



Effects of Heat Stress on Dairy Reproduction

Heat stress not only affects the productive ability of your cattle but also their ability to conceive and sustain a pregnancy. It is important to understand the effect heat stress can have on reproduction and how you can help minimize the effect.

Impacts of Heat Stress on Behavioral Estrus



We all know that when you see a cow standing to be mounted, she is in estrus, and we should inseminate her. However, there are other signs of estrus that we should look for to let us know if she is coming into estrus (heat) or going out of estrus. Knowing these signs will make it easier to know when to inseminate your animals. As a cow or heifer nears estrus, she will exhibit an increase in locomotion and exhibit restless behavior. She may exhibit an overall nervousness and increase her level of bellowing. At this time, she may attempt to mount other cattle, but she is not receptive to being mounted and should not be inseminated at this time. At the start of estrus, some cattle will have a small amount of watery mucus. As the animal nears ovulation, she will stand to be mounted. While standing to be mounted is the primary sign of estrus on which to base timing of insemination, there are several secondary signs of estrus to observe for as well. Cattle in standing estrus tend to

be very friendly, eat less, have abundant, more cohesive clear mucus, and the vulva lips are red and swollen. An animal that stands to be mounted should be inseminated. Once a cow or a heifer has ovulated, she will again mount other animals but will not stand to be mounted. Other signs that she has ovulated are dirty flanks, a rough tailhead, and bloody discharge¹. When you see these signs, it is too late to inseminate her. During heat stress, cattle are less likely to move around, so it becomes increasingly important to know all signs of estrus, increase observation times, and utilize estrus detection aids. The number of standing events expressed during estrus in summer months can be 50% or fewer than the number observed in winter months².

Estrus Detection Aids to Beat the Heat

During the hot months of summer, cattle spend a greater amount of time lying down. This change in behavior makes it harder to detect estrus. Therefore, we need to be more strategic about when to estrus detect and utilize some aids to help us. Seventy percent of standing events occur from 6 pm to 6 am, the coolest part of the day³. With the majority of the standing events occurring during the night, it is critical to include estrus detection aids. Traditional aids such as paints and chinks work well when applied to the tailhead. Apply the product to the tail head and look for signs of it being worn away by the brisket of the riding cow. Pressure activated devices work similarly. These devices are glued on the animals' tailhead and turn color when they have been pressure activated. These devices can give a false positive if the animal leans against a hard surface, such as a stall post, fence, or tree. Estroprotect patches can also be used to help detect estrus. These patches have a protective coating that is rubbed off by the brisket of the mounting cow. If the protective coating is missing, this is a sign that the animal stood when mounted. The

Amanda Young¹, Heather Schlessler¹, Ryan Sterry¹, Paul Fricke^{1,2}

¹University of Wisconsin – Madison Division of Extension and ²Department of Animal and Dairy Science
July 2020

protective coating on these patches can also be rubbed away by various structures the animal leans against. Newer technologies such as pedometers, activity monitors, etc. can also be used. These newer technologies incorporate computers and are recommended for farmers who are comfortable with the technology. Timed Artificial Insemination (AI) may also play a greater role during heat stress to synchronize cows for insemination, although inseminating cows during summer heat stress may reduce conception rates, deciding not to inseminate cows is a greater detriment by decreasing 21-day pregnancy rates and extending days open⁴.

Impact of Heat Stress on Fertility and Early Embryonic Loss

Dairy records analysis from the UW teaching and research herd, as well as for herds in the upper Midwest often show a decrease in conception rates over the summer months⁵. While all the possible causes behind this decrease in fertility are not fully understood, indicators point towards a decrease in oocyte quality, fertilization failure, and an increase in early embryonic loss. Early research on heat stress and reproduction used embryo transfer as a tool. Conception rates are greater for cows receiving a quality embryo compared to AI during times of heat stress. Embryos are typically transferred to recipients around day seven following estrus, indicating the damage heat stress causes to the egg or embryo occurs early on⁶. It also indicates that lactating dairy cows can conceive during times of heat stress if damage to the oocyte and early embryo can be mitigated.

Because the damaging effects of heat stress on reproduction occur early on in the maturation of oocytes, at the time of fertilization, and early embryonic development, farm management efforts should focus on heat abatement efforts ahead of predicted heat stress events or as soon as heat stress is observed. Damage to oocytes and early embryonic development cannot be undone, making prevention and heat abatement practices the key management factors. Historically embryo transfer has been cost prohibitive for commercial dairy herds. Advancements in this technology may make this practice more economically feasible in the near future.

The estrous cycle is divided into two main stages of development. The follicular phase of development is the phase in which the oocyte (egg) matures on the surface

of the ovary in a follicle (or fluid filled sack). As the oocyte matures the size of the follicle increases, until the largest (antral) follicle ruptures releasing the oocyte for fertilization. Heat stress can impair the selection of follicles, and result in larger pre-ovulatory follicles. Larger follicles, and delayed ovulation, have been shown to reduce conception rates⁷.

Fertilization of the oocyte is also affected during heat stress (rectal temperature ≥ 102.2 F) events. One study found the fertilization rate decreases from 83% for cows not experiencing heat stress to only 37% for cows under heat stress⁸. This shows that an increase in maternal body temperature likely alters the oocyte resulting in a decrease in fertilization rate.

Heat stress can affect the development and rate of growth of the early embryo⁹. In fact, effects have been seen as early as the two and four cell stages. Heat Stressed embryos develop slower causing them to be underdeveloped by day 17, a critical period in embryonic development. Underdeveloped embryos do not produce enough interferon-tau, the hormone that reduces prostaglandin F₂ alpha secretion. Without interferon-tau, or insufficient production, prostaglandin release will cause Corpus Luteum (CL) regression, resulting in early embryonic loss, and the cow or heifer returning to estrus.

Impact of Heat Stress on Twinning

Multiple environmental factors and genetics impact the twinning rate in dairy herds. One of the environmental factors is the season. A review of DHIA calving records by Silva del Rio et al. found a lower incidence of twinning from conceptions that occurred from April to June, and greater incidence from conceptions occurring from August to October¹⁰. Seasonal effects are most commonly observed in lactating dairy cows, and far less common for conceptions occurring in non-lactating heifers. Genetic testing of twins has shown 95% of twins are dizygous (non-identical from two separate eggs) further pointing to multiple ovulations as the primary cause for twinning. Heat stress increases twinning by increasing the number of dominant follicles selected during a follicular wave, thereby resulting in multiple ovulations at the end of the estrous cycle.

Impact of Heat Stress on Bull Fertility

Farms that use natural service bulls do not have to actively estrus detect, since the bull is doing that job for them. However, bull fertility is affected by heat stress as well. The process of making sperm takes 61 days in the

bull. It takes an additional 14 days to travel from the testis to the tail of the epididymis, where it waits for an insemination event. A heat stress event that occurs while the sperm are developing will not show up in the ejaculate for 2 – 4 weeks due to the time it takes sperm to move through the reproductive tract. It will also take 6 – 12 weeks before normal sperm production is restored¹¹. Therefore, a heat stress event on July 1st is not seen until mid to late July, and the effects will last until October. Due to the length of time, the bull's sperm is compromised, it becomes important to prevent heat stress in the bull. If a potential heat stress event occurs, it is critical to have the bull's semen tested before breeding.

- lactating dairy cattle following embryo transfer or artificial insemination. *Theriogenology* 31:765
10. N. Silva del Rio, S. Stewart, P. Rapnicki, Y.M. Chang, P. M. Fricke, An Observational Analysis of Twin Births, Calf Sex Ratio, and Calf Mortality in Holstein Dairy Cattle; *Journal of Dairy Science*. Volume 90, Issue 3, 1255-1264.
 11. *Pathways to Pregnancy and Parturition*, P.L. Senger, Second Edition

References:

1. <https://extension.psu.edu/heat-detection-and-timing-of-insemination-for-cattle#section-3>
2. Nebel, R.L. & Jobst, Shelly & Dransfield, M.B.G. & Pandolfi, S.M. & Bailey, T.L. (1997). Use of radio frequency data communication system, HeatWatch, to describe behavioral estrus in dairy cattle. *Journal of Dairy Science*. 80.
3. Artificial Insemination Program – Canada (get reference from office)
4. De la Sota et al., *Theriogenology* 49:761;1998
5. Fricke, Caraviello, Weigel, Welle. Fertility of Dairy Cows after Resynchronization of Ovulation at Three Intervals Following First Timed Insemination *Journal of Dairy Science* 86:3941-3950.
6. Peter J. Hansen, Reproductive physiology of the heat-stressed dairy cow: implications for fertility and assisted reproduction. *Animal Reproduction*. Vol 16 no 3.
7. Roth, Z., R. Median, R. Braw-Tal, and D. Wolfenson. 2000. Immediate and delayed effects of heat stress on follicular development and its association with plasma FSH and inhibin concentration in cows. *J. Reprod. Fertil.* 120:83-90.
8. Hackbart, Ferreira, Dietsche, Socha, Shaver, Wiltbank, and Fricke. Effect of Dietary Organic Zinc, Maganese, Copper, and Cobalt Supplementation on Milk Production, Follicular Growth, Embryo Quality, and Tissue Mineral Concentrations in Dairy Cows. *Journal or Animal Science*. 88:3856-3870.
9. Putney, Drost, and Thatcher (1989) Influence of summer heat stress on pregnancy rates of