PRODUCTION TOOL

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Breeding soundness examination of the boar

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Summary

This article describes the procedure for conducting a breeding soundness examination in the boar, including collection of a history, examination of the genitalia, semen collection and evaluation, and suggestions for culling criteria.

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Artificial insemination (AI) has become an increasingly common practice in the swine industry, and the value of boars for both AI and natural mating has also increased. It is therefore important to promote routine breeding soundness examinations (BSEs) on boars, which can help to identify poor or questionable breeders before they affect herd fertility and/or destroy an AI stud's reputation. It will also protect the buyer if a prepurchase BSE is performed or is part of the purchase agreement. Reputable sellers generally welcome a BSE because it establishes credability and reduces the number of boars that have to be replaced for lack of breeding performance/infertility.

Many of today's boars go through extensive serologic testing and isolation procedures for disease control. Matching health profiles between herds is crucial. For some boar studs and their customers, it may be disastrous to introduce boars of unknown or questionable disease status into the herd. An epidemic disease may affect all the boars and their subsequent fertility, or may be transmitted via their semen to other swine herds.

If the boar performs poorly on a prepurchase BSE, much time, energy, and money could be saved. A prepurchase BSE can identify boars with penile hypoplasia, persistent frenulum, poor or no libido, penile lacerations/scarring, poor/no sperm motility, inadequate sperm numbers, poor sperm morphology, and musculoskeletal problems that prevent mating or mounting a collection dummy, and boars that are "bleeders." A BSE can also identify cases of masturbation/"balling up" of the penis into the preputial diverticulum, a condition that is surgically correctable.[1]

A BSE should be used as a screening test, not as a predictor of fecundity. Fecundity can only be assessed through 50 test matings, which are the ultimate "bottom line" that measures a boar's value to a breeding herd. ABSE, however, can identify boars that should be immediately culled. The swine industry would greatly benefit if unacceptable boars could be identified before time and money is invested in them.

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History

The first step in a BSE is to take a thorough animal history. The age (accurate—not an estimate) of young boars is especially important because their spermiogram will change during puberty. The record should include boar name or identification (number, tag, earnotch, tattoo) and breed and should note previous sexual experience, type of housing, rearing conditions, show record, body condition, production records, history of any previous exams, libido, mating ability, type of mating system (e.g., AI, hand, pen), farrowing rates, litter size, herd of origin, disease status, results of any testing (i.e., disease[s] and porcine stress syndrome), the frequency of past collection/breeding, past injuries, illness, treatments, and the preventive medicine program of the boar's herd.

The boar's fertility may also be affected by temperature extremes, so it is important to ask whether the boar has ever been febrile or has been exposed to high ambient temperatures.[1–3] Fertility may also be affected by exposure to extreme cold (-18°C) for more than a day. In this extreme weather, testes are held close to the body, increasing the temperature to which they are exposed.[3]

Clinical exam

All boars should be evaluated for locomotion defects prior to purchase. Most producers can make an adequate examination of this function, but many boars are now delivered sight unseen and when they are found to be unsound, trauma during shipping or transport is blamed. However, many lame boars may have degenerative joint disease (DJD) or osteochondrosis (OC).[4,5] Nearly 100% of commercial animals are affected with one or both of these conditions if one examines the ulna, femur, and humerus.[5] These conditions are heritable.[6] If the boar is clinically lame he may still be evaluated, but you should consider how the lameness may affect his ability to mount.

In addition to locomotion defects, boars should be examined for signs of atrophic rhinitis and internal and external parasites, and should be serologically tested for selected diseases such as pseudorabies virus (PRV, Aujeszky's disease virus), *Brucella suis*, porcine reproductive and respiratory syndrome virus (PRRSV), swine influenza virus (SIV), transmissible gastroenteritis virus (TGEV), *Actinobacillus pleuropneumoniae*, *Mycoplasma hyosynoviae*, leptospirosis (six strains), and porcine stress syndrome (if the status is not known).

Examining the genitalia

Palpate and measure the testes (Table 1). They should be symmetrical, firm, and slightly resilient. Some studies have observed the left testis to be slightly larger than the right, although if this difference is not found to be statistically different,[2] it is not a concern. Accurate testes size can be measured using real-time ultrasound.[7]

The epididymides should be palpated. They should be symmetrical from left to right; bilateral abnormalities are rare. The heads are usually very firm and the tails are usually tense and quite large (4–5 cm in adult boars).

The prepuce and preputial diverticulum should be examined for signs of irritation or infection, and evidence of preputial diverticulitis should be investigated. Some boars collect large amounts of urine in the preputial diverticula or masturbate in them. Evidence of blood, excessive urine, semen, or gel may warrant further investigation and treatment or surgery.[8]

The penis is best evaluated during the semen collection phase of the BSE. Fully extend the penis to examine it for persistent frenulum, lacerations, ulcers, scars and evidence of hair or bedding material irritation/infection/damage. Penile development and erection also should be evaluated. Incomplete erection[1] can be evaluated during natural or hand collection while penile hypoplasia is probably best evaluated under anesthesia.

Examine the teats, noting the number, spacing, quality, and evidence of "pin" or inverted nipples. These factors appear to be heritable, so if you note defects, the sons or daughters should not be retained for use as breeding animals.[7]

The scrotum should be free of scarring, abscesses, thickening, irritation, or evidence of mange. The testes should be freely movable within the scrotum and no excess fluid should be palpable. Some fluid may be present, especially in older boars, but its significance relative to semen quality is not known.[7] I have found ultrasonography to be most beneficial in further diagnosis of scrotal problems.

Table 1

Size of the testes in relation to age in the boar

Age	Minimum testes size	Expected testes size
6–7 months	4.5 ×7 cm	5.5 × 8.5 cm
8–9 months	5 ×8 cm	6 ×9.5 cm
10–12 months	5.5 ×8.5 cm	6.5 × 10 cm
12–15 months	6 × 9.5 cm	7 ×11 cm
15+ months	6.5 × 10 cm	> 7 × 11cm

Semen collection

Three methods of semen collection have been used for the boar:

- artificial vagina,
- gloved hand, and
- electroejaculation.

Artificial vagina

The artificial vagina was the first method used,[2] but has fallen out of favor because it is so easy to collect semen by hand.

Gloved hand technique

The gloved hand technique has been described by various authors.[1,7,9] An accurate spermiogram is best obtained if the boar has had 2–4 days of sexual rest before semen is collected. It is important to use a vinyl rather than a latex glove because some latex gloves are spermicidal.[10] As the boar mounts either a dummy or receptive female, form a cone with the collecting hand, letting the boar thrust into the coned hand. As the penis enters the hand, grasp it by the glans penis, applying pressure only to the distal coiled portion of the penis. If pressure is applied to the shaft of the penis, the boar may lose his erection and dismount. If the grip is firm enough, the boar will extend his penis fully, stabilize his stance, and start to ejaculate. With extremely shy boars, it may be necessary to allow the boar to enter a sow and then retract the penis smoothly and quickly by hand to allow collection to continue in the gloved hand. Some boars may have handler and pressure preferences.

Collect the semen in a prewarmed 37°–38°C container with a 300-500 mL capacity, with gauze or a filter loosely stretched across the opening to separate out the gel fraction. I use two collection containers so that I can collect the sperm-rich and sperm-poor fractions separately. Ejaculation usually takes 3–5 minutes, with some boars going through two or more ejaculation cycles, which can extend the collection period up to 20 minutes. Boars should be allowed to go through a complete cycle and dismount on their own to keep bad habits from forming or making them reluctant to collect in the future.

The presperm fraction, about 5–15 mL in volume, is usually clear and should not be collected. This is followed by a gel fraction which will be separated out by the gauze. The creamy sperm-rich fraction follows the gel fraction, but can be interrupted by clear vesicular gland fluid as well as more gel. This variation is normal. Normal ejaculate volume will range from 100–300 mL in young boars to 100–500+ mL in mature boars. Volume will vary based on age, response to collection and frequency of collection; as such, semen volume is only important when calculating total numbers of spermatozoa.

Electroejaculation

Electroejaculation (EE) is also an option and is particularly useful for collecting difficult/dangerous-to-handle boars. Semen collected using EE is comparable to semen collected using the gloved hand technique.[11]

Anesthesia is necessary for EE and presents some risks as well as added costs. Porcine stress syndrome-positive animals are at extreme risk, and this information should be obtained in the history or ascertained by testing prior to EE. Porcine stress syndrome risk is reduced if acepromazine (0.5 mg per kg bodyweight) is given prior to anesthesia. The owner should be appraised of the risk of anesthesia whenever electroejaculation is performed. In most cases, 5–10 minutes of light general anesthesia is all that is required for sample collection.

Anesthesia also allows a much better chance to observe and palpate the penis, testes, and epididymides for abnormalities.

It is usually easy to gain access to the medial or marginal ear vein. We prefer to restrain the boar with a snare. Apply a tourniquet to the base of the ear, and introduce a 21/23 gauge butterfly catheter into the marginal ear vein, and then give the anesthetic agent(s) by bolus. Intravenous (IV) administration reduces the cost of anesthesia compared to available intramuscular (IM) anesthetics, but requires more skill and materials.

Although no anesthetics are approved for use in the pig in the United States, several different anesthetics/combinations of anesthetics are available and work well.[1,2,8] The veterinary-client-patient relationship guidelines are necessary for this procedure, and proper withdrawals prior to market should be followed. Anesthetics that work well include:

- sodium thiamylal 1 g IV bolus (10 cc total volume);[9]
- thiopental sodium 6–18 mg per kg IV;[12]
- tiletamine and zolazepam (Telazol®) 2.0 mg per kg IV or 4.4–6 mg per kg IM;
- Telazol® reconstituted using 250 mg (2.5 mL 100 mg per mL) xylazine + 250 mg (2.5 mL 100 mg per mL) ketamine administered at 1 mL per 75 kg bodyweight IV;[13] or
- 4.4 mg per kg bodyweight Telazol®, 2.2 mg per kg xylazine and 2.2 mg per kg ketamine given IM.[13]

No preanaesthetic will usually be necessary. The latter dosage IM will give good surgical anesthesia for short procedures such as preputial diverticulectomy, detusking, vasectomy, etc. All the above anesthetics have a fairly wide margin of safety and more can be given, usually at ¼ to ½ the original dose for longer procedures. We have had good success giving additional dosage necessary after induction via the anterior mammary vein or abdominal vein. This vein is usually found subcutaneously just lateral to the teats.

Once the boar has been anesthetized, place him in lateral recumbency and clean the rectum of feces and lubricate it. Exteriorize the penis either by manual manipulation or by inserting a closed Bozeman atraumatic uterine forcep into the prepuce, rotating and opening the instrument to allow the penis to enter the jaws, closing the forceps and then gently extracting the penis. Once extracted, the penis is grasped with a piece of gauze to prevent occlusion of the urethra. If done properly, this procedure causes no damage to the penis and may be the only way that a hypoplastic penis or a persistent frenulum can be identified. Insert a boar probe, which is approximately 35 cm long and 3.75 cm in diameter with six annular electrodes fixed at a 5-cm length from the end of the probe, into the rectum.[9,14] Any of the adjustable models for bull EE are adequate. Begin stimulation at low levels and repeat it at 4–5 second intervals with a period (5–10 seconds) of rest between stimulations. Most boars will ejaculate within 4–5 stimulations and many will continue to ejaculate during the resting phase, especially if the probe is gently moved in and out of the rectum a few centimeters during this time. One may try to collect the whole ejaculate at this time or simply collect enough of the sperm-rich fraction for evaluation.

Semen evaluation

When evaluating semen, you should assess:

- concentration,
- motility,
- morphology, and
- total sperm numbers.

Concentration

Concentration is the number of sperm per mL of semen. It can be estimated crudely by color:

- in a watery to opalescent sample, sperm cell concentration will range from $0–200 \times 10^6$ per mL,
- in a milky sample, sperm cell concentration will range from $200–500 \times 10^6$ per mL, and
- in a creamy sample, sperm cell concentration will range from $500–1000 \times 10^6$ per mL (Evans. *Proc 7th Ann SC Large Animal Medicine Shortcourse*, 1993:45-51).[1,5,9]

Concentration can also be calculated using a hemacytometer or by photometric means. Photometric measurement uses light transmission absorbance as the means to calculate concentration. Because of differences in seminal plasma and sperm density, the machine must be calibrated for the proper species (i.e., bull and stallion settings will not give proper readings for boars). Accuracy of the sperm count using photometry will also vary, but it is a fast and a fairly reliable way to estimate sperm concentration.

Motility

Sperm motility should be evaluated as soon as possible after collection. Temperature changes, exposure to sunlight, disinfectants, water, etc., will all affect sperm cells detrimentally.[5] Examine a drop of undiluted semen on a prewarmed glass slide and observe for wave motion. Then, cover the drop of semen with a coverslip and attempt to estimate progressive motility. If the sample is too concentrated, dilute it with an isotonic medium (0.9% saline) and observed under a coverslip again for progressive motility. When in the field, you can trap a small air bubble under the coverslip and observe motility around the edges of the air bubble as well as morphology of the trapped sperm in the thin layer of the air bubble. A normal boar ejaculate should have > 70% progressively motile sperm.[3,6]

Morphology

Morphology should be evaluated at 1000× magnification. Staining is not necessary if using phase contrast or differential interference microscopy (DIC), but is necessary if using light microscopy. Diluting the semen sample by placing a drop or two of the semen into 1–3 mL of formal buffered saline will make it easier to directly observe the sperm with phase contrast, DIC, or light microscopy. Morphology stain (eosin-nigrin) is easily obtained from the for Theriogenology (Hastings, Nebraska). Normal semen should not contain any blood, pus, or other foreign materials. If it does, a further diagnostic workup may be warranted; or the boar can be culled immediately, or a re-examination can be performed at a later time.

Table 2

Suggested minimum spermiogram values for boars used for natural or AI service[7]

Parameter	Natural service	AI service
Color	opaque to white	opaque to white
Total sperm numbers	$>15 \times 10^9$ sperm / ejaculate	$>15 \times 10^9$ sperm / ejaculate
Gross motility (raw)	> 60%	>70%
Abnormal morphology (including cytoplasmic droplets)	< 25%	< 20%
- cytoplasmic droplets (proximal and distal)	< 15%	< 15%

Boars not meeting these criteria should be culled or reevaluated.

Examine at least 100 cells and then classify the cells as either normal or abnormal. The age of the boar must be taken into account when doing this, because young boars (6–7 months of age) will have a higher percent of abnormalities (e.g., cytoplasmic droplets, abnormal heads) than older boars.[3] Some boars may also reach puberty at a later stage or have suffered an injury or infection that delays spermatogenesis. Defects that should be noted in the morphology classification include proximal droplets, abnormal heads, coiled tails, midpiece defects, head defects (include acrosomes), bent tails, and detached heads (Table 2).[2,15] Total abnormal morphology of sperm cells should not exceed 25% in natural service or 20% in boars used for AI. This total includes both proximal and distal cytoplasmic droplets.[14] Distal droplets are not related to a decrease in fertility except when a concurrent increase in proximal droplets is seen.[5,14] Abaxial tail attachments are normal in the boar.[5]

Boars with a normal spermiogram (i.e., fewer than 20%–25% abnormal sperm cells per ejaculate) but that have a history of low litter size may warrant further investigation for a chromosomal abnormality. Up to 50% of hypoprolific boars may exhibit a chromosomal translocation. A blood sample for cytogenetic evaluation may be sent to the veterinary diagnostic labs at the University of Minnesota, the University of California-Davis, or the University of Saskatchewan in Canada.[5]

The culling decision

After carefully evaluating all parts of the BSE, the evaluator must predict the breeding future of the boar and classify him as satisfactory, questionable, or unsatisfactory. A single exam may not adequately predict breeding soundness and further exams may be warranted.

Breeding soundness examinations of boars can be a valuable tool in selecting and culling boars for natural mating or AI. While not the ultimate test of fertility, it is the only practical method we have to predict breeding potential without expending more time, effort, and money on test matings and comparing farrowing rates and litter sizes. Boars with a high percentage of motile and morphologically normal spermatozoa are usually very fertile. (Evans. *Proc 7th Ann SC Large Animal Medicine Shortcourse*, 1993:45-51). Those not meeting these criteria should either be culled or reevaluated at 30–60 day intervals. Boars being routinely collected for AI, especially from boar studs, should be examined at least once a month and after any illness or injury. Likewise boars being used in a natural mating system should be examined routinely (quarterly). Many commercial operations routinely use heterospermic matings or pooled semen to compensate or cover for the subfertile boar (Evans. *Proc 7th Ann SC Large Animal Medicine Shortcourse*, 1993:45-51). If we can identify subfertile/nonfertile boars, the savings to the swine industry would be significant.

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