University of California
Agriculture and Natural Resources

California Dairy Newsletter

Vol. 10, Issue 3 September 2018

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Long-term Impact of Heat Stress on Reproduction of Dairy Cows

Dr. Anna Denicol - UC Davis, Department of Animal Science

With high temperatures averaging 98-103°F during July (2018) across the Central Valley and other areas of California, the topic of heat stress (and all the problems it brings to dairy cows) is again at the center of every conversation. As temperatures go up, we watch reproductive efficiency of our herds go way down, with strategies for heat abatement only partially taking care of the problem.

Although the exact numbers are different in every dairy, studies looking at the effect of season on fertility found that compared to winter, there is about a 50% drop in fertility during summer and a slow recovery during the fall months until "normal" fertility returns the following winter. Infertility during heat stress is multifactorial and affects multiple parts of the reproductive tract and other body systems. Direct effects on reproduction include altered secretion of estradiol and progesterone and decreased quality of the pre-ovulatory follicle. However, these effects do not entirely explain why there is such a delay in the return of fertility. To better understand the long-term effects of heat stress on cow fertility, we designed a study to evaluate responses of the early stages of ovarian follicles to heat stress.

The ovary of a cow (and females in general) is full of tiny follicles called primordial follicles that can only be seen under a microscope. These follicles must grow into primary and secondary follicles before turning into antral follicles that respond to synchronization injections for ovulation and insemination. It takes around 90-100 days for a primordial follicle to grow to the antral stage, which means that when a cow is inseminated, the egg, that will hopefully generate a calf, began growing three months prior. We isolated primary and secondary follicles from cow ovaries and individually cultured them in the laboratory under two conditions: control (seven days at 101.3°F) or heat stress (101.3°F for 16h and 105.8°F for 8h, daily, for seven days). These temperatures and times were chosen to mimic what cows may experience during one week of high air temperatures. Exposure to heat stress decreased the proportion of viable follicles by 10%, and growth rate of heat-stressed follicles was 50% lower than control's growth rate; moreover, there were fewer follicles actively growing in the heat-stressed group after one week. Interestingly, primary (smaller) follicles seemed to be more resistant to heat stress compared to secondary (larger) follicles. Even more interesting, some follicles were able to remain viable and grow under heat stress very similarly to the ones cultured under normal temperature. At this point, we don't know whether these follicles would have the necessary quality to generate a pregnancy.

We concluded from this study that heat stress impairs early growth of ovarian follicles, which contributes to the delayed return to fertility. One of our current goals is to find strategies to protect early ovarian follicles from the effects of heat stress, so fertility can be recovered faster after the hot season ends. Another avenue, however, that will likely give us a more permanent solution, is to investigate what makes some follicles more resistant than others. We are investigating these "heat tolerant" follicles in search for cellular and genetic adaptations that allow for maintenance of growth and viability during heat stress.

The Easiest Way to Accurately Measure Forage Nutrient Yields

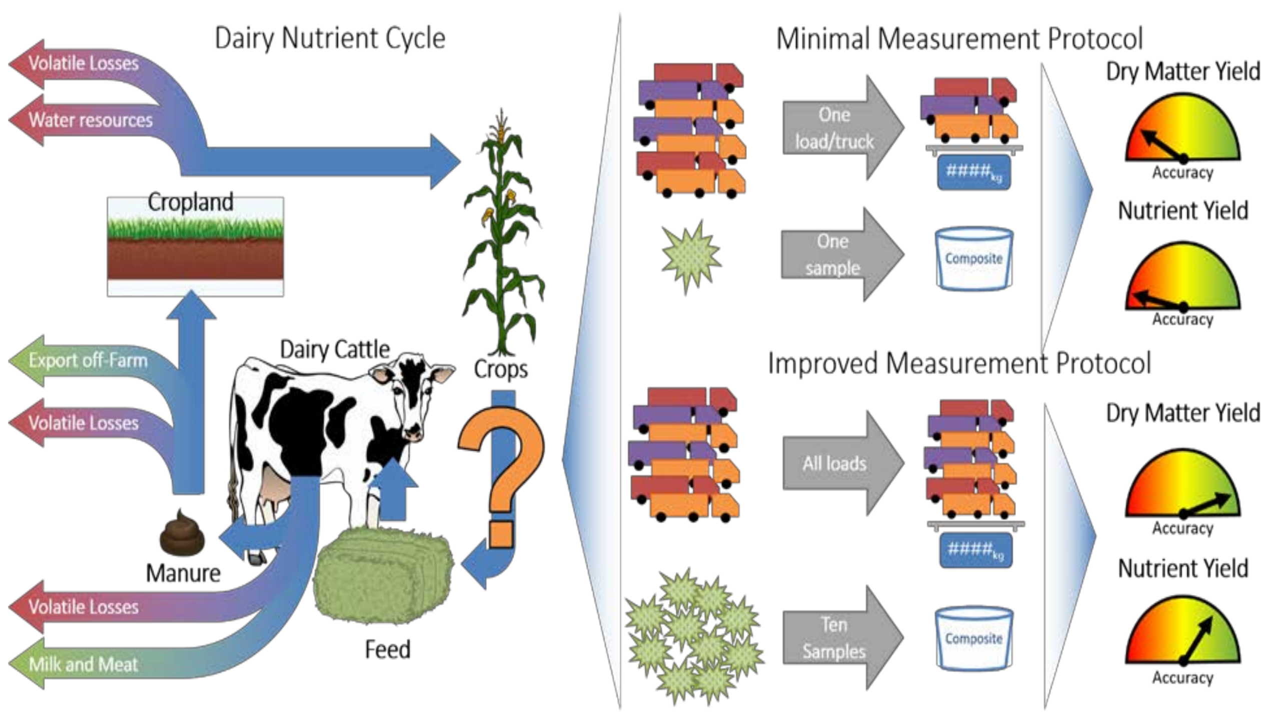
Christine Miller - UCD graduate student, and Deanne Meyer Ph.D. - UCCE Livestock Waste Management Specialist

Forage yields affect many aspects of the dairy, including harvesting costs, feed inventories, and ration formulation. For this reason, it is important to measure the weight, dry matter concentration, and nutrient concentrations of harvested forages accurately. Recent research on fields of forage corn, sorghum, and small grains identified the most efficient ways to accurately measure yields.

The research showed that accurately measuring the total weight of harvested forage should be the first priority. A common way of measuring the total weight of harvested forage is to weigh a few truckloads and multiply the average load weight by the total number of loads. On some study fields, the total harvest weight using this method was off by more than 30%. The total weight was especially off when transport trucks were not the same size or when the chopper had mechanical problems. Many farmers already weigh every load of forage to ensure an accurate measurement. Installing an on-farm scale is often a good investment, but if it is not an option, consider hiring a custom chopper with portable or on-board scales.

Creating a representative sample of forage for lab analysis is another high priority. The moisture and nutrient concentration of a single grab sample is sometimes off by more than 20%. Creating a composite of grab samples from different truckloads gives a more representative sample without increasing analysis costs. It is also important to collect grab samples throughout the harvest. Grab samples from back-to-back loads are less helpful because they tend to be from a similar part of the field. To get a better composite sample, combine ten or more grab-samples spread equally across the duration of harvest.

With the mentioned improvements, your yield measurements should be within 10% of the true yields. This additional accuracy will secure fair prices from custom harvesters, improve feed inventories, and simplify feed purchases.



California Sorghum Silage: Nutrient Composition and Fermentation Characteristics

Jennifer Heguy - Dairy Advisor, J.P. Martins - Dairy Advisor, and Deanne Meyer, Livestock Waste Management Specialist

Sorghum is a summer forage option when water is short. In our ongoing project to obtain information on sorghum as a forage, silages from the 2016 harvest were sampled at feedout. Piles and bags were sampled from the exposed face, avoiding the ends.

<u>Dairy profiles:</u>

- Dairy size ranged from 320 to 5,550 milking cows.
- Farmed sorghum ranged from 42 to 574 acres.
- Sorghum type was forage (11 structures) and grain (5 structures).
- Sorghum was stored in either one of 12 piles or 4 bags; piles and bags were stored on dirt (50%) or concrete/gravel (50%) surfaces.
- Inoculant use was reported in 4 structures.
- All dairies utilized custom harvester services.
- Days ensiled at sampling ranged from 99 to 439 (median = 225 days).

Nutrient composition of sorghum samples are in **Table 1**. Fermentation characteristics are in **Table 2**.

<u>Interpreting the numbers:</u>

- There were no differences in nutrient composition or fermentation characteristics between grain and BMR type sorghum. Combined information is presented.
- Presence of sugarcane aphid-infested material had no effect on nutrient composition or fermentation characteristics.
- In this data set, sorghum displayed lower levels of starch and Non-Fiber Carbohydrates (NFC) with higher fiber and ash content compared to typical California corn silages.

<u>The take-home:</u>

Sorghum quality was variable. Opportunities exist to improve California sorghum silage quality and management, as it may replace corn as an agronomic crop in years of water shortages.

Table 1. Nutrient composition of California sorghum silage (n=16)

		% of DM						
	DM	**CP**	**ADF**	**NDF**	**Starch**	**NFC**	**Ash**	**NDFD 30, %NDF**
Mean	27.9	9.7	34.0	48.7	8.0	26.3	13.2	30.1
Median	27.6	9.5	34.2	49.1	6.9	26.5	12.9	29.9
Minimum	22.4	5.9	29.7	44.7	0.3	19.1	10.3	26.9
Maximum	35.2	12.8	39.2	55.9	18.7	34.3	16.9	34.9
Stand. Dev.	3.5	1.7	2.2	3.2	5.4	4.8	2.1	2.4

Table 2. Fermentation characteristics of California sorghum silage (n=16)

	% of DM				
	Lactic Acid	**Acetic Acid**	**Propionic Acid**	**Butyric Acid**	**pH**
Mean	7.5	4.0	0.0	0.1	4.0
Median	7.6	4.1	0.0	0.0	4.0
Minimum	3.5	1.6	0.0	0.0	3.7
Maximum	9.8	6.6	0.3	1.3	4.3
Stand. Dev.	1.6	1.5	0.1	0.3	0.2

New Nutrient Management and Soil Quality Advisor – Stanislaus, San Joaquin, & Merced Counties

My name is Anthony Fulford, and I am the newly appointed Nutrient Management and Soil Quality Advisor serving Stanislaus, San Joaquin, and Merced Counties. I am a native of Illinois and received a B.S. in Forestry from Colorado State University, an M.S. in Soil Science from Southern Illinois University, and a Ph.D. in Soil Fertility from the University of Arkansas. It was during graduate school that I realized I wanted to understand how effective nutrient management could sustain and improve ecosystem services. I continued on with postgraduate research where I focused on soil health testing and nutrient management practices for corn, soybeans, and wheat in Ohio. Currently, I am developing an extension program and would like to hear your questions about soil health or nutrient management and what information would be most beneficial at the farm level. This input will be critical for building an extension program capable of delivering relevant and timely recommendations.

I am excited by the opportunity to work with California dairy farmers to advance nutrient management and soil health. While my general interest in nutrient management continues to expand, my postgraduate research focused on phosphorus and potassium fertilization of corn and soybean in Ohio. The objective of this research was to see if we could balance phosphorus and potassium fertilization with nutrient removal in corn and soybean grain to effectively maintain long-term (9 years) soil test phosphorus and potassium levels. The main result for this project was that we were unable to maintain initial soil test phosphorus and potassium levels using the estimated removal rates. In fact, our results highlighted an inability to adequately manage phosphorus and potassium fertilizer according to the "build-and-maintain" philosophy of nutrient management. These unexpected results are leading us to rethink our long-term nutrient management objectives and these changes will likely be reflected in revised fertilizer recommendations for Ohio.

In my new role with the University of California Cooperative Extension in Stanislaus County, I will again be evaluating nutrient use efficiency under best management practices. Using best nutrient management practices requires an understanding of the crop's nutrient requirement. However, as was apparent from my postgraduate research, knowledge of the nutrient supplying capacity of the soil is also necessary to determine the need for supplemental fertilization. Therefore, when incorporating best nutrient management practices, it is important to have accurate and reliable soil test information that can help you avoid costly over- or under-fertilization. Prior to joining UCCE, I worked closely with farmers, educators, and consultants to conduct on-farm nutrient management and soil health research and look forward to continuing this work here in California. Please contact me if you have any questions or suggestions for the content of my extension program.

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Buyer beware: Homework is Important When Reducing Methane Emissions

Deanne Meyer, Ph.D. - UCCE Livestock Waste Management Specialist

Soon the results of the second round of funding recipients for the Alternative Manure Management Program will be announced. These funds are managed through the California Department of Food and Agriculture (CDFA) from non-general fund sources. The recipients will implement practices on their dairies that result in long-term methane emission reductions and maximize environmental benefits. The intent of this program is to reduce the formation and release of methane to the atmosphere. The basic categories that will be funded in this round include solid separation (prevention of organic material from going into lagoons), conversion from flush to scrape, or improved pasture management. For the first two categories, additional management of the solids or slurry must also occur and includes one of the following: open or closed solar drying, forced evaporation with natural gas-fueled dryers, daily spread, solid storage or composting (in a vessel, aerated static pile, intensive or passive windrows). As applicants were preparing their packages, many questions occurred about products with claims that they were CDFA compliant. Note: CDFA does not approve a particular product or vendor. CDFA does identify categories of technologies or management practices that are eligible for funding. Simply stated, any claim to be CDFA compliant is merely the vendor's claim and not that of CDFA. You may check in on the process or sign-up for email notifications about the funding process at the CDFA website https://www.cdfa.ca.gov/oefi/AMMP/ . Contact CDFA if you are uncertain if a potential management practice may fit the next funding call.

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Survey of Antibiotic Drug Use in California Dairy Cows

The University of California's School of Veterinary Medicine and Division of Agriculture and Natural Resources are reaching out to California dairy owners and managers for their experiences with antibiotics for adult dairy cows. California dairies have received a mail survey which should take 20-30 minutes to complete.

The survey goals are to 1) further the understanding of the industry's needs and expectations for the availability and effectiveness of antibiotics for adult cows, and 2) guide future recommendations and best practices. It is important to complete and return the survey because antibiotics are valuable chemicals to the health and welfare of our dairy cattle and to public health. Each dairy's response is very important to the future use of antibiotics for dairy cows in California. Responses are confidential, anonymous, and protected.