



# Repro Tracks

► by **Bill Beal**, beef cattle reproductive physiologist, Virginia Tech

## AI success depends on proper semen handling

*The technique for artificial insemination (AI) and the site of semen placement are often cited as the “keys” to achieving a high AI conception rate. However, the handling of semen before and after thawing can also significantly influence the success of AI. Care should be taken to avoid thermal damage of stored, frozen semen prior to thawing and cold shock of thawed semen after thawing.*

### Breeder question No. 1

*I just learned to perform AI on my cows. After breeding several cows I began to wonder if lifting canes of semen from the tank to pull a straw for breeding damaged the other straws in that cane, especially when the weather is hot. I rush to get each straw out of the cane and into the thaw bath, but they can be hard to grab hold of. How long can I take without causing damage?*

**Response:** Semen stored under liquid nitrogen remains at  $-320^{\circ}\text{F}$  and can be stored indefinitely without damage to the sperm cells. Exposing a straw of semen to air warmer than  $-320^{\circ}\text{F}$  quickly raises the temperature of the frozen sperm. If the temperature of the frozen sperm cells exceeds  $-80^{\circ}\text{F}$ , ice may begin to recrystallize within the frozen cells and cause damage. A standard semen straw [0.5 milliliter (mL)] exposed to room temperature air ( $68^{\circ}\text{F}$ ) for 10 seconds will reach this critical temperature. Therefore, a common recommendation is to retrieve a straw in 5 to 8 seconds to avoid damaging unused straws in the cane.

The likelihood of warming unused semen straws above the critical temperature ( $-80^{\circ}\text{F}$ ) can be reduced if during retrieval the goblet holding the straws is never raised above the “frost line” within the neck of the tank (see Fig. 1). The frost line in most tanks is approximately 3 inches (in.) below the opening at the top of the tank. As shown in Fig. 1, the liquid nitrogen vapor in the tank should maintain the temperature 3 in. down in the neck of the tank at less than  $-100^{\circ}\text{F}$ . Hence, if all semen in the cane remains below the frost line, the unused straws of semen returned to the tank should never exceed the critical temperature.

Another practice that will make retrieval of a single straw easier and decrease the risk of thermal damage is to use a pair of specially designed forceps (tweezers) for

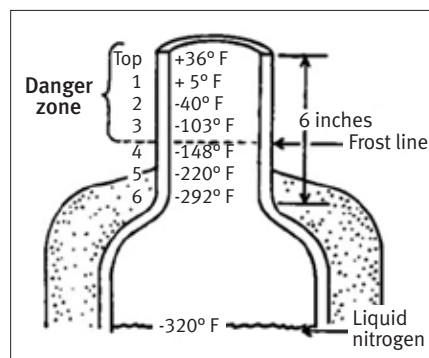
removal of straws. The plastic forceps are designed with grooves to facilitate grasping a single straw without touching the unused straws in the goblet. Using forceps (rather than fingers) provides two advantages:

- 1) unused straws are not touched by your warm fingertips; and
- 2) the  $6\frac{1}{2}$ -in. forceps allow you to keep the cane further down in the neck of the tank when a straw is being retrieved.

Both advantages decrease the risk of warming the unused straws to above  $-80^{\circ}\text{F}$ .

Using the forceps is a “pain” at first, and most technicians whine about learning to use them. However, with a little practice you can become adept at retrieving straws with the forceps. Every time you do so, you are reducing the risk of damaging the unused straws of semen you return to the tank. Long-term, the “winner” here is your AI pregnancy rate, which can be compromised by repeatedly warming unused semen straws prior to their use.

**Fig. 1: Temperature in neck of semen tank**



Source: Lineweaver and Saacke, 1980.

### Breeder question No. 2

*I have heard several AI technicians talk about avoiding “cold shock” of semen after it is thawed for insemination. I thaw semen in  $95^{\circ}\text{F}$  water and place the loaded AI gun in my shirt. I know it cools some while I place it in the*

*gun and while I am carrying it in my shirt. Is it likely to get cold shock in this process?*

**Response:** Cold shock is the condition caused by cooling sperm cells *rapidly* after thawing for insemination. The effect is particularly noticeable if after thawing at  $95^{\circ}\text{F}$ , sperm cool very quickly to a temperature below  $60^{\circ}\text{F}$ . The rapid cooling can cause structural changes in the tail of sperm cells and affect the motility pattern and viability of the sperm. Both effects can reduce fertility of the semen.

Cold shock is dependent on the rate and degree of cooling of thawed semen. Common sense tells you that after initial collection from a bull, sperm cells must be diluted in an extender, cooled to near freezing and then very rapidly frozen. However, the cooling process of semen prior to freezing is very slow. Hence, it follows logically that thawed semen can withstand a slow and slight decrease in temperature after thawing, especially if the semen remains above  $60^{\circ}\text{F}$ . Damage from cold shock occurs when the rate of cooling is rapid and the semen reaches temperatures below  $60^{\circ}\text{F}$  very quickly.

Obviously, the greatest risk of cold shock comes when environmental temperatures are very low and the wind chill factor is high. However, it is difficult to pinpoint a specific temperature at which cold shock is likely to occur or to predict how much damage will result. Therefore, whenever semen is thawed there should be an effort to prevent cold shock. Three procedures are important:

- 1) thaw semen in  $95^{\circ}\text{F}$  water;
- 2) warm the AI gun prior to loading thawed semen; and
- 3) once loaded, keep the AI gun near the body to reduce the amount and rate of cooling.

It sounds as though the procedures you have been employing should be adequate to prevent cold shock of semen.

**Editor's Note:** Bill Beal is a beef cattle reproductive physiologist and Professor Emeritus at Virginia Tech. He conducts research involving estrus synchronization, artificial insemination, embryo transfer and the use of ultrasound technology. This column is designed to provide answers to questions about reproductive management commonly posed by commercial and purebred breeders. If you have questions or comments related to the reproductive management of cows or bulls, e-mail them to Dr. Beal at [wbeal@vt.edu](mailto:wbeal@vt.edu) or mail them to him at the Dept. of Animal & Poultry Sciences, Virginia Tech, Blacksburg, VA 24061-0306.