Flipping over new cooling technology

It's not too late to make adjustments in your dairy operation to keep your animals cool and comfortable during hot summer months ahead.

By Ron Goble

Summer in the West can be brutal on milk cows, especially in Arizona where it's not unusual for daytime temperatures to be in triple digit range of 100-115 degrees Fahrenheit.

Research conducted by John Smith, S.D. Anderson, and Robert Collier, University of Arizona, Tucson, et al, showed the effects of adjustable and stationary fans coupled with misters on Core Body Temperature (CBT) and resting behavior of lactating dairy cows in a semi-arid climate.

Dairy producers in the Southwest take special pains to keep their cows cool when the mercury rises to summer-time levels. Cooling measures should kick-in when ambient temperatures at the dairy reach 68° F. The previous heat stress threshold was 72° F established in the 1940s and '50s, when cows produced a lot less milk than they do today. Smith related the progress is "like turning a Volkswagen into a Ferrari."

"Current research shows heat stress actually began to affect the animals at 68° F, much lower than we realized," said Smith, who presented the findings during a program earlier this year at World Ag Expo, in Tulare, Calif.

University of Arizona's John Smith presented results of a heat stress abatement study at the 2012 World Ag Expo in Tulare, Calif.

"We hypothesized that a vertical rotating cooling system is more capable of reducing heat stress compared to stationary fans by providing more uniform cooling," said Smith. "Our objective was to evaluate two cooling systems: a standard system and the FlipFan® Dairy Cooling System, which employs fans rotating around the horizontal axis to adjust for sun angle and wind speed."

This system, developed by Schaefer Ventilation Equipment, is a new technology which couples fans and misters with shade throughout the entire day by rotating along a horizontal axis to compensate for angle of sun and wind speed.

A previous version of this technology employed "shade tracking" fans and misters oscillating around a vertical axis (Shade Tracker; Advanced Dairy Systems LLC). This system was limited by the fact cows were only in the "arc" of the cooling rotation for only a portion of the time, Smith noted.

The updated technology enables cows to remain in the cooling zone as they follow shade movement, benefitting from fans and misters throughout the day, and minimizing heat stress and milk production depression.

The effects of heat stress on milk yield are both indirect, through a decrease in feed intake, as well as direct, through reduction in rate of milk synthesis, leading to a loss in milk production. Hot ambient conditions also have a negative impact on reproductive performance. Consequently, heat stress has a profound negative impact on dairy profitability, researchers agree.

“If we just look at the milk we lose during the period of heat stress ... in California we have about 150 days of lost production,” Smith said. “Ten pounds of milk per cow will amount to 1,500 pounds of milk, or $270 per cow, during the heat stress time period.”

Cows going through the transition period and early lactation during heat stress in June and July, “start losing peaks, but here’s the scary thing; many times our peaks don’t come back until winter ... and in California, that can be January,” Smith warned. “Go home and plot your peak milk production by month of calving. It might scare you. So, anything we can do to reduce the dip in milk production in the summer ... has a huge impact on milk production throughout the year.”

Smith also discussed the advantage of cross-ventilated freestall barns when cooling cows. Generating air flow through a tunnel ventilated barn is much less efficient in cooling cows than the cross-ventilated barn where air flow is optimum at about 7 mph through a baffled delivery system. Effective air flow was blocked by the cows themselves in a tunnel barn setup, as opposed to the cross-ventilation system which pulls the air through and among the cows, Smith explained.

Arizona heat stress study

A study was conducted on Grand View Dairy farm in Buckeye, Ariz., in August 2011. All cows were housed in dry lot corrals with adequate shade structure (4.2 m2/cow) orientated north-south. Shade structures were equipped with cooling systems comprised of fans and high-powered misters installed below the western edge of the shade structure and with one of the following design treatments: 1) stationary fans and misters that remained in a fixed position facing eastward (“control” group); or 2) the rotating FlipFan® Dairy Cooling System (“treatment” group). Fans for both groups were spaced at 100 inches (2.54 m) center-to-center and operated at 0.5 h.p. for 16.5 hours/day (8:30 a.m. to 1 a.m.) Cooling system operating times were set to maximize water availability.

Mister nozzles were the same for both systems and continuously sprayed water at 220 psi. All pens were also equipped with feedline soakers which were operated for 45 minutes after each milking. Cows in the control group were milked at 2 a.m., 10 a.m., and 6 p.m. Cows in the treatment group were milked at 3 a.m., 11 a.m., and 7 p.m. Fans and misters were used for cooling the holding pen in both treatment groups. All pens spent approximately 45 minutes in the parlor for each milking.

Sixty four (64) multiparous, lactating Holstein dairy cows [milk production = 66.5 lbs of milk/day (30.2 kg/day) and DIM = 123 days] were allotted to pens (8 cows/pen; 4 pens/treatment) containing either stationary fans and misters or the adjustable fans for the treatment group. Cows were equipped with an intravaginal HOBO U12 temperature data logger (Onset Computer Corp.) attached to a blank controlled internal drug-releasing device (CIDR; Pfizer Animal Health, New York, NY).

One hundred forty four (144) multiparous, lactating Holstein dairy cows (milk production = 67.1 lbs/day (30.5 kg/day) and DIM = 125 days) were also allotted to pens (18 cows/pen; 4 pens/treatment). Cows were equipped with one HOBO® Pendant G data logger (Onset Computer Corp.) attached to the inside of either the right or left hind leg.

Data collection

Ambient temperature and relative humidity were recorded continuously for the duration of the study by HOBO® U23 Pro v2 data loggers placed in solar radiation shields (Onset Computer Corp.) at two locations on the farm. Wind speed and direction was also recorded by a weather station located on site. It got a little over 100° F and relative humidity a little over 30% in the afternoons, Smith said.

Body condition scores (BCS) and locomotion scores were recorded for all cows. Due to the short duration of the trial, effect on milk production was not analyzed. Vaginal temperature (e.g. CBT) was obtained from intravaginal data loggers recording temperature continuously for six consecutive days. Resting behavior was obtained from the leg position data loggers recording continuously for five consecutive days. Data for both experiments were collected simultaneously.

What they learned

Average temperature-humidity index (THI) for the 6-day trial was 80.2 and ranged from 76.3 to 84.4. Under these conditions, cows were subjected to continuous heat stress.

Average 24-hour CBT was cooler ($P < 0.01$) for the treatment group compared to the control group (101.9°F vs. 102.3°F). Average hourly CBT was cooler ($P < 0.01$) for the treatment group at all times with the exceptions of 6 to 7 p.m. and midnight to 3 a.m. Average hourly CBT was cooler for the treatment group at all times except from midnight to 2 a.m. Average hourly CBT for both treatments was highest at 8 a.m., after which CBT began to drop dramatically. The CBT of cows in both groups decreased greatly once the cooling systems were turned on at 8:30 a.m.

Time durations where CBT remained at various temperature intervals also differed ($P < 0.03$) between groups. Cows in the treatment group remained below 101.5°F for more time than the control treatment (335.4 vs. 174.5 minutes). Conversely, control cows spent more time above 101.5°F (1265.5 vs. 1104.6 minutes). Cows in the treatment group lay down about 1 hour more each day than control cows ($P < 0.0001$); treatment group cows also had more lying bouts for each day (12.8 vs. 10.7).

A difference in CBT between groups was seen as a direct effect of adjustable fan technology, which was able to continuously cool animals under shade throughout the day. Previous versions of “shade tracking” technology oscillated, decreasing the amount of time cows were in the cooling zone.

It is expected that cows with lower CBT will spend more time lying down than cows with higher CBT. The greater number of lying bouts for cows in treatment group is indicative of their lower overall CBT compared to the control cows. Cows will change their position to benefit from the shade and cooling capabilities of the fans and misters.

On the other hand, control cows are forced to choose between shade and the cooling system and will likely remain in one location for a longer duration of time, resulting in fewer changes in posture (e.g. standing or lying) throughout the day. The higher number of lying bouts of the treatment cows may also explain increased lying time.

Although milk production was not analyzed, previous research suggests that the lower CBT and increased resting time of the treatment group should result in an increase in milk production. Current results justify further long-term studies to quantify this possible benefit.

Bottom line results

The adjustable fans were more effective at lowering CBT, increasing resting time, and minimizing heat stress of lactating dairy cows in a semi-arid climate compared to standard non-adjustable cooling systems. In order to achieve the greatest benefit from this system, it is recommended that it be operated continuously during periods of heat stress. This assumes that an adequate source of water is available, Smith said.

FYI

- ***For more information*** on cow cooling, contact **Dr. John F. Smith** at **jfsmith@email.arizona.edu**.