Virginia Cooperative Extension
Virginia Tech • Virginia State University
www.ext.vt.edu

Dairy Pipeline
Department of Dairy Science
Volume 42, No. 4
May 2021
www.vtdairy.dasc.vt.edu

# Heat Stress and Fetal Programming in Dairy Cattle: Multi-Generational Effects

*Authored by K.A. Alward, Ph.D. Student with Dr. Rebecca Cockrum, Department of Dairy Science;* rcockrum@vt.edu

Heat stressed cows cost U.S. dairy producers over $1.1 billion per year. These cows exhibit a reduced feed intake which contributes to a reduction in milk production—the main cost associated with heat stress. In addition, these animals also have reduced reproductive function and are less likely to get pregnant after breeding. This leads to a greater chance that they will be removed from the herd and impacts farm profits. Even so, the *pregnant animals* exposed to heat stress may be the largest risk for the profitability of a dairy farm. For animals that are already pregnant, heat stress not only negatively impacts the calf in-utero with changes that persist into adulthood, but these effects are seen in offspring of those calves heat stressed in-utero. Therefore, exposing cattle to heat stress during pregnancy, can have lasting negative effects for up to three generations. This article will examine how heat stress negatively affects calves in-utero and the resulting changes in those calves and their offspring.

During fetal growth, there are critical time periods during which tissues and organs are undergoing development. During this time, external stimuli or insults can drastically impact the fetus, permanently altering various structures and functions, which is known as fetal programming. At the cellular level, stress to the fetus can change the amount of methylation present on sections of DNA. The amount of methylation present turns genes on or off and affects physiological processes. Calves that are heat stressed in-utero have abnormal methylation patterns on genes that are essential for transcription, immune function, cell signaling and enzymatic activity compared to calves that were not heat stressed. Differences in methylation pattern between heat stressed and non-heat stressed calves in-utero explains the physiological differences seen in these animals after birth.

After birth, heat stressed calves immediately exhibit signs of reduced performance compared to non-heat stressed counterparts. These calves have a reduced growth rate persisting through puberty and compromised immune function resulting in increased incidences of disease. After these calves reach puberty, are bred, and begin producing milk approximately two years after their heat stress in-utero, they produced 10 pounds per day less milk than non-heat stressed animals. These cows will continue to produce less milk in their second and third lactation as well and are more likely to be culled from the herd as a result.

Unfortunately, the negative effects of heat stress in-utero carry over into the next generation of offspring as well. During fetal gonad development, primordial follicles of that developing fetus are being created. These primordial follicles will develop into oocytes after puberty and if fertilized, will become an embryo. Heat stress causing DNA methylation reaches these primordial follicles, permanently altering them. This results in the granddaughters of heat stressed cows also producing less milk

(~3 pounds per day less) in their first lactation compared to granddaughters from non-heat stressed cows.

Heat stress may only last a few days and dairy cows can often recover their milk production levels comparable to production prior to heat stress. However, for pregnant animals, the structure and function of the calf in-utero has already been permanently altered and will exhibit reduced performance after birth. In addition, offspring of the heat stressed cow will produce calves that will perform poorly compared to calves whose maternal grand-dam were not heat-stressed during gestation. These multi-generational effects cost producers money for years in the future from poorer performing animals and demonstrate the critical need to cool cows during gestation.

# Evaluating A Dairy Herd's Reproductive Management

*Authored by Dave Winston, Extension Dairy Scientist, Youth, Department of Dairy Science; dwinston@vt.edu*

Reproductive management on the dairy farm can be challenging because it involves the interaction of animals, people, and technology. Cows and heifers require adequate body condition, a good plane of nutrition, and a healthy reproductive tract for reproductive success. People working with the reproductive program need to be well-trained in heat detection and artificial insemination technique and compliant with protocols. Reproductive technologies, from the simplest to most complex, can improve performance, but must fit the needs of herd management and be economically feasible. This purpose of this article is to examine common ways that reproductive efficiency can be evaluated.

**Pregnancy rate** is a good overall indicator of reproductive management. It is defined as the percent of cows that are eligible to become pregnant that do become pregnant in a given period of time, usually 21 days. It is a function of the herd's heat detection and conception rate.

East region average: 20.6%
Goal: ≥ 24%

Pregnancy rate is reported on a DHI-202 Herd Summary. Herds enrolled in PCDART should use Standard Report 126 for evaluating pregnancy rate. In Dairy Comp 305, the BREDSUM\E command will provide a 21-day pregnancy risk report.

The **voluntary waiting period** (VWP) is the desired waiting time from freshening until a cow is eligible to be bred. It is determined by the herd manager, not a calculated value. Most commonly set at 60 days, the VWP should be established taking reproductive health and production level into consideration. It is extremely important that the VWP be reflective of what a herd is practicing. If not, calculated values for other parameters may not be completely accurate. Compliance with the VWP is indicated in the **percent of all first services less than the VWP** on a DHI-202 Herd Summary. It is recommended that this value be 0%. If above 10%, one of two things should happen. Either be more compliant with the VWP by waiting to breed cows until they pass the VWP or by lowering the VWP to match practice.

Heat detection efficiency is reported as **percent of heats observed** on a DHI-202 Herd Summary. Simply put, it is a calculation that compares the number of heats or breedings reported against the number of heats expected during the test period.

East region average: 46.9%
Goal: ≥ 67%

Producers may be using visual observation, heat detection aids, estrus synchronization, or a combination of these to identify cows for insemination. If percent of heats observed does not meet the goal, reevaluate the heat detection program for ways to increase efficiency and/or improve protocol compliance.

**Days to first service** is the number of days from calving until first breeding date. It is a function of the VWP and heat detection.

East region average: 90.3 days
Goal: VWP + 10 days

Herds that have high average days to first service should focus on improving heat detection practices. Implementation of an estrus synchronization program can be an effective way to keep days to first service in check.

**Conception rate** is defined as the percent of services that result in a pregnancy.

First service conception rate
East region average: 42.3%
Goal: ≥ 45%

Overall conception rate
East region average: 38.5%
Goal: ≥ 40%

Possible causes of low conception rates include poor artificial insemination technique, poor body condition, negative energy balance, and disease. If multiple inseminators are used on a farm, it can be helpful to track conception rates by technician. The best technician(s) should be utilized more heavily. Those with low rates could be retrained or reassigned. Conception Tracker in PCDART is helpful in analyzing conception rates by technician provided that technicians are identified when the other breeding information is recorded.

**Days open** is the number of days from calving to successful breeding date. On a DHI-202 Herd Summary it is listed as **projected minimum days open**. Days open for cows without breeding dates and in milk longer than the VWP are included in the calculation. For those cows the higher of days open as of test day plus 10 days OR average days to first service for the total herd is used to calculate the projected minimum.

East region average: 141 days
Goal: ≤ 130 days

The **calving interval** is the period of time from one calving until the next calving, usually measured in months. The **projected minimum calving interval** is days open plus gestation length. It is affected by the VWP, heat detection efficiency, conception rate, and reproductive culling.

East region average: 13.9 months
Goal: ≤ 13.6 months

Accurate, complete information is an essential part of reproductive management. It is important to review key parameters routinely as a means of evaluating a herd's reproductive efficiency.

==========

**Data presented for the East region averages was retrieved from DairyMetrics (Dairy Records Management Systems) on April 14, 2021*

# Upcoming Events

**Regular Women in Agriculture Meetings**
Every 1st Tuesday @ 7:30 pm

**Virginia Spring Dairy Show**
May 1, 2021

**Women in Agriculture Gathering – Northern District**
Orange County, May 14, 2021

**Show like a Pro Workshop**
May 15-16, 2021

**Women in Agriculture Gathering – Central District**
Buckingham County, May 18, 2021

**Fencing School**
May 19, 2021
Mauzy, VA

**Women in Agriculture Gathering – Southeast District**
Suffolk County, May 21, 2021

**Women in Agriculture Gathering – Southwest District**
Wythe County, May 21, 2021

**June Dairy Month Poster Contest**
Postmark Deadline June 15, 2021

**State 4-H Dairy Quiz Bowl**
June 12, 2021

**Franklin County Livestock Show**
June 12, 2021

**June Dairy Month Baseball Game**
June 17, 2021

**Virginia Dairy Expo**
July 9, 2021

**Virginia Colored Breed Show**
August 5, 2021

**State 4-H/FFA Dairy Youth Field Day**
August 6, 2021

**Virginia Summer Holstein Show**
August 7, 2021

**Hokie Cow Classic**
Coming Fall 2021
Date TBD

If you are a person with a disability and require any auxiliary aids, services or other accommodations for any Extension event, please discuss your accommodation needs with the Extension staff at your local Extension office at least 1 week prior to the event.

For more information on Dairy Extension or to learn about current programs, visit us at VTDairy—Home of the Dairy Extension Program online at www.vtdairy.dasc.vt.edu.

Dr. Christina Petersson-Wolfe,
Dairy Extension Coordinator &
Extension Dairy Scientist,
Milk Quality & Milking Management

Visit Virginia Cooperative Extension: ext.vt.edu