ENVIRONMENTAL MODIFICATION UPDATE

by

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The most economical method to cool dairy cattle even in Florida's humid climate is evaporative cooling. Evaporative cooling works by using energy from the air to evaporate water. This lowers the temperature of the air and raises the relative humidity. While evaporative cooling works the best in areas of low humidity. In Florida, humidity levels are low enough to allow cooling to occur when the air temperatures are the highest.

Types of Evaporative Cooling Systems

1. Fogs - Very small particle size. Fog particles stay suspended in the air and evaporate before they reach the ground.

2. Mist - Larger particle size than fog. Mist droplets will drop slowly to the floor.

   Fog and mist systems spray small water droplets into the air and cools the air as the droplets evaporate. The cow inhales the cool air and it can exchange heat with the air and remove heat from the body. There are several disadvantages to fogs and mists. First they can be easily blown away under windy conditions and most certainly are blown away when used with fans. If the mist or fog builds up on the cows hair coat, it can trap a layer of air between the skin and the water which can build up heat. Respiratory problems can also arise from these fog and mist systems if proper ventilation is not provided.

3. Fan and Sprinklers or Showers - This method does not rely on cooling the air, but uses a large water droplet size to wet the hair coat and skin of the cow and then water evaporates from the hair and skin which allows the cow to loose heat more effectively through its skin.

   Air movement or the use of fans makes this system the most efficient. Usually the water is put down in a short time period 1-2 minutes (about 0.05" of water) while the fans are running, then the fans are evaporating the water from the cows for the rest of the 15 minute cycle. This water fan sequence runs continually until the ambient temperature goes below 78°F.

Fans & Sprinklers vs. Fans and Misters

Many dairymen have tried using fans and misters instead of fans and sprinklers. For the last two years we have compared the cooling effects of these two methods at a feed barn at Levy County Dairy. In the 1988 study (Table 1), the cows receiving fan and sprinkling method had lower respiration rates and rectal temperatures than cows receiving the fans and misting treatment.

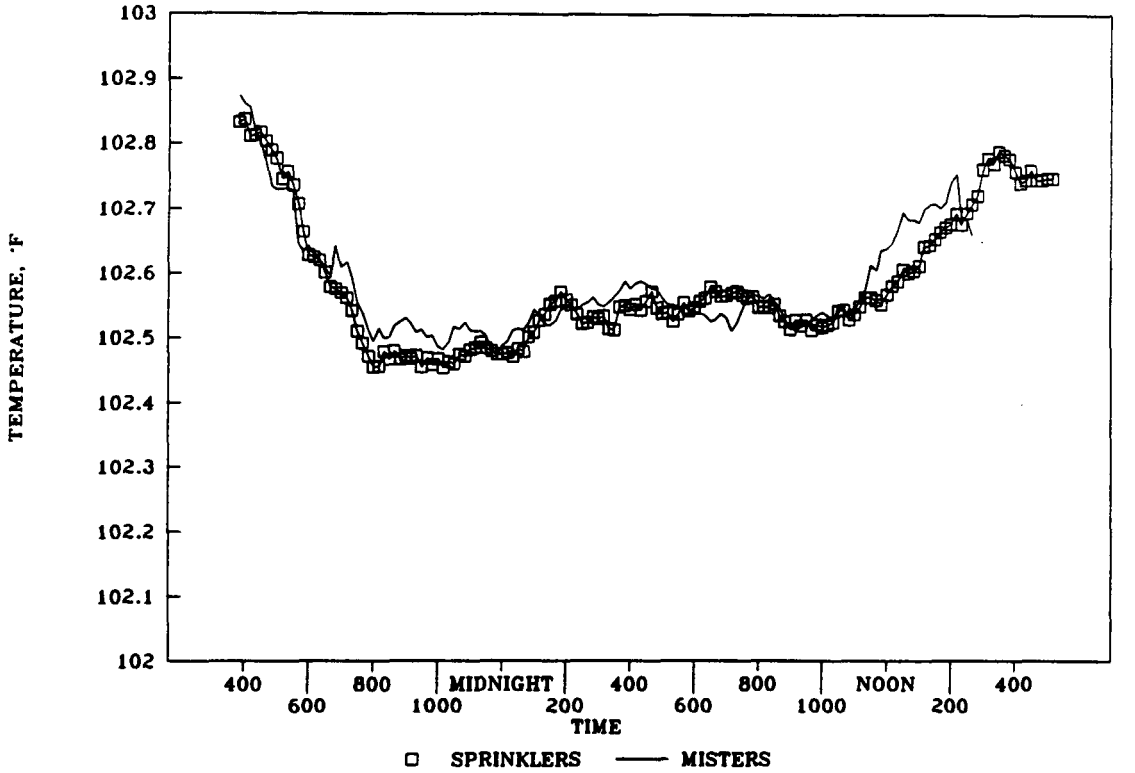
Table 1. Physiological Measurements (1988).

Measurements	Misting	Sprinkling
# of cows	211	203
Respiration rates	87	72
Rectal temperatures	103.18	102.34

In 1989, the same experiment was repeated on the same dairy. In this trial the cows temperatures were monitored every ten minutes by a transmitter inserted into the vagina of the cow. The transmitter was mounted upon a blank or non- hormone producing controlled internal drug release device (C.I.D.R.*). The transmitter sent a signal to a radiotelementry system which recorded the temperatures. This system allows us to monitor body temperature without disrupting the cows normal movement thus no additional stress is forced upon the cows by restraining them to take temperatures.

In this study the cows receiving the sprinklers had lower temperatures than did the cows with the misters (Figure 1).

Figure 1. Vaginal Temperatures - Sprinklers vs. Misters



*The Carter Holt Company of New Zealand and American Cyanamid Company

Painted vs. Unpainted Shade Cloth

The effect of providing shade has been well documented and is becoming standard practice in Florida. The question always arises,what is the best shade? The recommendation of white metal roof is still probably the best recommendation.

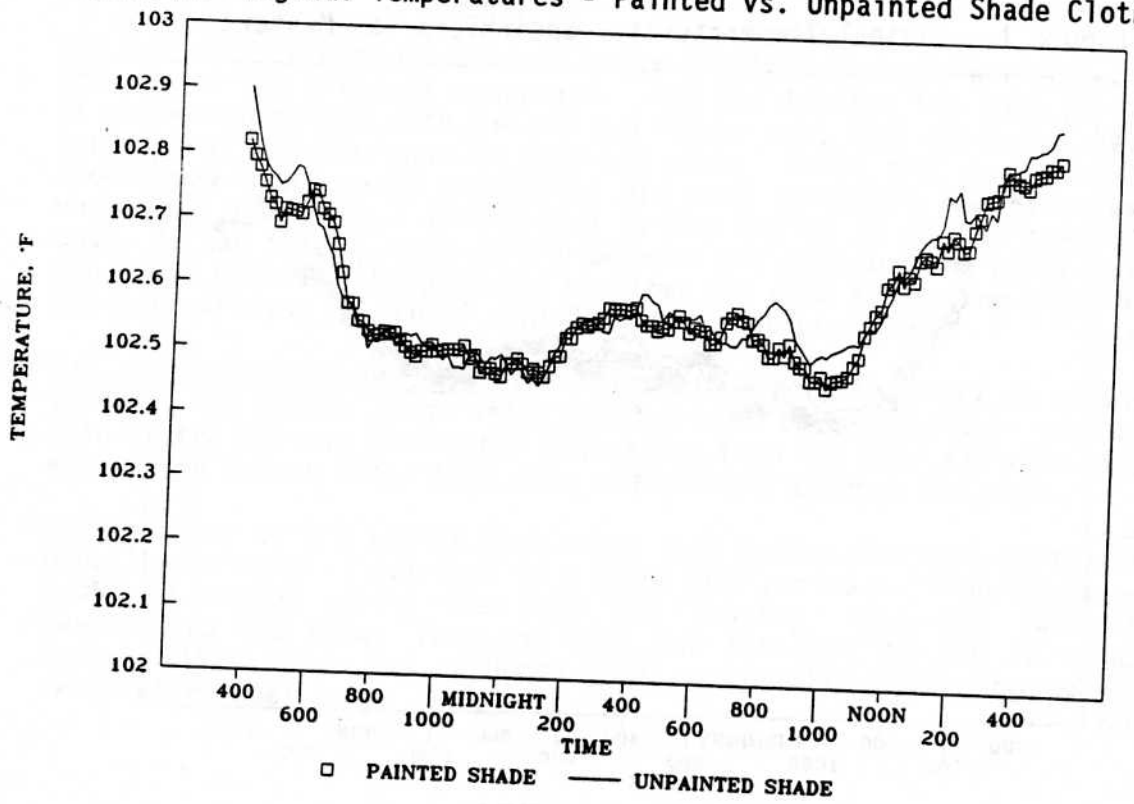
Shade cloth has been used for many years because it is less expensive than permanent structures. In 1989, we compared 80% shade cloth with a metal shade structure and the same shade cloth painted with a radiant barrier coating*. The results of the black globe temperatures at 5′ from the floor demonstrate that the shade barn and the painted shade cloth were about equal.

Table 2. Black Globe Temperature

Treatment	Black Globe Temperature
Outside in sun	117.8
Metal shade barn	85.2
Unpainted shade cloth	86.2
Painted shade cloth	85.4

We also used the vaginal transmitters to record temperature through out the period. While the cows body temperatures were quite similar during the daylight hours, the cows under painted shade cloth were at times cooler.

Figure 2. Vaginal Temperatures - Painted vs. Unpainted Shade Cloth



*Lo/MIT, SOLEC, 29 Waters Avenue, Trenton, N.J.

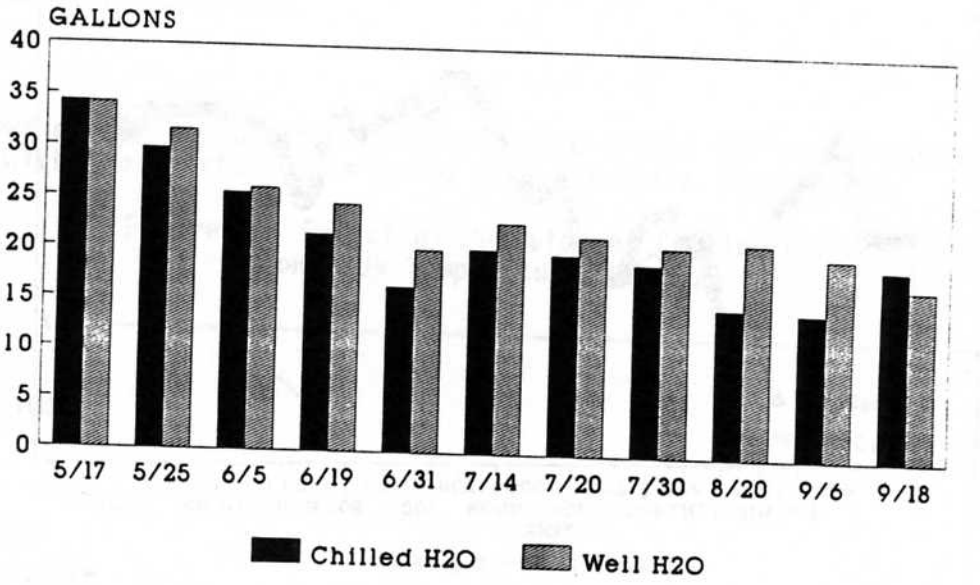
Chilled Water Experiment

Recent work in Texas has indicated that there may be some effect of cows drinking chilled drinking water on reducing heat stress and increasing milk production. A 300 cow trial was completed, 150 control cows and 150 cows receiving the chilled water. This trial lasted from May through September, 1989; the treatments were switched each month. The Paul Mueller Company provided and installed the refrigeration equipment and North Florida Holsteins provided the electricity, cows and water tanks.

North Florida Holsteins uses a dry lot system, with fence line feeding and permanent shade structures located about 50 yards from the feed line. There were four water tanks in each lot, two located near the feed line, and two near the shade structures.

The cows with access to well water drank on the average a little more water per day than with chilled water. The big observation made was as the ambient temperature got warmer during the year the amount of water consumed per day dropped (Figure 3).

Figure 3. Water Consumption, Per Cow Per Day



This was probably due to the fact that the cows had to leave the shade to drink. When it got hot during the day, they did not leave the shade structures, except to take a swim in the cooling ponds. We observed very little drinking of the pond water. The pond water temperature was close to 90° during the summer.

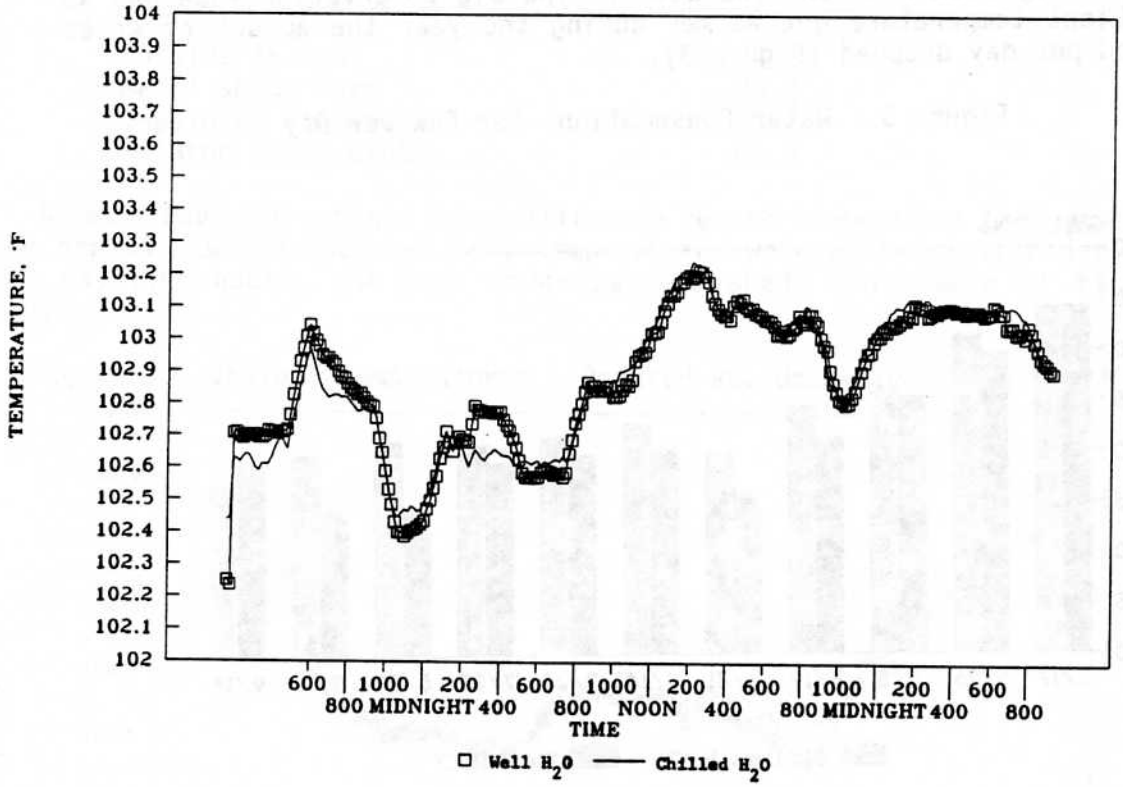
There was no difference in milk production between the chilled water and well water treatments (Table 3).

Table 3. Cooled Drinking Water Experiment

Response	Well Water (75 - 80°F)	Cooled Water (57 - 61°F)
MY, lbs/d	61.4	61.7 (NS)
Fat, %	3.44	3.35
Protein, %	3.21	3.24
3.5% FCMY, lbs/d	61.8	61.1 (NS)

These cows were monitored with the vaginally mounted transmitters. There was no difference in body temperature between the two groups (Figure 4).

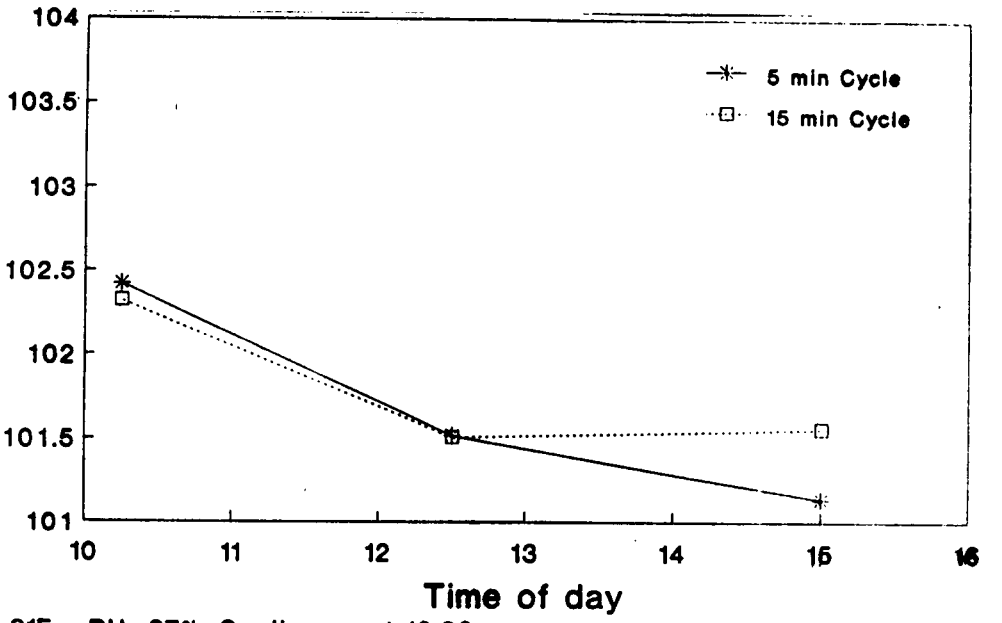
Figure 4. Vaginal Temperatures - Chilled Water vs. Well Water Cows



The Effect of Length of Sprinkling Cycle

Our present system of fans and sprinklers is based on a 15 minute cycle. Water on for 1-3 minutes, in some cases, the cows may escape the sprinkler cycle and it could be possible that they may not get wet for a long period of time. Day one of the experiment, the cows with the five minute cycle were more effectively cooled than the cows with the 15 minute cycle. (Figure 5).

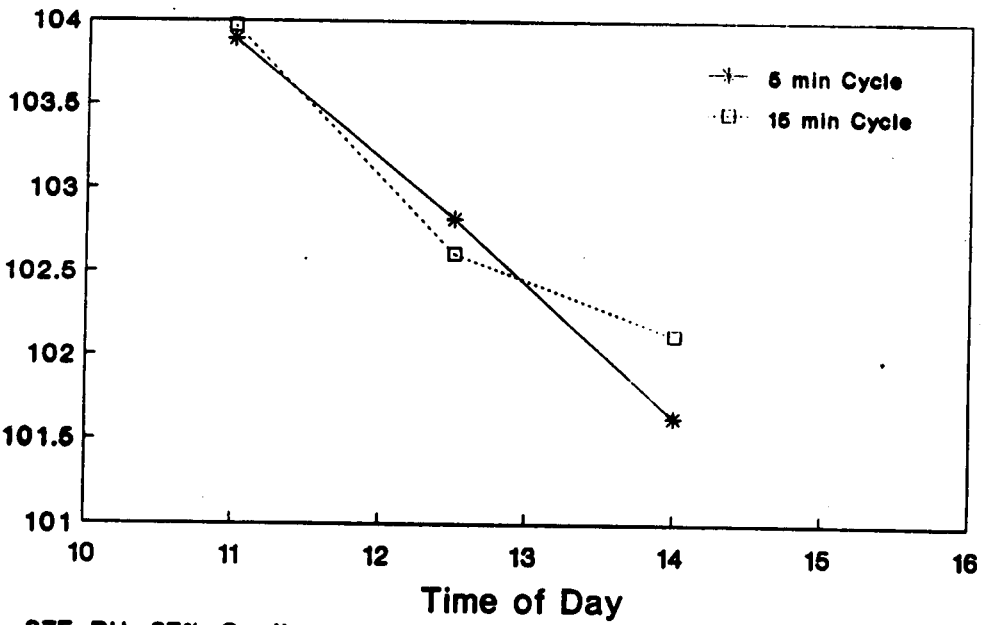
Figure 5. Effect of Duration of Cooling Cycles on Body Temperatures (Day 1)



91F , RH= 67%, Cooling on at 10:30
Treatment*time - P<0.05

Cows on day two of the experiment also showed the same results as day one, with the shorter cycle being more effective (Figure 6).

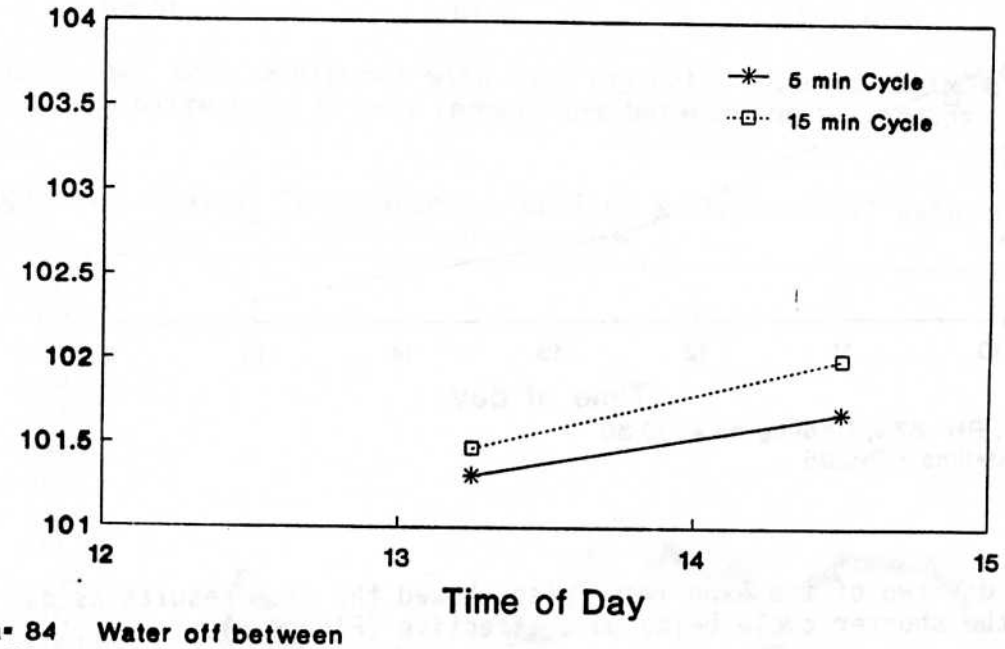
Figure 6. Effect of Duration of Cooling Cycles on Body Temperatures (Day 2)



87F, RH= 67%, Cooling on at 11:15
Treatment*time - P<0.07

During this trial we showered the cows and then turned off the sprinklers, leaving the fans on, and observed rectal temperatures. There was no difference between the two groups but it does point out that on a 84°F day, with no water, the cows do not heat up greatly and the cycles could be lengthened and be effective. Because of problems with adjusting timers on the 15 minute cycles, this trial will be repeated this year (Figure 7).

Figure 7. Body Temperature Rise Without Sprinkling



Ta= 84 Water off between
13:30 to 14:30; Treatment*Time - N.S.

Effect of Barn Height on Barn Ambient Temperature

This study was done by Russ Giesy, IFAS Dairy Specialist in West Central Florida. This study answers one big question that is asked by dairymen. How high should I build a barn? The low barns in this study were 10 feet in height or less at the eaves. High barns were about 12 feet in height at the eaves. The range in this study was 8 feet to 20 feet in height. The temperature measurements were made with thermograph machines from the IFAS weather station.

The high barns provide lower inside ambient temperatures than low barns. Low barns with fans only achieved temperatures that high barns did without fans (Table 4). If one is to build shade barns, it is important to make them at least 12 feet high at the eaves. The extra cost will easily pay back the cost with free natural ventilation. In Florida, all barns will need fans and sprinklers to effectively cool the cows. Low barns will never achieve the cooling capacity even with fans and sprinklers that high barns will.

Table 4. Effect of Barn Height and Barn Ambient Temperature

	Number of Observations	Temperature from 10 am - 6 pm Mean	Minimum	Maximum
Outside	5	104.3	98.1	110.0
Trees	1	89.5	89.5	89.5
Shade cloth	3	92.6	91.2	93.6
Lobarn, NF	1	96.2	96.2	96.2
Lobarns, Fans	3	91.3	90.1	92.0
Hibarns, NF	3	91.6	90.4	92.8
Hibarns, Fans	2	89.3	88.6	90.0
All Barns	9	91.5	88.6	96.2
Barns, NF	4	92.8	90.4	96.2
Barns, Fans	5	90.5	88.6	92.0
Lobarns	4	92.5	90.1	96.2
Hibarns	5	90.7	88.6	92.8

Effect of Application Rate of Water on Body Temperature and Milk Production

This study was conducted by Ms. Sandy Means, a Ag. Engineering graduate student at the Dairy Research Unit. This was a summer long experiment that varied water rates applied to sprinkle the cows. The measurements taken were respiration rates, vaginal temperature, milk yield, feed intake, environmental temperatures and climatic data.

The data from this experiment is still being analyzed but the preliminary results indicate that the more water that is applied, the cooler the cows are more feed they consume and the more milk is produced (Table 5).

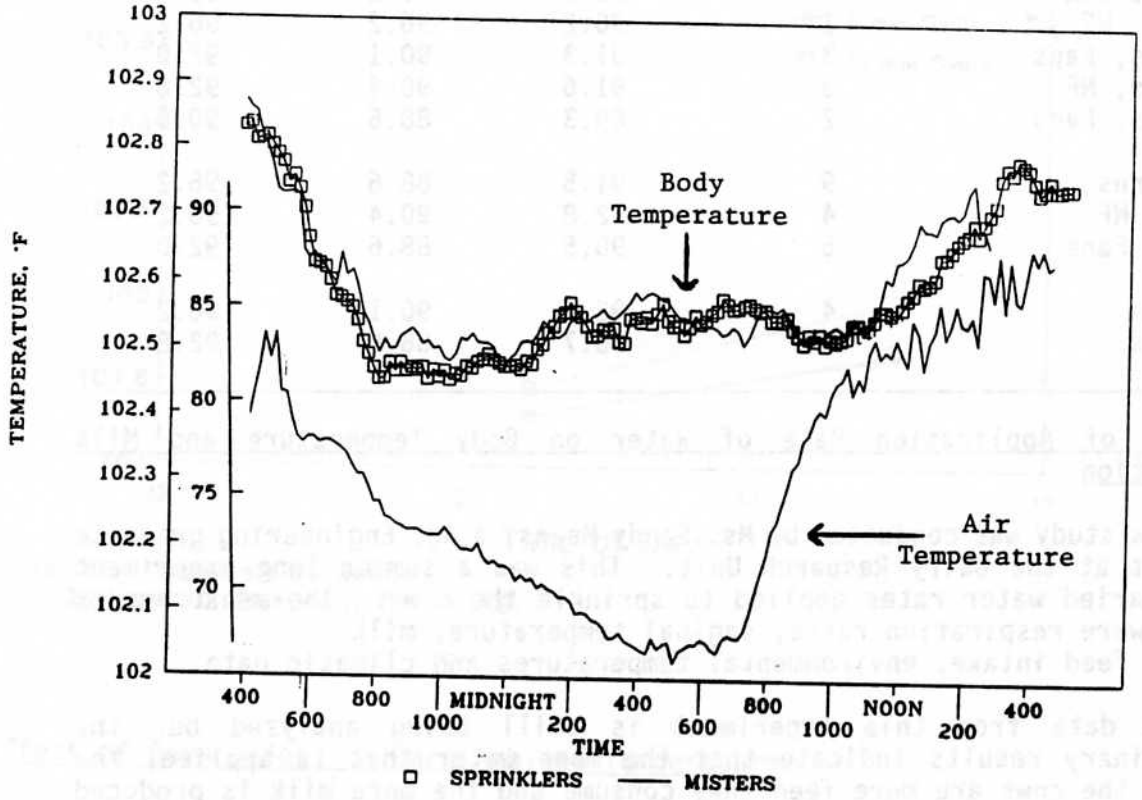
Table 5. Effect of Water Application Rates on Body Temperature and Milk Production

Water Rates G.P.M.	Body Temperature	Milk Production
1.38	Decrease	Increase
2.17	↓	↓
3.1		

What's Planned for the Future

1. Determine effect of cooling cows at night with fans and sprinklers. Our research has shown that we can cool cows to achieve high production during the summer months but reproductive efficiency has not improved. This is due to the fact that the cows do not cool off at night when they go outside. This is probably due to the very high humidity at night which makes evaporative cooling impossible (Figure 8).

Figure 8. Body Temperature vs. Air Temperature



2. Repeat the chilled water experiment on a dairy that feed and water are provided under shade.

3. Repeat the experiment using varied sprinkler cycle length.

4. The effect of high speed fans and longer cooling cycles on body temperature.

5. Determine the amount of run off water that can be recovered from sprinklers cooling system and determine if this water can be economically recycled for flushing floors.

6. Use reflective roof coating on calf hutches to determine if they will lower calves body temperature.

Summary

1. Fans and sprinklers are more effective than fans and misters.
2. Painting of shade cloth had little effect on body temperature.
3. Chilled water had no effect on milk production and body temperatures under dry lot conditions.
4. Shorter length of sprinkler cycle may be more effective depending on barn conditions.
5. Barn height is very important in providing natural cooling.
6. As rate of application of water is decreased, milk production decreases and body temperature increases.