Test-tube calf embryos more likely to survive Texas summers

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Think you're uncomfortable in the extreme Texas summer heat? Try being an ovulating 1,200-pound mother cow.

Studies have shown that heat-stressed dairy cows suffer from damage to their ovarian follicles. Moreover, the eggs produced by the damaged follicles may also be damaged, said Dr. Todd Bilby, Texas AgriLife Extension Service dairy specialist.

Worse, after becoming heat-stressed, other studies have shown the eggs she ovulates for the next 40 or 50 days are likely to be damaged as well, according to Bilby.

Bilby and his graduate student, Brandi Stewart, have found a way to double pregnancy rates during the summer and increase the number of heifers born as compared with conventional artificial insemination commonly used on dairy farms. They believe this method could save dairies in Texas and throughout the country lots of money.

Thus heat stress puts "the heat on a dairy operator" in a number of ways, Bilby said. Not only does it reduce milk production, but by lowering fertility and increasing miscarriages, it costs the American dairy industry $1.5 billion annually.

"That's an estimated economic loss of $132 million to the Texas dairy industry alone," Bilby said.

Heat stress is also hard on the developing embryo if the mother cow does become pregnant. Consequently, it may die in the first two to three days of its development, he said.

"If a lactating dairy cow's egg actually becomes fertilized during summer, for which she only has a 50 percent chance, then there is still a very good chance the cow will not become pregnant because the early growing embryo is more likely to die within the first three days of life," Bilby said.

This is also bad news for the dairy cow and reduces profit margins for the dairy operator. When a heifer or a mature mother cow doesn't become pregnant, the dairy operator not only loses a calf, but the cow won't be giving birth, which in turn means she won't lactate, so he loses valuable milk production.

As it's prohibitively expensive to feed and care for a non-productive cow until the next time she has another chance to become pregnant, the operator often has to make the hard choice of selling her to the packing plant, Bilby said.

She's not just laid off; she's hamburger.

For decades, modern dairies rely mostly upon artificial insemination, using frozen sperm, to get cows pregnant as they come into heat. Since the late 1980s and early 1990s, embryo transfer systems -- test-tube calves -- have been used.

As the egg is fertilized in lab under climate-controlled conditions, the resulting in-vitro embryo is not subject to the heat-stress induced mortality rate of an in-vivo embryo, Bilby said. The in-vitro embryo is transferred to the mother cow when it is seven days old.

However, embryo transfers have issues of their own, he said. The first issue used to be cost of producing viable embryos by causing cows to super-ovulate -- producing large numbers of eggs at one time -- with fertility drugs. But today, there's an alternative. Eggs can be harvested from slaughterhouse cows, then fertilized in the lab with semen from high-quality bulls. Several hundred eggs can be fertilized at a time at a greatly reduced cost over super-ovulation methods.

Bilby's and Stewart's study used 722 cows from participating Central Texas dairies in the summer of 2009. The study compared fresh and frozen embryos that had been fertilized with sex-sorted semen, which is gender biased towards more female sperm, and incubated for seven days before transferred to the mother cow.

Bilby and Stewart split the cows into approximately three equal-size groups. One group was artificially inseminated with traditional methods. Another group received frozen embryos. The third group received fresh embryos.

All cows were estrus synchronized using standard methods. The artificial insemination group was bred using either timed schemes or following detected estrus. The other two groups had embryo transfers seven days after completion of the estrus synchronization protocol.

During a period of 40 to 47 days after the transfers, all cows were checked to see if they were pregnant. Of those receiving fresh embryos, about 42 percent were pregnant. Those receiving frozen embryos had a substantially lower pregnancy rate of about 29 percent. As expected, the artificial insemination group had the lowest pregnancy rate of about 18 percent.

Bilby and Stewart diagnosed the cows again at 90 to 104 days after treatment. As expected, they found an overall drop in pregnancy rates,

but those receiving fresh embryos still had the highest pregnancy rate at more than 36 percent, compared to frozen embryos at about 28 percent and artificially inseminated at 17 percent.

"The use of in-vitro produced embryos with sex-sorted semen can bypass the deleterious effects of heat stress on fertility while increasing the number of heifer pregnancies," Bilby said. "This could be a viable option for producers to adopt to maintain fertility during summer months."

Bilby also emphasized that using fresh or frozen embryos pared with sex-sorted semen instead of artificially inseminating not only increased the number calves born, but also increased the number of heifers born. With frozen embryos, 80 percent of calves born were heifers and 88 percent with fresh embryos, compared to 50 percent using artificial insemination .

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