

Bulls Fertility Improved

UNIVERSITY PARK (Centre)—A 5 percent improvement in fertility for bulls used for artificial insemination could save millions of dollars for the nation's dairy farmers, a Penn State reproductive physiologist says.

"The average fertility of bulls used for artificial insemination is about 65 percent nationally, based on non-return rate information from commercial bull studs," says Dr. Gary Killian, associate professor of animal science. "A 5 percent improvement in fertility would have a significant impact. In Pennsylvania alone, there are between 700,000 and 800,000 dairy cows."

Thirty-five percent of the total state herd may be infertile at any given time. These cows, which are neither producing milk nor offspring, must still be fed, although they are not providing farmers with a return on the investment of feed.

Killian is involved in basic re-

search on the function of sperm and the sperm membrane in animals, specifically bulls and rabbits. His results could lead to improved male fertility and ultimately the development of a male contraceptive for animals, he says.

He began his research at Kent State University, where he teamed with Dr. Ed Gelerinter, professor of physics. The two use electron spin resonance spectroscopy to study biophysical changes in the sperm because of environmental factors.

They struggled with ESR technique for five years before discovering, by accident, Killian says, that they were able to measure electron flow through the mitochondria in the sperm cell. This meant that they could measure the rate of metabolism for the whole cell. (Mitochondria are the tiny, rodlike structures found in the cytoplasm of most cells.)

"The ESR technique allows us to see the biophysical changes in a

cell, but it takes a tremendous amount of work to verify the interpretation of an observation. It can be very frustrating," Killian says.

He and Gelerinter are the only two researchers in the world using ESR to measure sperm mitochondrial flow. Their novel technique measures metabolic rate precisely and with a sensitivity from 100 to 1,000 times greater than other methods. They have been able to duplicate their results, demonstrating the soundness of their technique.

Their research is funded by the National Institutes of Health. Killian also recently received an \$87,144 grant from the Public Health Service of the U.S. Department of Health and Human Services. He also is co-investigator for an NIH-funded project that will involve the purchase of a modern ESR for Penn State.

"We don't understand how sperm are primed for fertilization, but we believe the environment they are exposed to play a key role in the process. With ESR, we

found that sperm were responding to their environment by changing the metabolic rate. We don't yet know what the trigger or stimulus is, but we have found two different types of stimuli that act at the sperm membrane, causing certain reactions within the cell," Killian says.

Lectin, a substance that binds to specific complex sugars on the surface of the sperm membrane, creates a specific change in metabolic rate. So do monoclonal antibodies, which are targeted against specific proteins and cause specific responses, he adds.

"The signal (from Lectin or

monoclonal antibodies) is transferred from the cell surface (membrane) to the interior of the cell where the mitochondria are located. This process is called signal transduction, and regardless of where the stimuli react, the signal is conveyed to the interior of the cell.

"If we can discover how to block signal transduction — how to turn sperm on and off — we could eventually create a male contraceptive, or, perhaps, improve the fertility of a subfertile bull. Abnormal fertility may be related to faulty signal transduction," he says.

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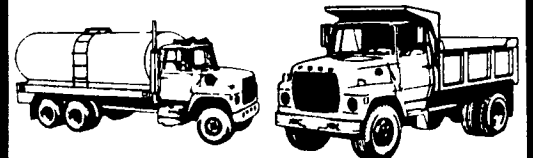
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