Cow Comfort and New Barns: The Latest in Florida

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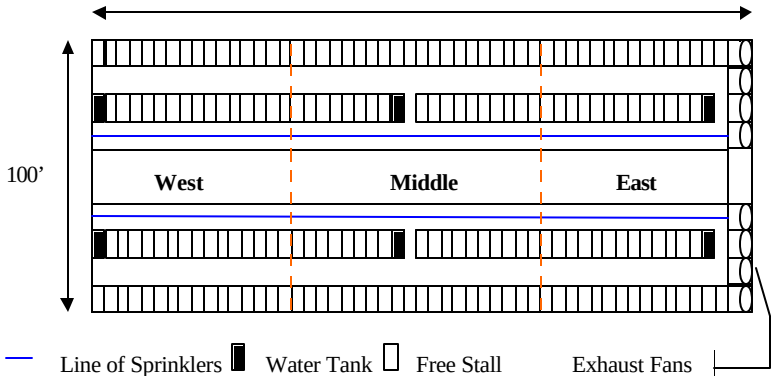
The words "cow comfort" have become a well-used term lately. It can refer to many things. In the Southeastern U.S. it must include eliminating the effects of environmental stresses on the dairy cow in the summer. These stresses include reduced dry matter intake, increased clinical mastitis and somatic cell count (SCC), reduced reproductive performance, feet problems caused by wet and muddy conditions, and lower milk production due to smaller calf sizes at birth. All of this is due to high temperatures and high humidity and high rainfall. This paper will deal with new facilities in Florida that try to relieve environmental stresses on dairy cattle.

2001 Study. A study was done at North Florida Holsteins dairy farm where we compared the internal temperature of tunnel-ventilated barns to the internal temperatures of open-sided free stall barns. The tunnel ventilated barn was 400'x100'x14'.8" at the eaves. The underside of the metal roof was sprayed with foam insulation. The barn had canvas curtains on the sidewalls and had an open front. It was a 4-row tail-to-tail free stall barn with a drive-through feed alley. Sprinklers mounted above the feed bunk line provided evaporative cooling. Ventilation was provided by 30 belt driven exhaust fans (48" in diameter with (1 hp) motors (ACME Fan Co., Model # DDP-48). The fans were activated when the temperature exceeded 72ºF. At 75ºF, all fans were activated. The sprinklers were also activated at 72ºF and ran 1.5 minutes every 5 minutes.

Environmental conditions were read hourly by three data loggers (HOBO H8 Pro RH/Temp, mark ONSET®) located next to the exhaust fans (east), in the center of the freestalls and at the end opposite the exhaust fans (west) as shown in Figure 1. Ambient dry bulb temperature and relative humidity were recorded

Figure 1.



and Equation 1 was used to calculate THI as a comfort index.

Environmental conditions observed in the tunnel-ventilated barn were compared to conditions in another freestall barn 500 feet away. Dimensions of both barns were the same. The second barn was open sided with a roof ridge vent 3' wide. Roof slope was 3:12 (33%), the same as the first barn, but the metal roof was not insulated. The second did not have exhaust fans. Instead, it was ventilated with three 23' diameter ten blade-ceiling fans driven by 0.56kw (0.75 hp) motors (HVLS Fan Company Lexington, K.Y.). The fans were mounted in the middle of the barn over the feed alley (Figures 2 and 3).

Figure 2.

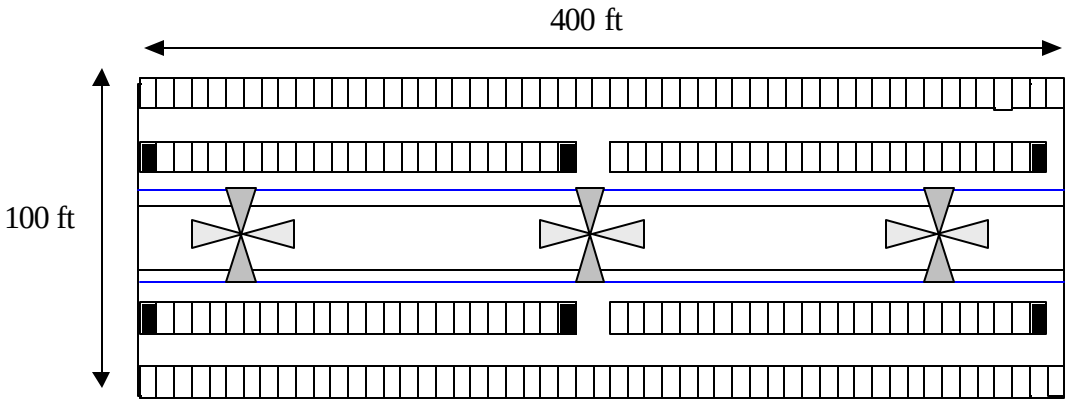
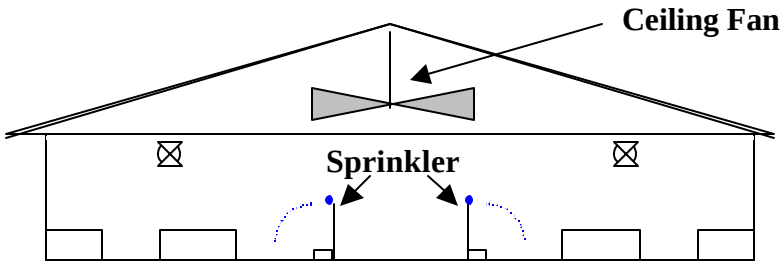


Figure 3.

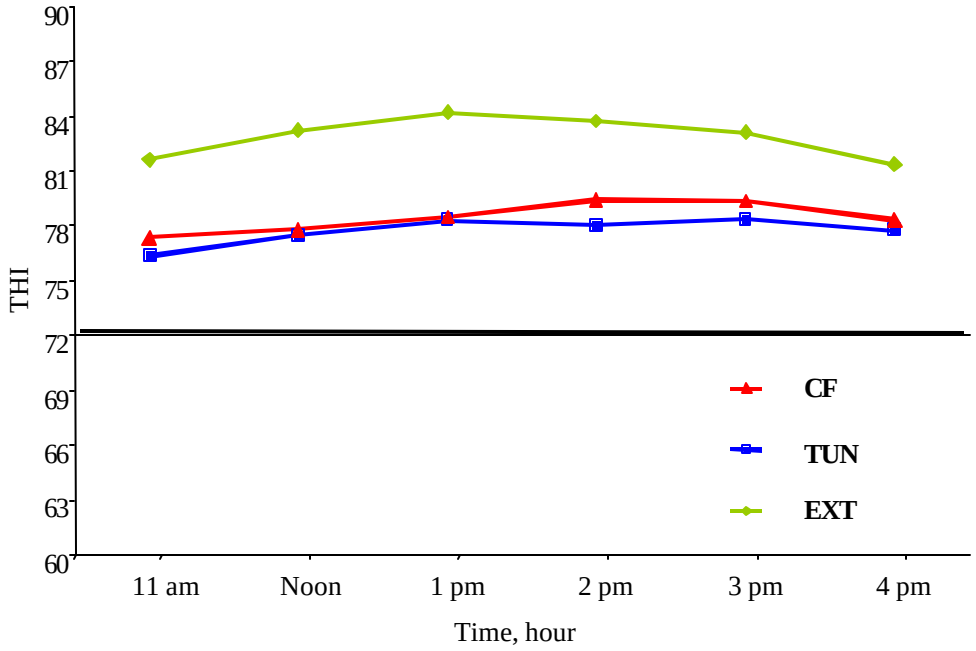


In addition to the ceiling fans, forty 36" diameter (0.5 hp) fans were located over the top of the free stalls (Figure 3). These fans were located 15' apart. The sprinklers were identical to those in the tunnel barn using the same timing and temperature set points.

Temperature and relative humidity were measured manually each hour from 11 am to 4 pm. Data were collected at three locations inside the barns and the average of the three values was used with Equation 1 to calculate THI values. SAS (SAS Institute Inc.) was used to analyze results using a randomized block design and Turkey's Test at 5% probability.

As shown in figure 4, environmental conditions in both the barn equipped with tunnel ventilation (TUN) and in the barn equipped with ceiling fans (CF) were more comfortable for cows than conditions observed outside.

Figure 4.



Environmental conditions inside the two barns were not statistically different. THI values above 72 are considered to produce heat stress for producing cows. The average THI value was 83 for the external environment and 78 for the two barns.

One of the questions often asked of tunnel ventilated barns is, "What is the change in temperature and humidity inside the barn?" because the air will pick up heat and humidity from the cows as the air moves through the barn. This barn is not a sealed tunnel cooled barn, i.e. cool cells, which elaborately cool the air as air is drawn through them into the barn. This does not seem to be a problem because the front of the barn is open and the fans only act to evaporate the water from the cows to cool them.

Temperatures and relative humidity % were recorded every 15 minutes by the HOBO System (Figures 5 and 6). In this tunnel barn the east end was the location of the fans and the west end was open.

Figure 5.

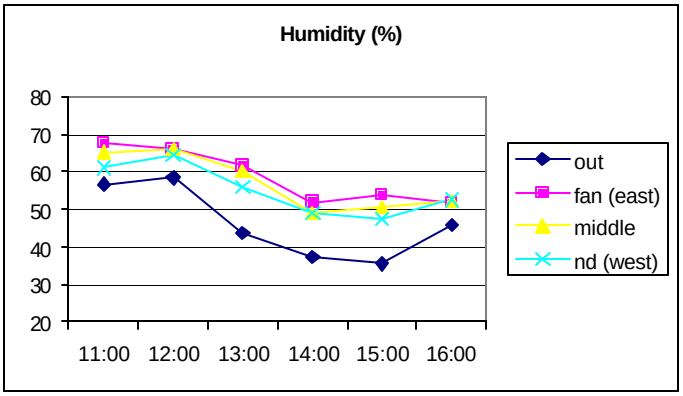
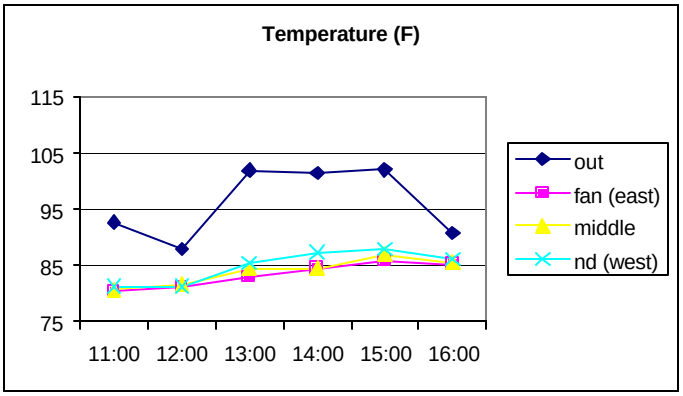


Figure 6.



Cows were monitored for location and time for their activity during the warm part of the day. In figure 5, the barn got slightly warmer until 3:00 pm (15:00 hrs) and the west end was the warmest because it was receiving the afternoon sun (Table 1).

Table 1: Temperature (°F) by Time and Location

	11:00	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**
Out	92.7	87.8	101.9	101.5	102	90.7
Fan (east)	80.5	81.3	83.1	84.6	85.9	85.2
Middle	80.7	81.7	84.3	84.6	87.1	85.6
Nd (west)	81.4	81.4	85.5	87.4	88	86.3

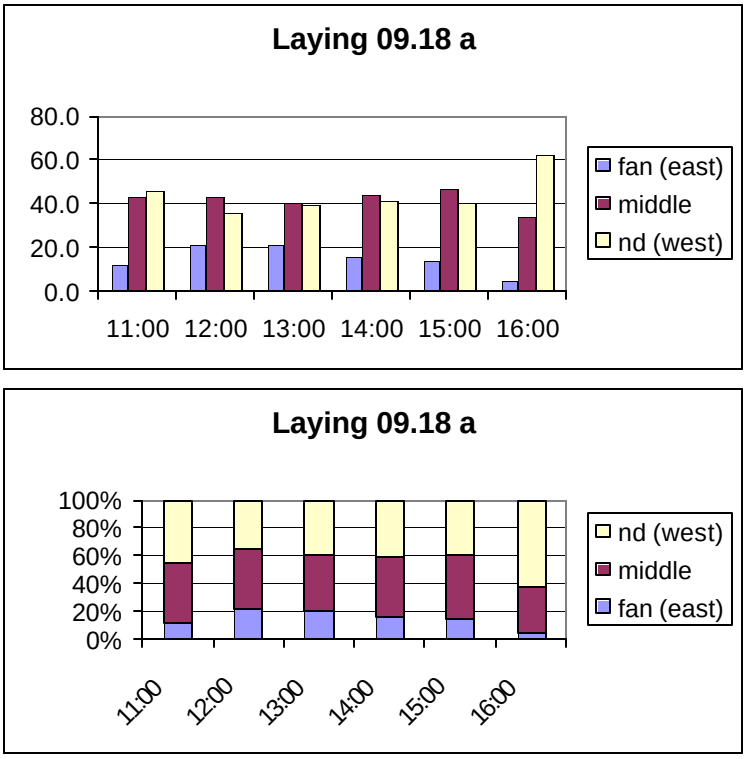
The humidity increased in the barn from west to east as the fans moved the cows' moisture and the sprinkler moisture towards the fans in the east end of the barn (Table 2).

Table 2: Humidity (%) by Time and Location

	11:00	12:00	13:00	14:00	15:00	16:00
Out	56.7	58.3	43.7	37.4	35.5	45.7
Fan (east)	67.5	66.1	61.6	51.8	54	51.7
Middle	65.1	66	60	49.2	50.5	52.2
Nd (west)	61.1	64.4	55.9	49	47.3	52.5

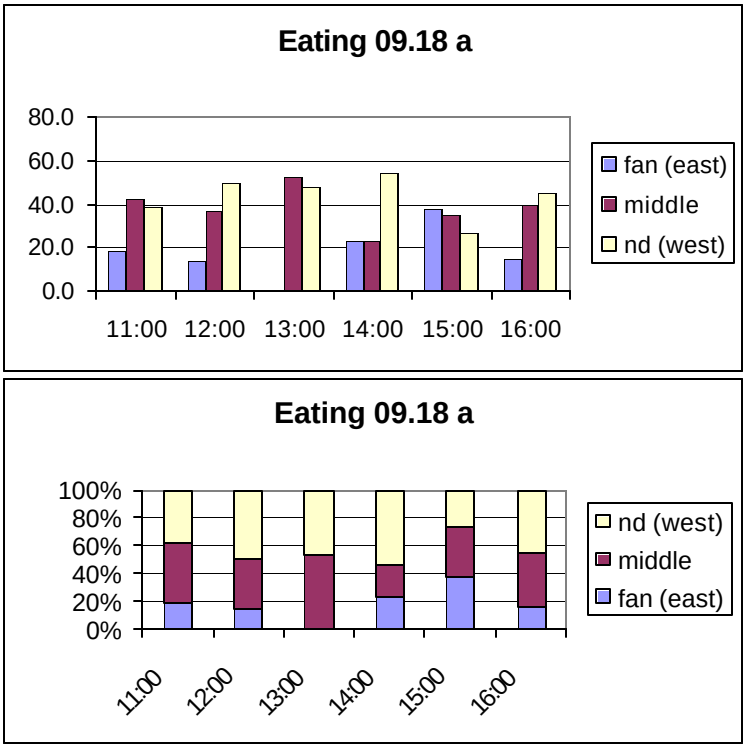
In figure 7 the proportion of cows lying down by location in the barn is plotted.

Figure 7.



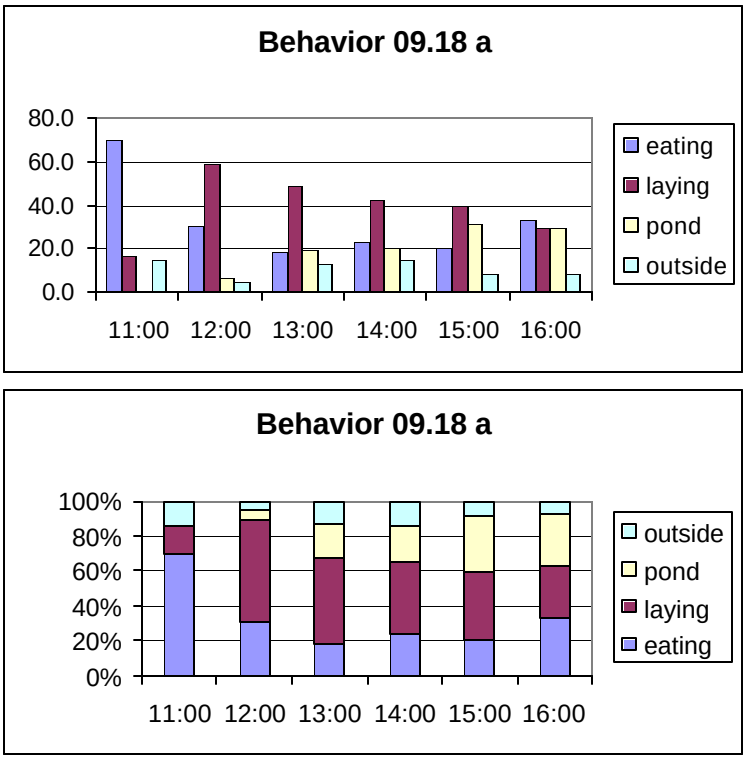
The proportion of cows eating during the day by location and time is shown in figure 8.

Figure 8.



The proportion of cows eating, laying down, in the cooling pond, or being outside is shown in Figure 9.

Figure 9.



In summary, cows behavior varies by time and location. There is much that can be done to remove dead spots in a tunnel barn such as adding fans, and opening the bottom of curtains. These modifications will vary from barn to barn.

2001 Air-conditioned Transition barn at Wisteria Dairy

Environmental conditions in this barn were compared to an adjacent open feed barn with sprinklers but no fans; there was a sea breeze instead.

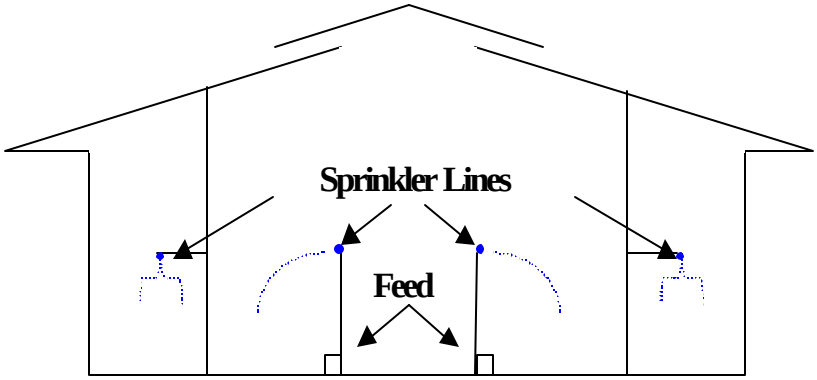
The reason for the transition barn was to try to reduce the environmental stresses associated with the precalving, calving and post calving period. In Florida most calvings take place outside, hopefully on green grass, Single cows seem to prefer to calve in isolation. They usually seek a muddy place out in the sun or by a fence. These conditions can often lead to overheating of the cow, leading to diseases for both the cow and the calf.

Research has shown that heat stress can reduce calf birth weight and thus reduce milk production in the following lactation (Coller et al., 1982; Moore et al., 1992).

The transition barn was 330' x 82' and 14.7' at the eaves. The wall insulation was R-16, sand floor in a loose housing configuration. There were five-25 ton air conditioning units (A.C.), which were activated at 70ºF. Electric bills ran $550.00/ month.

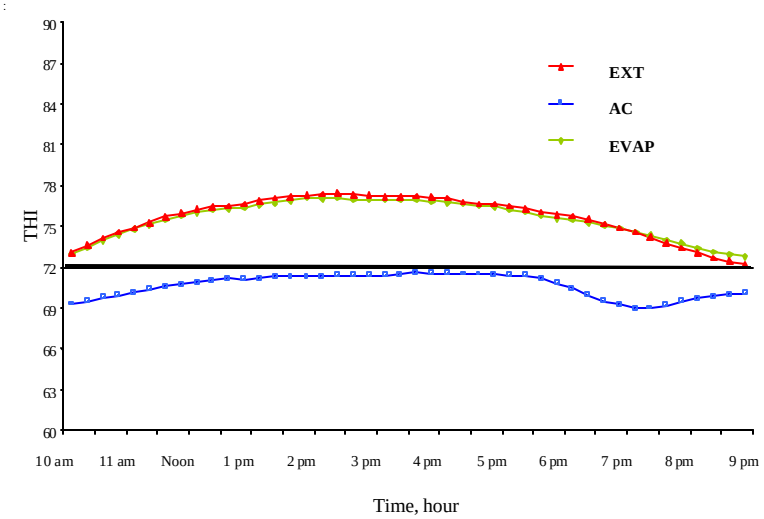
The feed barn was open sided being 165 'x 65' x 14' at the eaves. The roof was galvanized steel with a 2:12 slope. The barn had a drive through feed alley. Sprinklers were mounted at the feed bunk line and on the side of the barn. They were running continually above 75ºF (Figure 10).

Figure 10.



The THI Readings are in figure 11. The AC Barn never exceeded the 72 THI above which cows are considered to be heat-stressed. In theory the animals in this barn should perform as cows in cool weather. No cows died during calving. The cows' milk production was higher than the year before.

Figure 11.



As with the tunnel barns, new innovations have a learning curve. This barn did also. Ammonia gas was an aesthetic problem, not a health problem. Sizing of A.C. units to cow density could have been better, but in my opinion this barn was a success and I would build it if I had a dairy operation in Florida.

Conclusions

My belief is that if the main stream Florida dairy industry is to survive in the future we must be able to calve cows year around, keep dry matter intake in the summer at the same level as the winter, and reduce mastitis by keeping cows clean, dry and comfortable. We must also protect our dry and fresh cows from the ills of environmental stresses by some method and transition barns will be helpful to do that.

References

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Moore, R.B., J.W. Fuquay, and W.J. Drapala. 1992. Effects of late gestation heat stress on postpartum milk production and reproduction in dairy cattle. J. Dairy Sce. 75:1877-1882.