AI Advance

Sexed semen and other technologies offer added value to the AI industry.

Story by
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When the North American cattle industry began to utilize artificial insemination (AI) in the late 1930s, AI was considered "one of the greatest animal biotechnologies." Today — more than 60 years later — the technique is still the most viable means for advancing genetic progress among livestock.

Looking ahead, animal breeders continue to research sexed semen and other technologies that will add value and efficiency to the AI industry. Here's an update on AI research presented at the National Association of Animal Breeders (NAAB) annual conference in late August.

Look for sexed semen in 2003

Utilizing sexed semen to predict the gender of AI-bred calves has been promised to the cattle industry for several years. While the technique to sort sperm bearing an X chromosome (which would result in a female calf) from sperm with a Y chromosome (which would produce a bull calf) has successfully been developed, sexed semen has not yet been commercially available in North America.

By 2003 that should change, according to George Seidel, a distinguished professor at Colorado State University (CSU), who was involved in fine-tuning the research to develop today's sperm-sorting technology. "Within the next year there will be a license issued to sex sperm commercially in North America," Seidel predicts. Sexed sperm is already commercially available in the United Kingdom.

XY Inc., a Fort Collins, Colo., company, will most likely be the firm that issues such a license to organizations in the semen business, like a bull stud. XY Inc. has worked cooperatively with CSU to develop sexed semen for cattle, and it holds the patent and licensing rights for current sexing technology. They've been field-testing sexed semen with cattle since the late 1990s.

Based on those field trials, Seidel says that the prospect of sexed semen is "very encouraging." He reports that in a Wyoming trial with 1,200 first-calf heifers they had an accuracy of 86% females from more than 400 calves resulting from sexed semen.

For both the beef and dairy industries, Seidel says this ability to inseminate a select group of females specifically to produce female herd replacements, as well as breeding other cows in the herd to carcass bulls to produce males for meat, should add value to cattle enterprises.

When sexed semen finally becomes commercially available, Seidel offers these points for producers to consider in determining whether or not sexed semen fits their needs:

1. Using flow cytometry — the only method currently available to sort and sex sperm — is about 90% accurate at sexing semen. However, the present usable sort rate is 10 million sperm per hour, which equates to about one straw of semen and is obviously too slow for producing a large volume of sexed semen.

This speed factor has been much of the holdup in making sexed semen commercially available on a large-scale basis. To address the issue, researchers have been using insemination methods with 2 million or fewer sperm per dose and have had good success with breeding virgin heifers.

2. Sexing sperm damages them slightly. "We've known for years that the pressure in the flow cytometer does damage the sperm. Sexed sperm often swim in a stiffened way," Seidel says.

As a result of this, the fertility of sexed sperm is slightly lower, which in turn causes lower pregnancy rates in females bred with sexed sperm compared to control groups bred with nonsexed frozen sperm.

Researchers recently have helped reduce some of the damage to sorted sperm by decreasing the flow cytometry pressure from 50 pounds per square inch (psi) to 40 psi. The tradeoff in decreasing the pressure is that the sorting rate is also reduced.

"But, the improved fertility at 40 psi still results in more eggs being fertilized," Seidel says. And, with more research, he expects the fertility of sexed semen to continue to improve.

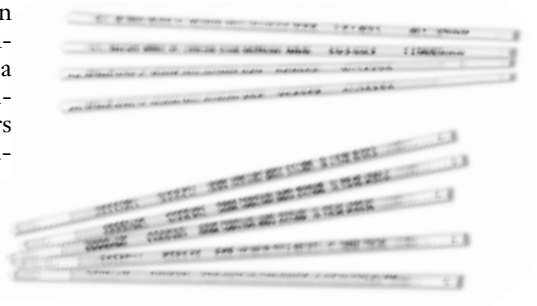
Another tip: Seidel says they've learned that when using sexed semen, the highest pregnancy rates can be achieved (46%-47%) by doing regular uterine body inseminations in heifers.

3. Calves from sexed sperm are normal. This is a commonly asked question, Seidel says, and he reports that in all their research there has never been a hint of difference between calves conceived via either sexed or nonsexed semen. He says a study on 574 calves resulting from sexed semen was "one of the dullest studies we've ever done."

4. Not surprisingly, sexing sperm will have a cost. Seidel anticipates that, when it becomes available, sexed sperm will cost approximately $30 more per unit than unsexed.

Pros and cons of the 0.25-cc straw

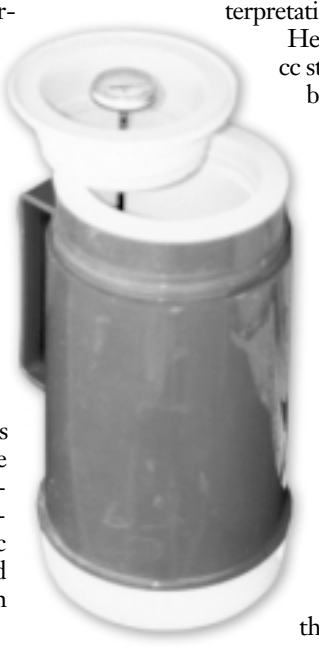
When semen ampules were replaced by the French straw, back in the late 1960s and early 1970s, the U.S. AI industry, after careful evaluation of each, opted for the 0.5-cc straw, while Europe and Canada chose to use the smaller-diameter 0.25-cc straw.



Because of its smaller diameter, the 0.25-cc straw lends itself to slightly faster freezing rates and the potential for a slightly improved post-thaw sperm survival. However, there was an important reason for the U.S. AI industry's decision to utilize the 0.5-cc straw, says Mel DeJarnette, a reproductive specialist with Select Sires.

"The smaller volume of the 0.25 straw also makes it more susceptible to post-thaw thermal insult. This is of little significance in Canada and Europe where more than 95% of all inseminations are performed by highly trained professional AI technicians. In contrast, most AI breedings in the U.S. are performed by a herd owner or an on-farm inseminator who can vary greatly in level of training and skill," DeJarnette says.

He adds, "The variation in inseminator skill in the U.S. was recognized as a strike against the smaller-diameter and more thermally sensitive 0.25-cc straws in the '60s, and that variable still exists in the U.S. today."



DeJarnette says the 0.5-cc straw is also considered more "user-friendly" than the 0.25-cc straw because it's easier to handle, easier to read, and there is less breakage during the straw retrieval from the storage tank.

Proponents of the 0.25-cc straw point out that the smaller straw requires less storage space, which can potentially lower storage and shipping costs, and reduce the quantity of extender and antibiotics needed to process a given amount of semen.

DeJarnette says this is a valid point, but that these factors contribute only a small amount to overall production costs.

Regarding the argument that the 0.25-cc straw results in slight increases in conception and pregnancy rates, DeJarnette says the conditions of these research projects are often overlooked. Most studies have been performed by professional AI technicians and often at very low cell numbers per dose so that potential differences would have an increased opportunity of being detected, he says.

DeJarnette adds that in the reality of the AI marketplace, all straws (U.S., Canadian, European, 0.25- or 0.5-cc) contain two to four times more sperm than is necessary to get the cow pregnant. "Thus, any improvement in post-thaw survival imparted by the 0.25-cc straw may allow the AI center to achieve the same fertility at lower cell numbers per dose — and thereby produce more straws from short-supply bulls. But this should not be expected to translate into higher conception rates in the field. There are volumes of research data to support this interpretation," he says.

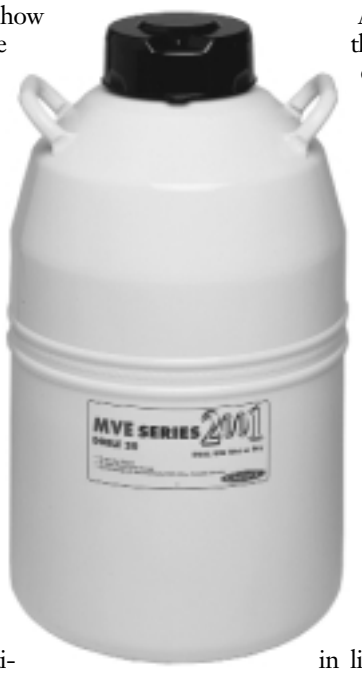
He concludes, "The 0.25-cc straw is absolutely capable of achieving conception rates comparable to those of the 0.5-cc straw, but it's certainly nothing new, nor is it a shortcut to higher conception rates."

Use the 10- to 15-minute rule when batch thawing

It's a familiar scenario: You're AIing a large group of cows that have been synchronized, and when thawing out the straws of semen,

you're tempted to speed things up by batch thawing several straws. Should you, or shouldn't you?

DeJarnette says the decision should be made based on how quickly the semen will be deposited in the cows. A good rule of thumb: Technicians should thaw no more straws than can be deposited in the cows within 10 to 15 minutes, DeJarnette says.



"Most researchers say there is no detectable deterioration in semen quality within 15 minutes of thawing, but my position is that once semen has been thawed, there is nowhere semen quality can go but down," he says.

Thus, DeJarnette says thawing 8-10 straws at once does not automatically mean conception rates will be compromised.

"If you're getting the semen in the cows within that 10- to 15-minute time frame, and it's thermally protected from hot or cold temperature changes during all steps of the process, you shouldn't have a problem, irrespective of the number of straws thawed," he says.

If you plan to batch thaw, DeJarnette says to consider these guidelines:

First, never allow straws to come in direct contact with each other during the thawing process. This slows the thawing process and results in reduced sperm viability.

Second, for the average technician with good breeding facilities, it's seldom advisable to thaw more than three or four straws at once. This is particularly true if you're using several different bulls, as it could lead to insemination errors and misidentified offspring.

And finally, remember that once thawed, sperm cells begin to burn up their limited energy reserves. "You want them to burn this energy on the way to the oviduct, not swimming in circles inside the straw," DeJarnette says.

As a refresher, standard thaw procedure calls for a straw of semen to be completely immersed in water that is held at 95° F for 45 seconds. A standard wide-mouth, foam-insulated thermos works well for this purpose.

A dual-purpose tank

A recent improvement in liquid nitrogen tank technology is a versatile tank that can be shipped "dry" and then converted to a liquid tank in the field, according to Paul Lydolph with MVE-Chart Industries.

Called the Doble, which is Spanish for dual purpose, the tank comes in six sizes and was developed primarily for exporting semen internationally. An absorbent layer in the base of the tank allows it to be charged with nitrogen and used as a dry shipper with a 30-day hold time. Once at the final destination, the tank can be filled with liquid nitrogen and used for long-term storage.

For more information contact MVE toll-free at 1-888-683-2796.

Take care of your tank

Tank management is essential to keeping your semen inventory secure. Here are guidelines from Select Sires for maintaining your tank and ensuring semen quality:

- Store your tank on a wooden pallet or board to avoid direct contact with concrete. Keep the tank level and out of drafty areas. Increased air movement around the tank can increase nitrogen consumption and reduce holding time.
- Avoid moving your tank more than is absolutely necessary. If you must transport it, grasp the tank by both handles to maintain its upright position. When transporting a tank in a vehicle, place it on a rubber mat to help absorb road shock, and strap it down securely.
- To protect semen quality, keep canisters as low as possible in the neck of the tank while removing straws for thawing. Exposing frozen semen to warm air temperatures and then re-cooling damages sperm cells and can reduce fertility. A well-lighted area can help in reading bull numbers on cane tops. Also, a semen inventory card will help avoid exposure by allowing you to go directly to the appropriate canister without having to search the entire inventory.
- With proper maintenance, a semen tank should last for 10 years or longer. But as tanks get older, they do become less efficient at holding nitrogen and may need to be filled on a more frequent basis. Increased nitrogen consumption rate is an early sign that your tank is losing its vacuum. Check your tank often for signs of frosting and every other week for nitrogen consumption rate.