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Dairy Focus at Illinois Newsletter

Summer is around the corner— make sure your cows don't get stressed

The principal functions of ventilation systems are to remove stale, moist air and bring in clean and fresh air. An adequate ventilation system needs a pressure differential to move air and must have controlled inlets and outlets for direct movement. It also has to turn over the air within the building at recommended rates.

Why do we care about ventilation? Cows have higher exposure to stress and disease when they do not have adequate ventilation systems (**Table 1**). Having inadequate ventilation systems that allow high humidity levels and high ammonia concentrations will reduce barn lifespan.

There are three different ventilation methods: natural, mechanical, and hybrid systems. In natural systems, inlets control air speed and direction and outlets provide draw for the inlets. Mechanical ventilation systems can work either with positive pressure (air is pushed into the building) or with negative pressure (air is pulled out of the building). Hybrid systems combine natural and mechanical systems.

Table 1. Function of ventilation systems and consequences of having an inadequate ventilation system.

Ventilation affects:	Inadequate ventilation results in:
Air temperature and moisture levels	Increased air temperature and humidity
Moisture condensation on surfaces	Increased condensation (e.g. water stains or mildew on walls and/or ceilings)
Air speed across animals	Increased ammonia concentrations
Odor and gas concentrations	Increased odors and dust in air
Airborne dust and disease organism levels	Increased disease organism loads

Cows are constantly producing heat and moisture. Holstein cows can maintain their productivity levels at a temperature range between 20˚F and 76˚F, if relative humidity is not too high. During summer, barn and ambient temperature should equal. Cows can better tolerate temperatures below this optimum range than above; for example, cows can withstand temperatures below 20˚F if they are kept dry and out of the wind. Cows are likely to suffer heat stress when their body temperature is above 101.5˚F (normal body temperature) and when their breathing rate is above the normal 50 breaths per minute. Cows suffering heat stress will have reduced feed intake and lower milk yield, and will also be at increased risk of laminitis due to their altered eating patterns, decrease in rumination, and longer

standing times.

The temperature–humidity index (THI) is a measure that combines the effects of temperature and relative humidity (RH) into a relative measure of heat and allows comparison of different temperature and humidity combinations. It has been estimated that each increment of THI above 72 could lead to a decrease in dry matter intake of 0.5 pounds per day, and to a 0.9 pound drop in daily milk yield (**Table 2**). Temperature-humidity index can be calculated as follows:

$$THI = Temp - [0.55-(0.55 \times Relative\ Humidity / 100)] \times (Temperature - 58)$$

Table 2. How cows can be affected by elevated temperature-humidity index.

THI	Consequences
< 72	No heat stress
72 – 79	Cows are looking for shade and standing for longer times, trying to decrease heat exposure and increase heat loss.
80 – 89	Respiration rate and water consumption are increased, and feed consumption is decreased.
90 – 98	Higher body temperature, longer standing times, and decreased feed consumption. Homeostasis will be challenged.

During winter, barn temperature should be no more than 10˚F above ambient temperature to avoid excessive levels of moisture inside the barn. The barn could have ventilation problems if water is condensing on the walls or ceiling, if there is any presence of mold, if the barn smells strange or if a strong ammonia odor is detectable. Also, areas with no air at all, animals that are are not breathing normally, are signs of ventilation failures. If the barn has fans, they all should be clean and working properly.

In the summer of 2014, the Dairy Focus Team visited 20 dairy farms located around central, northern, and southern Illinois. The purpose of the visit was to improve those farms by determining their strengths and weaknesses, and identifying opportunities for improvement as well as threats to the farms. One of the objectives of these visits was to investigate how ventilation systems were working and if there were opportunities to improve ventilation in Illinois dairy farms.

We found that the average temperatures in lactating cow barns were 83.7 ± 5.3˚F, 79.4 ± 4.6˚F, and 80.5 ± 3.4˚F in central, northern, and southern Illinois, respectively. For dry cow barns, the average temperatures were 80.7 ± 9.2˚F, 82.1 ± 6.4˚F, and 82.6 ± 5.5˚F in central, northern, and southern Illinois, respectively. As **Figure 1** shows, there were differences between ambient temperature and barn temperatures.

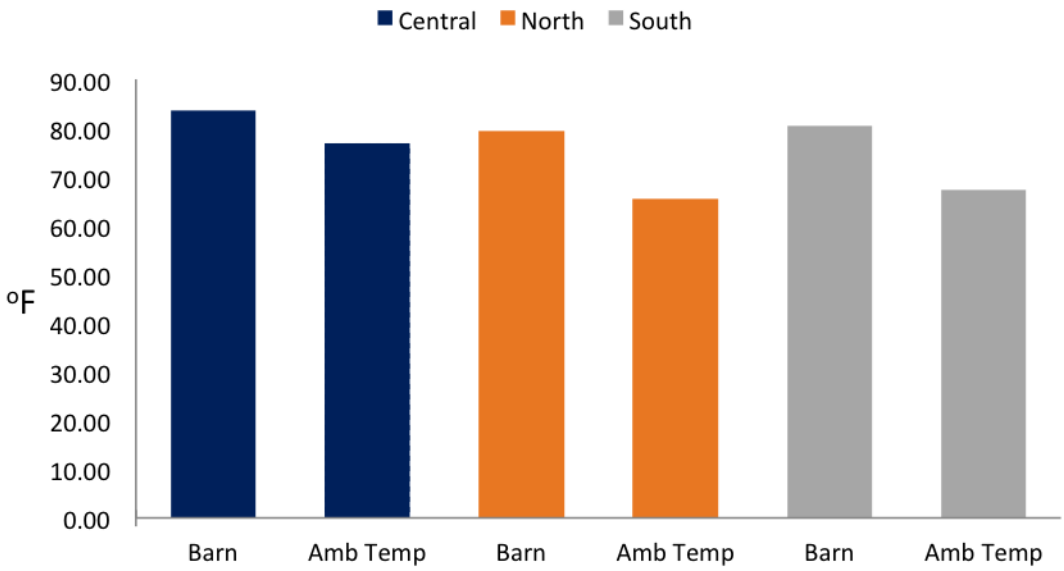

Figure 1. Differences between average temperature within cow barns and ambient temperature.

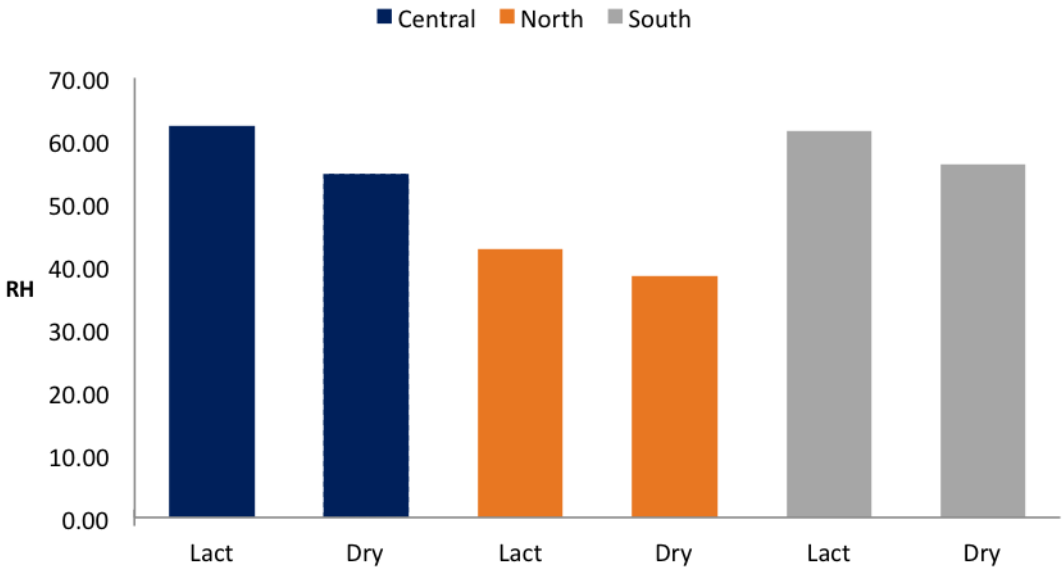

Figure 2. Differences in average relative humidity (RH) between dry and lactating cow barns within regions in Illinois.

There were differences in average RH between lactating and dry cow barns and within the three regions (**Figure 2**). Average RH levels in lactating cow barns were 62.4 ± 14.3, 42.8 ± 5.0, and 61.5 ± 6.3 in central, northern, and southern Illinois, respectively. For dry cow barns, average RH levels were 54.7 ± 7.5, 38.5 ± 2.6, and 56.2 ± 9.0 in central, northern, and southern Illinois, respectively.

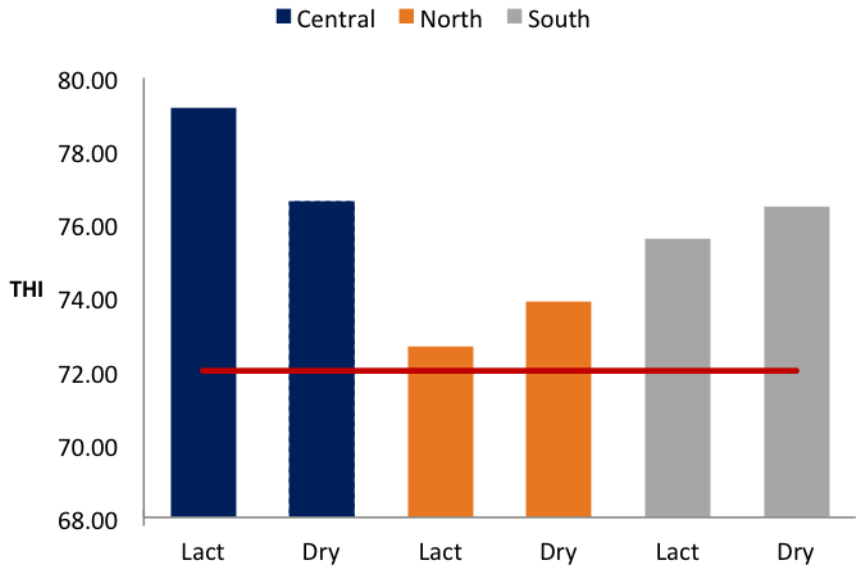

Figure 3. Temperature-humidity Index (THI) in dry and lactating cow barns within regions in Illinois.

The temperature-humidity index was higher than 72 in both lactating and dry cow barns in the three regions (**Figure 3**). Average THI values in lactating cow barns were 79.2 ± 4.2, 72.7 ± 3.3, and 75.6 ± 2.1 in central, northern, and southern Illinois, respectively. For dry cow barns, average THI values were 76.6 ± 7.7, 73.9 ± 3.9, and 76.5 ± 3.0 in central, northern, and southern Illinois, respectively.

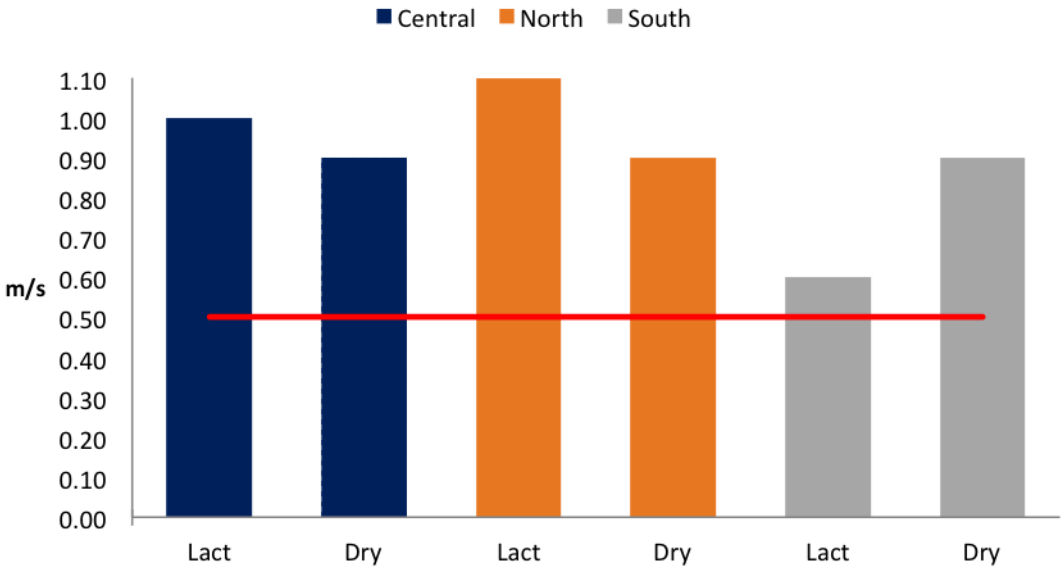

Figure 4. Differences in average wind speed between dry and lactating cow barns within regions in Illinois.

The ideal wind speed in the barn is 0.5 meters per second. However, the average wind speed in the barns we visited was greater than 0.5 m/s, and there were some spots in which it was equal to zero (**Figure 4**). Average wind speeds in lactating cow barns were 1.0 ± 0.8 m/s, 1.1 ± 1.1 m/s, and 0.9 ± 0.9 m/s in central, northern, and southern Illinois, respectively. For dry cow barns, average wind speeds were 0.9 ± 1.1 m/s, 0.9 ± 0.4 m/s, and 0.6 ± 0.4 m/s in central, northern, and southern Illinois, respectively.

Take Home Message

There is room for improvements in ventilation systems on Illinois dairy farms.

During winter, barn temperature should be no more than 10°F above ambient temperature to avoid higher levels of moisture inside the barn. On the other hand, during summer, barn temperature should be equal to ambient temperature.

A good ventilation system is necessary to avoid heat stress and its associate losses.

Last but not least, an inadequate ventilation system will not only affect cattle but will also decrease barn lifespan.

—Ines Rivelli and Dr. Phil Cardoso