 4 made a transition from natural to AI over a one-week period.

5. **General Considerations**

A. Good equipment and facilities are must:

1) A clean pen under the roof for collecting boars.
2) A clean, warm place for handling and extending semen.
3) Equipments - Need great care in handling.

B. Must have a genuine desire to use the AI - Willingness, time, attention to details, etc.

C. Must be able to detect estrus accurately.
1) The basics of collection and breeding are relatively simple & can be learned easily.

2) Thus, very often, a success or failure of a new AI program hinges on the ability to detect estrus accurately!

D. Transition from natural service?
(http://mark.asci.ncsu.edu/REPROD~1/).

1) Step one - Become familiar with the estrual behavior because the estrus detection is the most important factor for a successful AI program!

2) Step two - A successful strategy used on many operations has been a combination of hand mating followed by a second service with AI - Gradual transition!?

3) Step three - Once AI skills, as well as estrus detection ability, has been mastered, total conversion from natural service to AI can be implemented.

E. AL with purchased semen: (http://mark.asci.ncsu.edu/REPROD~1/).

1) Advantages - ↓ genetic lag, better quality semen, save labor costs, fewer boars needed, and less hassle.

2) Disadvantages - Can be costly & infrequent shipment with limited storage.

F. AI with farm collection: (http://mark.asci.ncsu.edu/REPROD~1/).

1) Advantages - Less expensive, availability of semen, and less worry on getting diseases.

2) Disadvantages - More equipment & technical expertise needed, perhaps less quality control, and more labor.

E. Boar ejaculate fractions to be collected:

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Volume</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-sperm (clear fluid &amp; gel-like)</td>
<td>10-25 ml</td>
<td>Discard</td>
</tr>
<tr>
<td>Sperm-rich (creamy white)</td>
<td>30-60 ml</td>
<td>Collect</td>
</tr>
<tr>
<td>Post-sperm (clear fluid &amp; gel)</td>
<td>70-130 ml</td>
<td>Collecta</td>
</tr>
<tr>
<td>Gelatinous material</td>
<td></td>
<td>Filter &amp; discard</td>
</tr>
</tbody>
</table>

aIf using the boar ejaculate < 2 h.