Air Velocity Improves Summer Cow Comfort in Free-Stall Barns

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Last summer's heat demonstrated to most dairy farmers the impact that heat stress can have on their animals. They experienced reductions in milk production of 25% with delayed recovery. Breeding difficulties and slow fetus development or even death occurred well after cooler weather returned. Incidence of disease, including mastitis, increased during the hot weather. Taking all these impacts into account, dairy farmers suffered severe economic loss due to the high temperature conditions. Granted, last summer was unusually hot, but heat stress conditions for dairy cows occur several times during most summers.

Modern free-stall barns are designed to provide maximum cow comfort in summer. Barns are located on high ground with no obstructions to wind, and the wind blows through large sidewall openings. This air exchange carries hot air and moisture away from the animals. The roof provides shade, and the open ridge removes hot air from near the roof and from the vaulted space above the walls. Drinking water is plentiful and easily accessible. So why, with all of these amenities, are cows heat-stressed? The cooling potential of this system is lost when the wind velocity falls below two mph and the air temperature rises above 75 F.

Dairy farmers in southern climates report benefits from delivering air at high velocity to animals. This is usually done by using strategically placed large-diameter fans. First, cow groups should be managed so they are in the holding area no more than 45 to 60 minutes per milking in hot weather. Overcrowding in a holding area causes heat stress conditions to escalate. Then, use large-diameter fans located above the cows and aimed down at them and toward the rear of the holding area to increase air velocity near the cows and move heat and moisture away from them. In the best situation, some of these fans bring outside air through a duct so as to provide fresh air to the holding area. If holding areas are less than 30 ft wide, locate three fans in the holding area above the entrance to the parlor. Wider holding areas require additional fans. Aim the fans down 30 from horizontal and away from the parlor. Space additional fans 30-ft apart (measured from the parlor) for fans up to 36-in. diameter, or 40-ft apart for fans more than 36-in. diameter. Size fans to deliver 300 to 500 cubic ft per minute (cfm) per cow in the holding area.

Heat stress causes a decline in feed intake. Providing high velocity air near the feed manger encourages cows to go there for relief. Reduced heat stress and proximity to feed can encourage feed intake. Locate fans above the alley where cows stand to eat. Aim the fans to blow air along the alley and at a point on the floor below the next fan in the series. Space fans along the alley at 30-ft intervals if less than 36-in. diameter, and at 40-ft

intervals if greater than 36-in. diameter. Place fans high enough to avoid damage by manure handling equipment and animals. Set thermostats to turn these fans on when temperatures exceed 78 F.

Since cows enjoy lying down 12 to 14 hours per day, the next place to provide high air velocity is in the resting area (free stalls). In a face-to-face free-stall arrangement, locate fans above stall divider support posts. The same spacing and aiming criteria listed previously apply. In the tail-to-tail free-stall arrangement, locate fans above the alley between stalls. With three rows of stalls on one side of the bunk, locate fans above the alley where cows stand to eat and in the other alley.

Where modern principles of natural ventilation cannot be achieved (i.e., concrete block walls, feed rooms and silos on windward wall, or other obstructions to wind flow), then air exchange is the first objective. I have seen success when dairy farmers install fans on the walls so air is blown into the barn. Space 36-in. diameter fans at 30-ft intervals along each long barn wall and aim them to blow into the barn. The blow-in arrangement provides air exchange and air velocity at the same time. On the outside of the wall, a supply of fresh air must reach the fans. Therefore, if fans are put on room walls (i.e., feed room), outside doors must be left open to get air to the fans. Shield the fans from animal damage and protect against human and animal injury. Aim the fans toward a point on the floor at a distance 30-ft from the fan. If free-stall fronts are less than 50% open along the path of air flow, they should be opened as much as possible by removing planks, etc. If that cannot be achieved, the fans should be aimed at the top of this barrier to air flow. If necessary, fans located above the alley where cows stand to eat can be added. (See earlier discussion.)

The blow-in arrangement is a form of a positive-pressure mechanical ventilation system. Adequate openings must be provided to allow air to escape the barn. These can be in the form of doors, windows, open ridges and eaves, etc. The location of the openings is not critical, but the total area of opening must be at least 2.5 square ft (sq. ft) for each 1000 cfm delivered by fans blowing into the barn. For example, a 120-ft long barn will have four fans on each side (eight fans total). If each fan delivers 15,000 cfm, the total flow is 120,000 cfm. Dividing the total by 1000 cfm and multiplying that by 2.5 sq. ft, the total opening needed is 300 sq. ft. Doors (10 ft by 10 ft) located at both ends of each of four alleys provide 800 sq. ft. This should give more than adequate area for air to exit the barn.

If outside temperatures drop below 60 F, high-velocity air can feel uncomfortable. Thermostats should be set to turn fans off before wind chill becomes a concern. If air exchange problems (high odor, humidity, and temperature) exist in the barn during cool periods (20-50 F), consider installing a couple of the fans so they can be turned around to exhaust air from the barn. Regulate openings (inlets) so air is drawn uniformly into the barn. In this case, try to achieve 1.4 sq. ft per 1000 cfm. As in our previous example, a 15,000 cfm fan will need 21 sq. ft inlet. A continuous open ridge 120 ft long would need to be 0.175 ft (2 in.) wide to achieve the desired velocity. In this case, all other openings (doors, windows, eaves, etc.) would be closed. Most open ridges are wider than this, so a

method of controlling the open ridge would be needed for this negative pressure mechanical ventilation system.

Fans can be used to relieve some of the heat stress encountered in the upper midwest. To get maximum benefit, they must be strategically located where heat stress is likely to cause the most impact on animals. Since dry cows are in the later stages of gestation, they should not be overlooked when it comes to heat stress relief.
