



# Heifer Genetics — Testing for Early Puberty and Fertility

**Both genetics and environment impact heifer fertility; University of Missouri researchers try to predict fertility using measurements and genetics.**

by *Heather Smith Thomas*

**F**ertility in cattle is the key factor in profitability for ranchers — no calf, no income. It costs money to develop heifers as replacement females. A heifer that is fertile, settles early in the breeding season and continues to have a calf every year is more profitable than a heifer that does not breed, breeds late or has only one calf, comes up open and must be replaced by another heifer that takes two years to develop.

There are several ways to select heifers but determining future fertility has been elusive. Jared Decker, University of Missouri (MU) associate professor, is involved in a research project looking at genetics of fertility and heifer puberty. He received a grant from the USDA National Institute of Food and Agriculture (NIFA) for this project and recruited 2,500 Red Angus heifers and 2,500 Hereford heifers as part of this research.

When Decker was hired as an Extension specialist and assistant professor, he started working with MU Chancellor's Professor of Animal Science Dave Patterson in the Show-Me-Select® Replacement Heifer Program. Decker was impressed with what Patterson was doing for beef producers.

"We had discussions about needing to do a better job of predicting fertility in beef cattle. That was the start of the idea for our current project," Decker says.

## **Background and evolution of this project**

Patterson has worked with Missouri cattle producers for many years, helping them improve their cow herds.

"I'm thrilled that Jared got this grant," Patterson says. "When I was in Kentucky earlier, we started a heifer program in Bourbon County. When I moved to Missouri, we started a statewide program."

Patterson's graduate work in Kentucky was in heifer development and puberty onset, looking at nutritional development and its influence on puberty onset.

"We followed that with how the heifers performed — when they became pregnant or if they became pregnant — and evaluated calving difficulty and breed-back as 2-year-olds," he says.

In the early 1990s there was a large influx of European breeds.

"The producers I worked with in Kentucky were having problems with heifers not reaching puberty on time (slow maturing) or becoming pregnant late, and there were too

many open at the end of breeding season. Calving difficulty rates were too high, and breed-back on 2-year-olds was horrible," Patterson says.

He wanted to create a program to help resolve these problems.

"What we started is still in place today, called the Bourbon County Elite Heifer Program," Patterson says.

This is what the Show-Me-Select Replacement Heifer Program was patterned after, when he came to the University of Missouri.

"Colorado State University had developed a reproductive tract scoring system. At first, I was skeptical about it," he says. "I had 300 heifers in my Ph.D. project at Kansas State University (K-State), and we were doing weekly palpations and blood sampling to determine puberty onset, along with daily heat detection. I wondered whether a tract scoring system would improve on that, but I soon realized it was a good evaluation and screening tool for heifers that were still a month to six weeks away from breeding."

Tract scoring helped determine which heifers were ready to breed and which ones needed more time.

"It also shows whether the heifers were well developed from a nutritional standpoint. There is both a genetic and environmental influence on puberty," Patterson says. "We collected all that data from the beginning when I started working here at Missouri. Working with the geneticists in our department, I hoped that the data could find its way into the national cattle evaluation, so that as genomic technology improved over time, we could marry the two — looking at the genetics of heifers and also collecting the phenotypic data in terms of tract score, pelvic area, etc., to see how that plays out in terms of not only puberty and cyclicity status of those heifers but even more importantly when they become pregnant."

One of his frustrations with some of the breed associations was in how they reported heifer pregnancy — a simple yes or no (pregnant or not), placing no value on when she becomes pregnant. The critical piece is whether they become pregnant early.

"The great thing about our group here at Mizzou (University of Missouri) is the collaboration between the genetics and physiology group. Jared Decker began putting a proposal together for this genetic project, to collect data for determining a genetic component," Patterson says.

Photo by Rahel Dotson



There are now about 150,000 heifers in the Show-Me-Select database, and there's hope Decker's research will help identify the genetic component of heifer fertility.

"Jared wrote the grant to look specifically at a couple breeds to dig deeper into this. He's working with herds in various parts of the country to ferret this out," Patterson says. "I think it will be a big contribution to the industry. Over time, it could impact heifer selection and improve reproductive efficiency in general."

### Fertile data

"Reproductive data is hard to collect and hard to separate genetics from management. Fertility is heavily influenced by management and nutrition, but if we can begin by identifying the genetics of the heifers that truly are superior from a reproductive standpoint, we can maybe make a difference," Patterson says.

Patterson's years of experience in heifer fertility studies has already proven that some puberty-related traits are heritable.

"When we started the work in Kentucky, after doing thousands of heifer evaluations, we began to see a relationship between the pelvic area and puberty onset. In the herd we worked with, at 10 months of age we took weekly blood samples from the heifers to determine the first rise in progesterone, which would indicate that they had reached puberty and were cycling. We were also taking weekly pelvic measurements. We also used this method in Missouri in the Show-Me-Select program. Pelvic area is highly heritable, but it is also related to frame size," he explains.

Patterson cautions on single-trait selecting replacement females based upon one measurement alone though.

"We don't advocate selecting heifers on larger pelvic areas because over time you end up with larger cows. We simply use it as a screening tool," he says.

Using data, Patterson set pelvic measurement criteria for females eligible for the Show-Me-Select program.

"Heifers need to meet the cutoff of 150 square centimeters at the pre-breeding exam," he says. "Based on our data, if they meet that requirement, they are good to go. If the pelvic area is under 150, those heifers are flagged in our database to be re-measured within 90 days after the start of the breeding season — which is basically the time of their first preg-check. We not only determine pregnancy status (open or pregnant) but also when the heifer became pregnant.

"A fetal age is assigned to every heifer, with ultrasound. In heifers that are not yet cycling, if their pelvic area is under 150 and you come back and measure them again within 90 days after the start of the breeding season, most of those heifers catch up once they start cycling. They will make the 180 square centimeters, which is the cutoff at that point in time for heifers to get into our program and be eligible for sale as bred heifers."

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— Dave Patterson, MU Chancellor's Professor of Animal Science

Heifers not meeting the program's requirements are more likely to have problems and are not included in the sales.

"If heifers have reached puberty at the time of the first exam and measure under 150, in many cases those heifers are destined to have small pelvic areas as cows and could have calving difficulty," he says. "If they are re-measured after breeding and are under 180 square centimeters, those heifers are not eligible for sale."

Patterson offers this example of why it pays to check the pelvic area of potential replacement females.

"One of the things we saw, early in the program, is that pelvic size and shape is a highly heritable trait. We worked with many veterinarians across the state, and I got a call one day from a veterinarian in northeast Missouri," he says. "We had a group of half-sisters (all from the same bull) that he measured, and he thought he had done something wrong and wanted me to check. All these heifers had rectangular pelvises; vertical measurements (height) were less than their horizontal measurement (width). There was no way those heifers would ever calve without a C-section."

### Managing for success

Today, what Decker is doing on the genetic aspect will hopefully shed some light on ways to help producers improve reproductive selection. A genetic test could be one more selection tool to help identify the most fertile heifers.

In any herd there are some cow families that are more fertile than others. Heifers in many cases perform similarly

to their mothers, conceiving early.

"We are excited about applying the genetics of this, since it could have a significant impact on the industry. On the reproductive side, we haven't been able to crack the genetics of some of these traits and hope we will be able to do so in the future. As genomic technology improves, I think this will be possible," says Patterson.

Of course, genetic selection will still need to go hand-in-hand with proper heifer development.

"If you look at heritability of reproductive traits, the only one that has significant heritability is age and weight at puberty. The rest are fairly lowly heritable, which means they are highly influenced by environment or management. We still need to feed and manage heifers appropriately, but if we start with a heifer that genetically has potential for early puberty, we are way ahead," he says.

Today, gathering data on replacement females is still one of the best ways to predict their future fertility.

"I would never buy replacement heifers without having tract scores done. In groups of heifers, you may find freemartins, abnormally shaped pelvises, small pelvises, pregnant heifers, etc.," Patterson says.

Doing a reproductive tract score to check heifers can eliminate any that have obvious problems.

"In doing our early work, we also ran into some heifers that had been implanted. In the early 1990s there was a push to implant heifers to increase skeletal growth and pelvic area and decrease calving difficulty," he says. "Many farms were bringing in large groups of heifers to develop and breed — and when we checked heifers a month or so before breeding season, some of the heifers that looked really good (well developed) did not have good reproductive tract scores. It was a complete mismatch. We started asking questions and in many cases those heifers had been implanted."

Implants were great for growth, but not for reproduction.

"Those were some of the things we learned, over time, then helped producers understand what might be good management and what might not. In many cases, the ones that had poor scores were simply because of inadequate development from a nutritional standpoint," he says.

Many breeds have focused on growth and performance, more milk, etc., but high-performance animals need more feed.

"This was one of the problems in the 1990s. We were losing many 2-year-olds because they failed to breed back again after their first calf," says Patterson. "Higher-producing females had a hard time breeding back under those nutritional conditions.

"We've been helping people understand some of these things, and now, we hope to have another tool to help us with selection, looking at the genetic side of heifer puberty and fertility." **HW**

