Fan Cooling Dairy Cows; Questions and Answers

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Dog dead hot summer days provide a particular challenge in keeping cows comfortable, healthy, and sustaining production of high quality, high volume milk. High air temperatures and humidity, intense solar radiation, and/or little or no natural air movement contribute to stressful conditions. These conditions are particularly stressful to dairy cattle and we see the effects in reduced milk production, decreased feed efficiency, reduced conception rates, and compromised growth rates of neonatal calves. Losses combine to cause huge economic impacts, even in the Northeast.

While the economic nature of the dairy business (a commodities-based supply and demand product) does not allow the capital and operating base to house cows in environments that totally mitigate the effects of heat stress, we can significantly reduce the effects of heat stress on many summer days.

Components of a heat stress abatement system include:

- Ensuring all cows always have free access to clean, fresh water
- Providing shade from sun’s solar energy
- Increasing barn ventilation rate
- Providing air directly over cows
- Increasing evaporative heat loss by intermittently soaking cows’ hair coats
- Adjusting feed ration composition

When considering implementation of a heat stress abatement system, many questions arise, especially under the topic of fan cooling dairy cows.

What is the overall goal of fan cooling cows?
The overall goal of fan cooling cows is to provide a high rate of air speed over cows’ bodies to increase body heat loss by convective means. Research has shown that target air speed over cows’ bodies should be 400 to 600 fpm. Most agricultural fans marketed for cooling cows can easily exceed this target velocity, even at many feet away from the fan.
Belt-drive or direct-drive fans, which one?
In most cases, direct-drive fans are preferred for fan cooling cows primarily because the desired performance of these fans is more easily maintained over extended periods of use than with belt-driven fans. Belt-drive fans have excellent airflow capacities and operate with comparatively little noise when the fans are first installed. However, their performance falls off with time as the belts wear. Producers that are committed to regular fan maintenance schedules can choose between either fan types.

Where specifically should cooling fans be located?
Another goal of fan cooling cows is to provide air movement in areas where cows perform beneficial activities. This means fans should be located over cow feeding and resting areas along with in the holding area. In freestall barns, this means rows of fans should be centered over feeding cows and also over cows lying in each row of freestalls as shown in Figure 1. Fans that are not centered over feeding or resting cows can result in significant air flow in nonproductive areas; cows will stand in these areas during stressful conditions to increase heat loss.

How far apart should fans be in a row?
Cows are like boulders in a river; water flow in the river is impacted by the boulders and air flow in a barn is impacted by the cows. Moving air that impacts a cow is slowed down and its flow direction is changed.

Cooling fans need to have a good ‘throw’, meaning airflow should be maintained a good distance away from a fan. This implies that air must be expelled in a fairly tight cone. Fans in rows with spaced longitudinally about 10 blade diameters (30’ for 3’ diameter fan, 40’ for 4’ diameter fan) maintain affective velocity when blowing on a group of cows. The fans can easily move air further than this but the initial cows cooled by the fan discharge air sufficiently interrupt the flow that cows further away do not reap the benefits.

What size fans should be considered?
Any size fan providing target air speed at cow level is much better than no cooling fans in the barn at all. However, because cows do affect the fan’s discharge airflow pattern and speed, smaller but more fans (due to the 10 blade diameter rule) have a better chance of providing the target air velocity on more cows than less but larger fans do. Three-foot fans are generally preferred over four- or five-foot fans.

When should I start running fans?
Barn air temperature and humidity together affect the environmental stress experienced by cows. When the two combine and threaten exceeding the upper critical point of cow’s thermal neutral zone, metabolic energy begins to be used to help a cow cool herself. As the environmental stress increases, more metabolic energy is used for cow cooling. Metabolic energy used for cooling takes away from other energy uses, most notably producing milk. Many Northeast dairy producers use thermostats to control cow cooling fans and setting the air temperature set point at about 70°F is suggested or even a little lower if multiple hot days followed by warm nights are predicted.

www.prodairyfacilities.net
www.abe.psu.edu/extension/extensionindex.html
How high should fans be mounted?
Fans should be located as low as possible to maximize air speed they produce at cow level. Mount fans just high enough above the alley floor so they don’t interfere with alley scraping or bedding operations or so cows cannot reach them.

What angle should fans be mounted to blow air?
Fans should be tilted from the vertical so they are aimed at the bottom of the next fan down the line as shown in Figure 2. The higher the fan is mounted above the floor, the greater the angle from the vertical needed.

Where should cooling fans be located in the milking center?
Cooling fans should be oriented in holding areas to direct airflow 180 degrees away from the parlor (preferred) or across the pen in the direction of prevailing summer breezes. (In many older holding pens, clearance is limited by low-lying truss chords or ceilings. Smaller (18- and 24-inch) fans are commonly used in these applications with a relatively close spacing between fans.

Do not blow air from the holding pen into the parlor since this can be unsanitary and moves hot, humid air into the milking area, which leads to uncomfortable conditions for milkers.

Use the 10 times the fan blade diameter rule to determine longitudinal spacing. Laterally, fans should be spaced 2 to 3 times their blade diameter.

What is needed to keep fans performing well in the long run?
Developing and implementing a regular maintenance schedule will go a long way towards sustained fan operation when the cows need it the most. Suggested maintenance for supplemental cooling fans includes:

- Regular examination of belts and belt replacement on belt-drive fans
- Quick repair of bent or broken fan blades and fan housings
- Cleaning of fan blades and housings before dirt sufficiently accumulates
- Intermittent monitoring of thermostats and cleaning of sensors

How much will it cost to own, operate, and maintain fans?
The estimated cost to own and operate cow cooling fans is important to know when comparing fan options. Fan initial cost is only a part of the overall economic decision making process. Data from fan manufacturers of potential fans utilized can be analyzed to determine the total annual economic cost for various fan option scenarios.
If I cannot afford to install all fans, where should I start?
When locating fans at your facility, use the following guideline presented in order of importance when incrementally installing fans:

1. Holding area
2. Milking area
3. Close-up dry cows
4. Calving area
5. Sick/treated cows
6. Fresh cows
7. High producing cows
8. Low producer cows

Fans incrementally installed in a lactating cow barn can be located in the following order:

1. Over the inner rows of stalls
2. Over the feed alley
3. Over the outer row of stalls

How do I know I’m getting a return on investment?
Calculating the net return on investment for a heat stress mitigation system is not easily accomplished. Consider some of the effects of heat stress:

- Depresses Appetite
- Slug Feeding - Acidosis, Laminitis
- Decreased Nutrient Absorption
- Reproductive Problems
- Compromised Unborn Calf Growth
- Future Milk Production
- Calving Difficulties

It is difficult to put a complete economic value as a result of the above heat stress effects but that is not to say we cannot give it some consideration. When cows continue to lie down in freestall or tie stalls for during environmentally challenging times as a result of air movement at cow lying level and consequently continue to produce pre-environmental stress levels of milk, we can call this sustained production. Dr. Rick Grant, President of Miner Institute, has shown that an hour of cow lying time means about 2.5 to 3.5 lbs. of milk per cow. So, if the fan cooling system contributes to sustained cow lying time and milk production, we can look at the economic impacts of fan cooling fans from a milk production only perspective.
What about ceiling-mounted high volume, low speed fans?
When considering fan types and placement other than described above, determine if the alternative will provide target air flow speed at cow level when cows are doing productive activities. Field measurements and observations have shown that high volume, low seed fans located over the center of a drive through barn do not provide target air speeds to cows when lying in freestalls.

In really hot weather, fans just blow around hot air. So what then?
The best way to cool a cow in the Northeast when it is hot is to use a combination of cooling fans and sprinklers. The role of the sprinkler system is to wet the cow’s hair coat down completely to the skin in 2-3 minutes of an overall 10 to 15 minute wetting/drying cycle. The overall governing process is to use cow body heat to evaporate the applied moisture (evaporative cooling) thus reducing her temperature; it takes about 890 Btu’s of energy to evaporate one pound of applied water.

Note: the nozzles used should produce large water drops that penetrate the hair coat and soak the skin to be effective. Small water droplets are to be avoided as they settle on the surface of the hair coat impeding heat transfer from the body.

The role of the fans, when used in conjunction with a sprinkler system, is somewhat different than when used for fan cooling cows. In this case, the fans are used to provide fresh air to the hair coat so additional applied water can be evaporated by the cow. If fresh air is not provided to the hair coat, then the evaporation process will be sufficiently hindered to the point where no additional evaporative cooling will take place. Therefore, a good air exchange – not just circulating air – is required to remove the moisture added to the animal space.

Initiate evaporative cooling at a higher temperature setting (usually 78-80°F) than used for supplemental cooling fans. Water should not be added in any situation where adequate air exchange and airflow around cows are lacking since the benefit achieved will be minimal and excess water will likely be present and cause problems.

In closing, it is important to remember that cow cooling fans are not positioned in a barn to provide barn air exchange (ventilation). Barns must have an effective natural ventilation system or mechanical ventilation system in order to provide suitable air quality for cows. Barns that lack suitable air quality need to be reviewed to determine the best way to provide requisite air exchange rates.
Figure 1. Lateral positioning of cooling fans over feeding cows lying cows in a freestall barn.
Figure 2. Longitudinal positioning of cooling fans over feeding cows in a freestall barn.