

# Analyzing Bull Fertility Generates Economic Savings

Research funded by the Angus Foundation examines proteomic markers associated with bull fertility that could lead to cost savings for producers.

by *Katie Allen, Angus Foundation*

**E**rdoğan Memili understands the importance of research, acquiring knowledge and using that knowledge to educate others. Looking over a lecture hall of students in his animal and dairy sciences senior seminar class at Mississippi State University (MSU), he discusses significant challenges facing agriculture. He asks his students to do a literature search and to find key articles to narrow the list down to the 10 greatest challenges associated with animal agriculture that have local and global impacts.

What were those 10 greatest challenges?

- ▶ Animal welfare.
- ▶ Agri-bioterrorism.
- ▶ Environmental impacts of animal agriculture.
- ▶ Food safety and security.
- ▶ The increasing human population and demand for food.
- ▶ The economics of animal agriculture, including the estate tax.
- ▶ Lack of education among food producers and consumers.
- ▶ Animal health.
- ▶ The need for more innovative animal



biotechnologies and research.

- ▶ Finally, misconceptions between the definitions of organic and conventional agriculture.

Memili, an associate professor in the Department of Animal and Dairy Sciences at MSU, has particular interest and experience in biotechnology and is always looking for “gaps” in technology — and how research can fill in those gaps. He provides experiential learning exercises in his classroom so students can identify problems and determine potential solutions. Memili takes the same “problem solver” approach in his research lab.

“I love the idea of research,” Memili says. “It is a way to develop ideas and discover new things.”

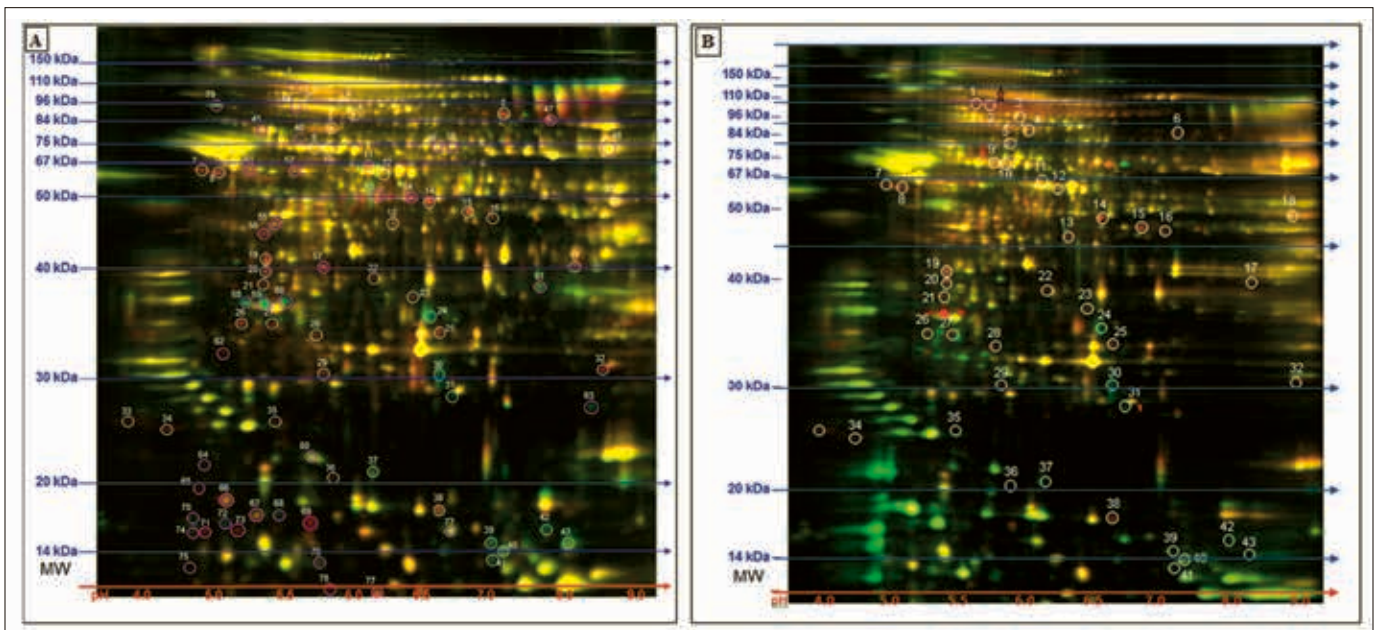
## Focusing on fertility

Narrowing his focus from agriculture in general to the cattle industry specifically, Memili recognized that one of the greatest challenges is understanding and predicting fertility, the most important factor controlling animal reproduction. Fertility of some bulls is just subpar, and the reasons why are not completely understood. Memili says there are gaps in the knowledge base, and these gaps are preventing efficient production of cattle.

From 2009 to 2011, the Angus Foundation provided \$40,000 in funding for the research Memili is working on at MSU titled, “Genomic and proteomic markers for Angus bull fertility.” “Reproduction and stayability” is one of the research priority areas of the American Angus Association’s Research Priorities Committee.

From a producer standpoint, efficiency is very important, as is fertility. From a consumer standpoint, meat quality is very important, and an increasing number of consumers want high-quality, yet affordable beef.

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▶ Differentially expressed sperm proteins between two bulls of varying fertility are identified by the circles on these images.

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Memili, along with several other researchers, has looked at fertility in dairy bulls in the past, but Memili saw an opportunity to turn the focus to Angus bulls, considering the influence of Angus genetics in beef production.

“In the area of efficiency and reproduction in Angus compared to dairy, more work needs to be done,” Memili says. “To improve efficiency and reproduction in Angus will enhance meat quality, so both producers and consumers will be happy.”

What Memili has gained from his research is that, in addition to fertility being tied to genetics, there is also an influence of proteins in bull sperm that affect fertilization and early embryonic development. Proteins are the major functional macromolecules that do the actual functions in the cells. In addition to the animal’s genetic makeup, expression of the proteins can be influenced by environment, including temperature and management.

Proteins do not always work alone, because they bind with other proteins and deoxyribonucleic acid (DNA). In essence, the sperm brings much more than half of the genetic material, which is a major find. Understanding how these proteins work with one another is key to understanding how to predict fertility more accurately.

### A closer look into the research

The overall goal of the project was to identify molecular markers, including proteins and single-nucleotide polymorphisms (SNPs), which are associated with bull fertility.

Memili and his research team examined sperm from Angus bulls with varying fertility from frozen semen samples provided by a semen company. They found more than 2,000 detectable protein spots in the bull sperm. Of these spots, 80 of them were the most differentially expressed when comparing phenotypically high- and low-fertility bulls. The researchers determined the identities of these 80 spots, which have been more closely examined to separate the low-fertility from the higher-fertility bulls.

The researchers have focused more on these protein spots rather than SNPs, which are the DNA sequences. Prior research in dairy bulls has shown associations between bull fertility and SNP markers are rather weak, SNP studies are expensive and extensive fertility data on Angus bulls is currently limited. This is because, unlike dairy bulls, fertility information for Angus bulls is challenging to obtain. Most often in



► Sule Dogan, a senior doctoral student at MSU in life sciences with a concentration in genetics, and Erdogan Memili work on the Angus bull fertility research in the laboratory. Dogan is the lead author of the manuscript developed about this study.

the Angus breed, natural breeding is used, so registration of artificial insemination (AI) records is less available and creates a limitation in ranking Angus bulls based on fertility.

Producers and semen companies, for that matter, can’t predict fertility, and Memili’s lab is focusing on this problem.

“These bulls produce large numbers of sperm, and when you look at them (sperm) under a microscope, they look normal,” Memili says. “Everything looks normal, but molecular defects can cause low fertility. There must be biomolecular markers that can predict the fertility of a bull.”

### What the future has in store

A manuscript Memili has co-authored about the research is currently under review for publication and looks specifically at his research findings and those 80 most-differentially expressed protein spots between the high- and low-fertility bulls.

Memili expects to increase the reliability of the protein markers by using many more samples in future studies. He says breeders will also need to understand how increasing fertility can influence other traits, such as possibly milk and/or carcass traits. This means thinking about the long term when selecting bulls and the interconnectedness between traits.

“We also need to understand how these traits are related to each other to help with breeding strategies,” he says. “We have to be really careful selecting traits on genetic

markers, because they might mask another trait. With any single-trait selection, it will take time to go back and rescue genetics lost of a previous generation.”

Memili is hopeful that this fertility research will help transfer data into knowledge. He realized the importance of investing in research, connecting that research to something useful, training students, and educating the public about the findings. Memili says it is easy to transfer knowledge in today’s society and technological capabilities.

### Application for producers

Not only does this research aim to improve the efficiency of cattle reproduction and create a clearer method to evaluate fertility in Angus bulls, it also looks to reduce costs associated with low fertility by helping producers eliminate low-fertility bulls early on, thus generating economic savings for those producers from not having to house and maintain those bulls.

Once the protein markers are validated using sperm samples from large numbers of Angus bulls with reliable fertility data, it is expected that these markers can be developed as a rapid bull-fertility-detection kit in one to two years and would be made available for producers to use.



**Editor’s Note:** Katie Allen is director of marketing and public relations for the Angus Foundation.