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Top Ten Considerations for Dry Cow Cooling[1]

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INTRODUCTION

While producers are quite familiar with the positive effects of cooling cows during lactation, fewer understand the impact of cooling dry cows. Yet there is increasing evidence that failure to cool cows when they are dry leads to negative effects on productivity and health in the next lactation. Perhaps more critical is the emerging data that indicates a significant impact of *in utero* heat stress on the developing heifer, which results in long term effects on that calf's productivity and health. This paper considers those topics, along with the economic and implementation considerations.

1) How does dry period cooling affect milk yield?

Cows that experience heat stress during the dry period make 8 to 10 lb less milk each day in the next lactation compared with herdmates that are cooled. There is no impact on milk composition, though component yields are increased with cooling. The effect is present on the first day of lactation and persists for at least 40 wk, though all evidence suggests it persists through the entire lactation. Mammary epithelial cell growth is depressed in heat stressed dry cows relative to cooled animals, and that is consistent with greater capacity to produce milk in the next lactation.

2) What are the metabolic effects?

Similar to lactating cows, heat stressed dry cows consume less feed compared with cooled cows. Despite the lower nutrient intake, there is no evidence that heat stressed dry cows experience any impact metabolically during heat stress. Indeed, there is no difference in basal or stimulated insulin, glucose, or free fatty acids between cooled and heat stressed dry cows. After calving there are some transient affects of dry period cooling; but they are all consistent with the observed increases in milk yield in those cows, and it is important to note that all cows are cooled during lactation, so those metabolic effects could not be due to continued heat stress.

3) Is cow health affected?

During the dry period, heat stress reduces antibody response to vaccination, and lymphocyte (i.e. white blood cell) proliferation is also lower. Thus, heat stress has direct negative impacts on the cow's ability to respond to pathogens during the dry period. Interestingly, there are carry-over effects of dry period heat stress on immune function, with those cows having lower innate immune responses in early lactation relative to their cooled herdmates, even though they are at a lower level of milk production. And cooled cows have higher circulating non-esterified fatty acid concentrations in blood, yet improved neutrophil responses. The improved

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immune status in cooled dry cows resulted in better responses to *S. uberis* challenge in early lactation.

4) What about reproductive performance?

The strongest indication that dry cow cooling does not negatively impact subsequent reproduction comes from a study that compared cows that were dry in the coolest months of the year (i.e. December to February) to those dry in the hottest months of the year (i.e. June to August). Cows dry in the coolest months produced more milk and were less likely to contract disease compared with those dry in the summer. Cows dry in the cool months had fewer services to pregnancy, as well as fewer days to pregnancy and thus fewer days open versus those dry in the hot months; all indications that despite higher milk yield, and being bred during the hottest months of the year, a dry period during the coolest months improves reproductive performance.

5) Is calf health and growth altered?

Calves born to heat stressed dams are lighter at birth, remain lighter at weaning and even through 12 mo of age, relative to calves from cooled dams. Calves that are heat stressed *in utero* are also shorter through a year of age. Passive transfer is also compromised in calves from heat stressed dams, with lower apparent efficiency of immunoglobulin (**IgG**) absorption translating to lower circulating concentrations of IgG through the first month of life. This is not due to a reduction in colostrum quality from the dam, but rather a limitation of IgG uptake. Specifically, we have evidence that gut closure is accelerated in the calves born to heat stressed dams. We have tracked calf health through the first lactation and found that more *in utero* heat stressed calves leave the herd due to sickness or illness before puberty, and thus fewer complete the first lactation.

6) Is heifer reproductive and first lactation performance affected?

Heifers born to heat stressed dams achieve puberty at the same age as those from cooled dams, but they require more services to achieve pregnancy. Most importantly, heifers born to heat stressed dams produce about 10 lb/d less milk in their first lactation compared to the heifers from cooled dams. This effect is apparent from the beginning of lactation and extends to at least 250 days in milk (**DIM**), and likely through the entire lactation. This response is not associated with differences in growth during the first lactation, as both groups of animals calved at the same bodyweight (**BW**) and had identical BW through the first lactation. Therefore the reduction in yield is not due to compensatory growth in the first lactation, so the lower yield is likely to persist into the second lactation and beyond. These fetal programming impacts are also known to be transferred to the offspring of the affected animal, so *in utero* heat stressed calves' progeny are likely to be lower productivity animals as well.

7) What are the economic impacts of heat stress for dry cows?

In a recent analysis we considered the economic losses associated with a lack of dry cow cooling across the US. Potential days during the year that a cow would experience heat stress were estimated for each state and the total number of cows in each state was used to estimate the total potential milk loss. The total potential loss from a lack of dry cow cooling is at least

$810 million annually. However, that estimate only considers milk losses, and does not include any impact on cow health or on the calf. Thus, the total negative impact is likely much greater. But prevention of the milk loss alone is enough to yield significant positive return on any cooling system improvements.

8) How do I assess heat stress?

Because temperature and humidity both influence the ability of a cow to lose heat to the environment, it is best to use the temperature-humidity index (**THI**) to assess the relative heat load on an animal. Rectal temperature (**RT**) is the gold standard to determine heat stress, and RT increases at a THI of 68, so abatement should begin before that THI is reached. In addition to RT, respiration rate (**RR**) will indicate the relative heat stress a cow is experiencing, and can be used effectively in a barn to determine if animals are heat stressed. For example, measuring RR by observation of flank movements of a group of sentinel cows within a pen should provide an indication of heat load. An average RR of 60 or greater suggests that heat stress is occurring and abatement strategies need to be employed to actively reduce the heat load on cows.

9) How are dry cows best cooled?

Methods of cooling are no different from those used on lactating cows. In a hot, humid environment such as we have in Florida, soakers, fans, and shade are effective abatement strategies for heat stress; whereas misters may be effective in more arid locations. However, shade alone will not provide adequate cooling for cows during high heat and humidity. Sand bedded stalls may also provide additional relief via conductive heat transfer to the sand. Overcrowding will exacerbate heat stress so be sure that dry cows pens are not above 100 % stocking rate.

10) Where can I get more information?

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