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Artificial Insemination in Swine

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The techniques and equipment necessary for artificial insemination (AI) in swine are readily available. When considering whether or not to use AI, two factors are noteworthy: the potential for disease control and the potential for genetic improvement. Other factors make AI attractive. For example, AI allows for the development of the closed herd, where no animals are brought into an existing herd. AI makes it possible for any size operation to bring new genetic material into the herd with minimum risk of introducing new disease organisms. When sows are placed in gestation crates after breeding, AI removes the necessity of taking the sow out of the crate for a second insemination 12-13 hrs. later. One drawback with the use of AI is that a higher level of management is required; however, several benefits result from the greater input of managerial skills. For instance, with better records, a greater awareness of the true reproductive status of the breeding herd will result. Subsequently, more effective selection of breeding stock can be carried out.

Heat Detection

The most critical factor in achieving maximum conception rates with AI is to inseminate females at exactly the right time. To accomplish this, the breeder *must* practice proper heat detection. The normal estrous or heat cycle of the pig is 20-22 days in length, but it can range from 18-25 days. The estrous cycle can be broken down into segments—the period of male receptivity (standing heat or estrus), lasting from a few hours to several days, and the nonreceptive period. The average length of estrus is 1-2 days for gilts and 2-3 days for sows. If the length of estrus is longer or shorter, the chances of picking the right time to inseminate a female are lower.

Estrus detection is a simple technique. The difficulty is in being sure that detection is carried out correctly. When the female is in heat, she often will try to find the boar herself. There may or may not be evidence of swelling of the vulva. In the presence of a male, the female will assume the mating stance; that is, she stands solidly when pressure is applied on her back. The final sign of standing heat is the "ear popping response," where the female's ears will repeatedly move toward an erect position as she assumes the mating stance. Determining the correct time to breed is based on the time the female first shows heat. Therefore, the more frequently heat detection is done, the more likely it is that insemination will be carried out at the appropriate time.

Based on frequency of heat detection, Table 1 presents a "rule of thumb" to determine the appropriate insemination time for fresh semen. When using frozen semen, twice daily heat detection should be the rule, and insemination should be delayed until 2-4 hrs. prior to expected ovulation time or approximately 24-30 hrs. after the onset of estrus. Ovulation occurs about 40 hrs. after the onset of heat.

Table 1. "Rule of thumb" for frequency of heat detection and time to inseminate females in heat.

Frequency of heat detection	Best time to inseminate*
Once daily	Every day they stand
Twice daily	12 and 24 hours after onset of heat

* If in heat longer than three days, discontinue inseminations.

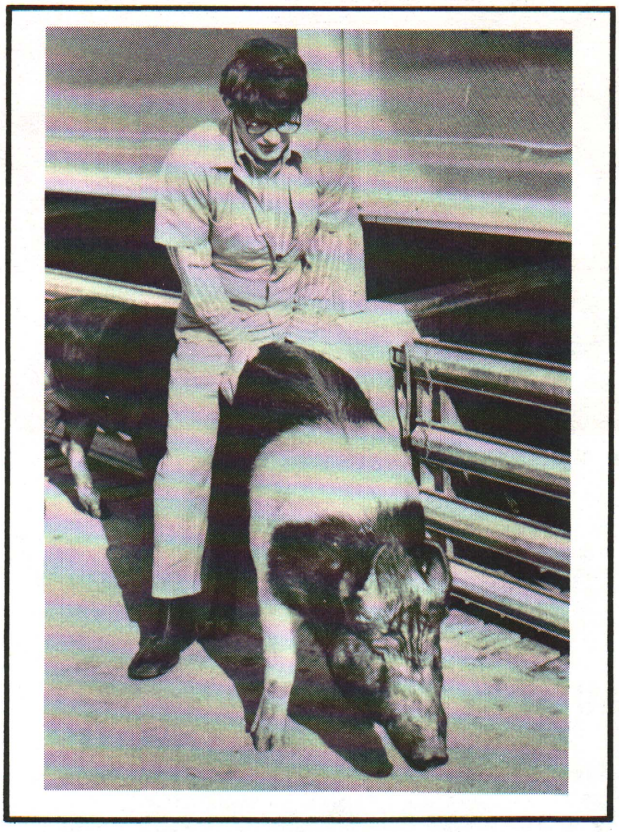

Figure 1. Method of detecting estrus in females. Note the erect ears and rigid stance with pressure applied to the back in the presence of the boar.

The best method of heat detection is to check each female in the presence of a boar by applying back pressure (try to sit on her back) to see if she will assume the mating stance as described earlier (Figure 1). Unless these criteria are met, the time of ovulation cannot be estimated accurately. Using a boar in combination with hand pressure is the most accurate method of finding females in heat. Researchers have shown that the presence of a boar increases the chance of detecting all females truly in heat by 30-40%.

If you must use a boar to check for heat, how does he fit into the AI program? First, the heat check boar can be raised on the farm. As the heat checker, he should be vasectomized. Second, by using AI, fewer, but genetically superior, boars can be used to breed many more females than with natural service. The average boar produces enough sperm to impregnate approximately 1500-2000 females a year. In a normal pen breeding system, a boar rarely breeds more than 200-300 females per year.

Boar Training and Semen Collection

Training a boar for collection of semen can be the most frustrating part of AI unless extreme patience is used in handling the boar; but with this patience, semen collection can be easy. Boars can be trained to mount a dummy sow or a sow in heat. The dummy sow is preferable since there is no size incompatability, nor is there a problem with a sow that won't stand still long enough for ejaculation to be completed. A simple plan for a boar collection dummy is shown in Figure 2. It is usually easier to train a young boar that has had no sexual contact with females than to train an older, experienced boar. Some boars probably can never be trained, although these are infrequent. These are likely to be the "shy breeder" type.

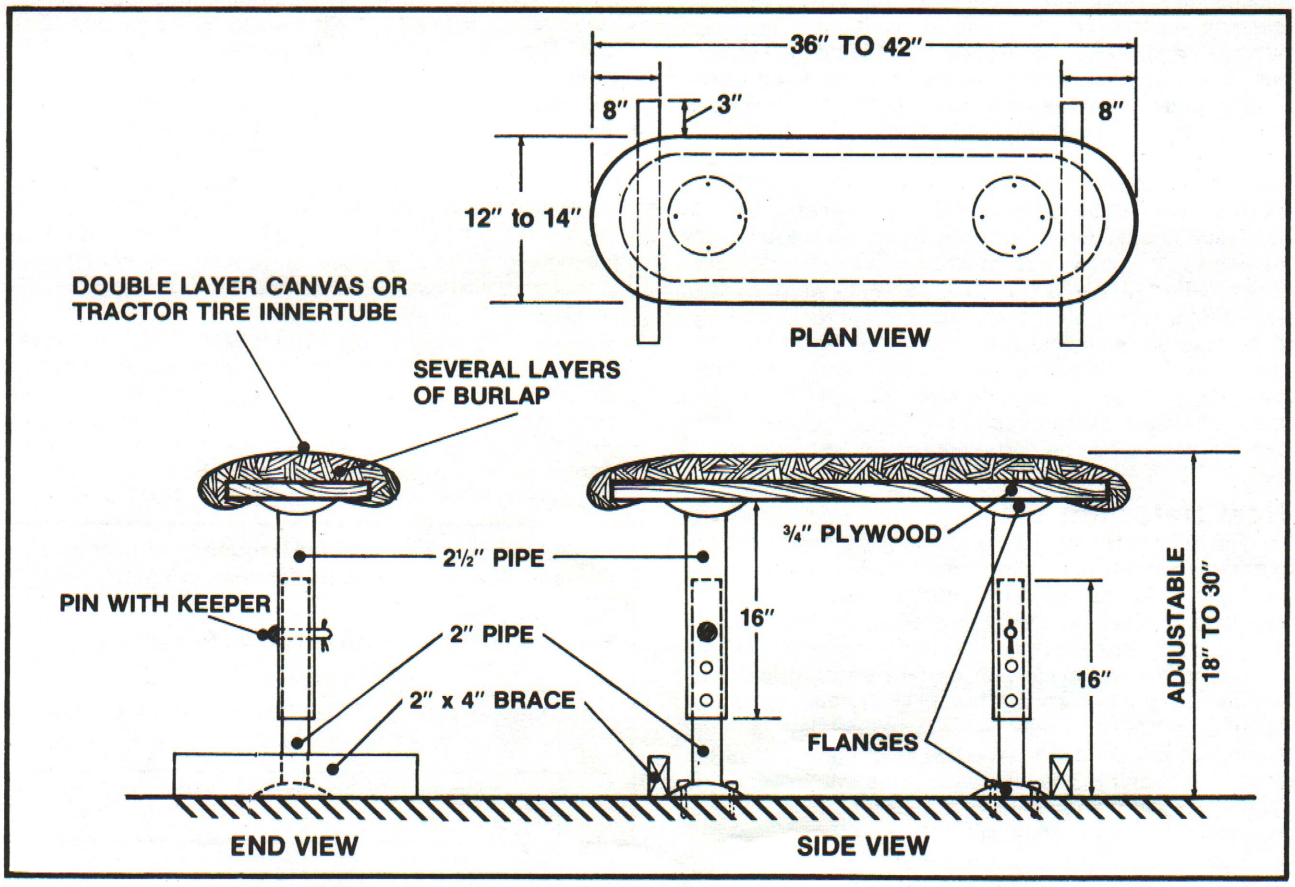

Figure 2. Boar collection dummy.

As soon as a young boar starts to rant, or at approximately 7-8 months of age, he can be brought into contact with the dummy sow to start training. Don't expect a boar to mount the dummy at first contact. Patience is very important. Handle the boar with care so that he will get acquainted with the collector and the dummy. Be sure the dummy is placed where there is adequate room to move around and where the floor is not slick. The dummy should be securely anchored so it can't be turned over.

If no mounts occur the first time or two, sprinkle semen, boar urine or fluid from the sheath of a strange boar on the ends of the dummy. Urine from a sow in heat is much less effective than the odor of a strange boar. If there are still no attempts to mount, try bringing several females in heat into the same area as the dummy, and allow the boar to mount a female in estrus several times. If there are further failures to mount, try collecting semen from the boar by placing a sow in heat close to the dummy; later, try collecting the semen using the dummy alone. An alternative method is to try collecting from the boar by using a female in heat adjacent to the dummy, later lifting the boar over to the dummy to finish collecting. If all attempts to use a dummy fail, then you may be restricted to using a sow in heat for each collection.

The stimulus for ejaculation in the boar is pressure applied to the spiral portion of the penis (Figure 3). Once the boar mounts, allow him to start thrusting; then quietly ease down beside him, and grasp the penis firmly enough to retain a grip, using your bare hand or a rubber glove. At the same time, begin pulling the penis (gently) from the sheath, and rapidly increase the pressure and pulling action until thrusting stops. Some boars require what seems to be tremendous pressure to stimulate ejaculation; others require only slight pressure. Occasionally a boar will start backing off or sliding off the dummy or even a sow when your hand touches his penis. To help prevent or correct this problem, one of the following may be helpful. If you're collecting from a dummy (Figure 2), try attaching a piece of pipe or a board, 2 in. x 4 in., to the bottom side of the dummy perpendicular to the length at about the half-way point. This will give the boar something to hook his front legs around. Normally an artificial vagina is of no value, but in the case of the shy-breeder type boar, it may facilitate obtaining a collection impossible to get otherwise. Fill the outer jacket of the device with 100 F water, and lubricate the open end. Guide the boar's penis into the open end, and wait for ejaculation to take place.

There are several phases to ejaculation. The first portion may consist of clear fluid and some gel-like substance. There are no sperm in this portion so it need not be collected. Then the sperm-rich fraction starts (creamy white), followed by more gel and clear fluid. Some gel will be noticed along with the sperm-rich fraction. There will be several alternating phases of sperm-rich and sperm-free fluid; the sperm-free phases need not be collected. The time for ejaculation can be as short as a minute but may be as long as five minutes. The average volume will vary somewhat with each boar, but approximately 150-200 cc (1/3 - 1/2 pint) can be expected (see Table 2).

Table 2. Semen characteristics and sperm output of boars.

Characteristics of average ejaculates	
Number of semen collections per week	2-5
Volume (ml)	150-200*
Sperm concentration (million/ml)	200-300
Total sperm/ejac. (billion)	30-60
Total sperm/week (billion)	120-150
Motile sperm (%)	70
Morphologically normal sperm (%)	80

* Gel-free volume

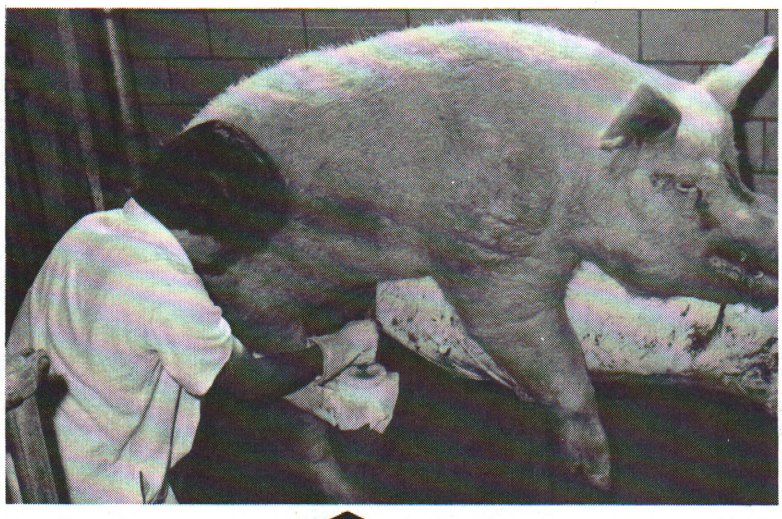

Figure 3. The stimulus for ejaculation in the boar is pressure applied to the spiral portion of the penis.

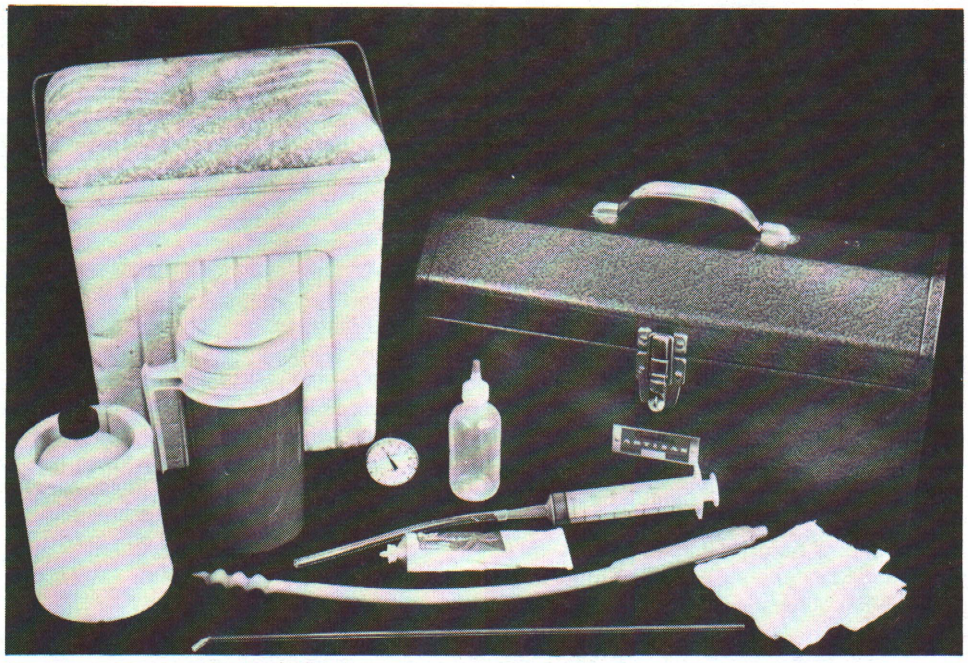

Figure 4. Equipment used in AI.

Semen Evaluation

Figure 4 shows the equipment necessary for collecting semen. A wide mouthed thermos bottle or a plastic (pint size) bottle with a narrow mouth can be used. If the thermos is used, consider placing a couple of layers of cheesecloth over the mouth to strain out gel and to prevent dirt from falling into the semen (Figure 3). The plastic bottle should be covered with 1 in. of foam rubber for insulation.

During and following collection, protect the semen from a rapid change in temperature. The insulation from the thermos or the foam is sufficient protection to prevent sperm damage for 5-10 minutes at 20 F. In a warm room (60-70 F), strain the gel from the semen (through a couple layers of cheese cloth) if not strained during collection. Note the volume of semen, since this will dictate how much extender you will need to add, depending on the number of females to be bred and whether or not semen will be stored. Throughout the collection and insemination process, care should be taken to be clean and sanitary.

Normally semen will have a chalky, creamy appearance, indicating high sperm concentration. As concentration gets lower, the opaqueness diminishes. A microscope is not essential to make an AI program work, but it could be useful. If you desire to use one, check it to verify concentration and motility and to check for abnormal sperm. Accurate sperm counting would require additional equipment. Motility, or the forward movement of sperm, was once thought to be a good indicator of fertility. However, visual observation of sperm is not a sure indicator of fertility. The only way to be certain is to test-mate prior to the breeding season. The test-mating does not, however, insure that the boar will remain fertile for the entire season.

Frequency of collection depends on the need for sperm. Ideally, a boar should be collected no more than two or three times a week to maximize sperm concentration and semen volume. When the need arises, collection once or twice a day can be maintained for 3-5 days; however, sperm numbers and sex drive diminish rapidly. This does vary to some extent with the individual boar.

The average ejaculate contains enough sperm to inseminate at least 6-8 females. The best rule to follow is to use the sperm as soon as possible after collection. Two factors are considered in insemination: number of sperm and volume of fluid. It has been shown that a minimum of two billion live sperm in an adequate volume of fluid are required to obtain adequate conception rates. Since some sperm will be dead, more than two billion are needed. Researchers have shown that approximately 50 cc fluid volume is close to the minimum, and it is recommended that 100 cc total volume be inseminated to maximize conception.

How much an ejaculate must be extended depends on the volume of the ejaculate collected, the number of females to be inseminated and whether or not short term storage will be used. If five females are to be inseminated with fresh semen, a total volume of 500 cc of extended semen is needed. If the ejaculate contains 100 cc, then 400 cc of extender is required to obtain the required 500 cc for five females. If some semen is to be stored for future use, then a higher rate of extension would be used, and microscopic verification of sperm concentration may be advisable. However, AI should be a routine procedure in herd management before short-time storing of semen is considered. Storage for more than two days is not advisable in most instances.

Before extending the semen, measure the temperature of the ejaculate with a good thermometer, and raise or lower the temperature of the extender to within two degrees of the semen. Gently but thoroughly mix the two. The extended semen is now ready for insemination or storage. For storage, allow the mixture to cool to room temperature, 70-75 F. Place the container of semen in a small styrofoam box or in a pan of water (same temperature as the semen), and put both in a refrigerator to maintain a temperature of 55-60 F. Since temperature varies greatly between refrigerators, check ahead of time to be sure the appropriate temperature can be maintained. These precautions are necessary to prevent the mixture from cooling too rapidly, thus causing damage to the sperm.

Usually, semen can be extended at a ratio of 1 part strained semen to 4-5 parts extender without any problem. Higher rates of extension very likely would not result in a

decrease in conception unless a ratio of 1:10 or greater is used. Then it is advisable to get an estimate of actual sperm concentration so at least 3-4 billion sperm are inseminated. To maximize litter size and conception rate, investigators have shown that the use of two or more ejaculates pooled from different boars can be advantageous.

Two formulas for semen extender are presented in Table 3—BL-1 and Egg Yolk. The BL-1 extender is available commercially and can be stored in dry form until needed. Either extender can be stored frozen. Freezing into cubes is a good storage method that is convenient to use.

Skim milk may be used as a semen extender if the following steps are taken prior to mixing with semen: (1) Heat in a double boiler to a temperature of 88-90 C (190-195 F) for 8-10 minutes. Be careful not to scorch the milk. (2) After cooling to room temperature, break one egg and add the egg yolk only (minus the membrane) to one quart of milk. Carefully mix for about 2 min., so as not to raise a froth. (3) Equalize (within 2 C) the temperature of the milk with that of the semen. (4) Add the extender to the semen by slowly pouring the milk down the side of the container. Semen extended with skim milk should be used immediately. Additional information regarding extenders, as well as other information, can be obtained with the aid of your state swine Extension specialist.

Table 3. Extenders for use with boar semen.

Component	BL—1 (1 quart)	Egg Yolk Extender (1 quart)
Egg Yolk (cc)		317
Distilled Water (cc)	*	739
Glucose (gm)	27.4	31.7
Potassium Chloride (gm)	.3	
Sodium Bicarbonate (gm)	1.9	1.6
Sodium Citrate (gm)	9.5	
Penicillin, (million Int. Units)	1	1.1
Streptomycin Sulfate (gm)	1	1.6

* Put salts in a clean quart container and fill to line with distilled water.

Insemination

Having already penned estrus females conveniently, take a breeding catheter, and apply light mineral oil, vegetable oil or KY jelly to the catheter for lubrication. Both the rubber spirette or the plastic type catheters will work; however, there are advantages and disadvantages to both. Many producers prefer the spirette because it is shaped much like a boar's penis, and the female's reproductive tract grips the spiral end just as it would during natural mating. This helps minimize backflow and also is a fair indicator of estrus. In addition, the spirette is flexible, and there is very little chance of injury to the female. The disadvantage is that it must be cleaned promptly after use each day. Unless used in a purebred herd or a known disease condition is present in the herd, the same catheter can be used for several females. When a positive record of ancestry is necessary, use a clean catheter for each female. In contrast to the spirette, the diameter of the plastic bovine or bent tip type of catheter is small enough that the female tract cannot grip it. Consequently, there is a greater chance for backflow to occur. Usually backflow is not a serious problem unless sperm numbers are expected to be at the minimum requirement, such as with frozen semen. With hard plastic catheters, there is a greater risk of injury to the female. Also, if the female is nervous or jumpy, the bovine catheter will slide in and out with every move, unlike the spirette type which is gripped tightly, flexes and bends, and usually doesn't fall out, even if the sow jumps away from the inseminator.

Seldom do females need more restraint than being confined to a small pen. Tight restraint or snaring should be avoided. Sometimes having a boar close by will help a nervous female to stand more solidly for insemination.

For insemination, put about 100 cc extended semen in a squeeze bottle (4 oz. size) with a cone-shaped tip (see Figure 4). A large syringe can be used but is more difficult to handle. During cold weather, put the bottle of semen in a protected area, such as a styrofoam box or your shirt pocket, until ready to inseminate the female.

Place a few drops of lubricant on the tip of the rubber spirette (not needed for the bovine type), and insert the tip into the vulva, pointing it toward the backbone to avoid the opening of the urethra. Slide the catheter along the top of the vagina until rather firm resistance is felt. The cervix is usually 8-10 in. (16-25 cm) inside the vulva but could be deeper in larger females. In some gilts, resistance may be encountered about 4 in. (10 cm) inside the vulva. This may be the remains of a membrane (hymen). When the cervix is detected, start rotating the rubber spirette counter clockwise (left hand thread) until it becomes "locked" into the cervix. The opening into the cervix is nearly impossible to miss as it has the shape of a funnel. Occasionally, a female will not clamp down on the spirette. This occurs mostly in sows or if the female is not in heat. Insert the bovine catheter until the tip is deep into the cervix, being careful not to penetrate into the uterus where injury could result.

When the catheter is in place, connect the semen container, and begin squeezing the semen through the catheter. If semen starts running out of the vulva (backflow), release the pressure, wait momentarily, and start again. Allowing the female to move around often helps minimize backflow. There are times when it seems nearly impossible to force the semen into the female—the opening of the catheter may be jammed against some tissue. Work the catheter around and continue. Check the opening of the squeeze bottle; it should be about 1/32 in. in diameter.

Cleaning AI Equipment

Following use, do not allow semen or other material to dry in the equipment. Use plenty of clean water for rinsing. Do not use soap or detergents to clean anything that will come in contact with semen since there will likely be residues that are harmful to sperm. Clean thoroughly with a brush and tap water to remove any gel particles left. Rinse all pieces in distilled or deionized water; then boil in distilled or deionized water for 20 minutes. Do not boil in tap water as this will leave a mineral deposit on the equipment. If you are not able to boil the equipment, a temporary sterilizing method is to rinse thoroughly with 70% alcohol. However, do not depend on the alcohol for continued use since some organisms are immune to its effects.

Frozen Semen

Frozen semen is available from one commercial source in the United States and one in Canada. However, before obtaining semen from Canada, be sure the shipment is cleared with customs and with the Animal and Plant Health Inspection Service (APHIS). Check the records accumulated for each sperm-donating boar under consideration. Your choice is just as important as if you were buying him for a permanent replacement. Evaluate the usual data regarding boar performance, but more importantly, evaluate data on his conception rates, litter size, and his progeny's

performance whenever available. Remember, the sperm of some boars do not survive well during the freezing and thawing process; therefore, it is important to check the performance record of the boar before using him.

The frozen semen state-of-the-art is not equal to freshly collected semen. On the average, conception rates will be 10-20% lower, and litter size will likely be about one pig less per litter. Apparently the freezing and thawing process alters the sperm in such a way as to make them more fragile. Being more fragile, the sperm must receive special handling as outlined in the thawing procedures received with the semen shipment.

Records

A certain amount of record keeping is advisable. Records of female identification and the dates in standing heat are valuable in scheduling breeding and in determining the volume of semen required at the next breeding period. In addition, through records, irregular cycle lengths, anestrus and other reproductive problems will become more evident, allowing corrective measures to be taken. A record including date of semen collection and strained volume should be maintained for each boar. These records may also include notes of the type and duration of any sickness the boar may experience. Anything that causes body temperatures to go up as little as 1-2 F can result in a 60-80% decrease in total numbers of viable sperm for several weeks. The normal body temperature is approximately 102 F — plus or minus 1 degree F.

Summary

To introduce new genetic material into your herd at a minimum risk of disease and to increase the use of a particular sire, the pork producer should consider an AI program. Providing a viable possibility for herd improvement, an AI program will require greater managerial input, but will result in greater awareness of any reproductive problems in the herd. A minimum of specialized equipment is needed to carry out a successful program. One of the best uses of AI is in bringing new genetics into the herd using frozen semen and semen collected on the farm for expanded use of fewer but superior boars. If a few simple suggestions are followed, AI will yield conception rates and litter size equal to or better than natural service.

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